Improving the Health and Safety of Transit Workers with Corresponding Impacts on the Bottom Line (2020)

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TRANSIT COOPERATIVE RESEARCH PROGRAM

TCRP RESEARCH REPORT 217

Improving the Health and Safety of Transit Workers with Corresponding Impacts on the Bottom Line

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TRANSIT COOPERATIVE RESEARCH PROGRAM

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FOREWORD

By Lawrence D. Goldstein
Staff Officer
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Transit workers experience more health and safety problems than the general workforce, primarily as a result of a combination of physical demands, environmental factors, and stresses related to their jobs. In response, *TCRP Research Report 217* focuses on the prevalence of these conditions, costs associated with these conditions, and statistical analysis of data on participation in and the results of health and wellness promotion programs. The objective of the analysis was to improve understanding of how extensive these problems are and to identify potential approaches that transit agencies can undertake to develop an effective response. In preparing this study, the research team undertook a multifaceted approach that used diverse sources of information including case studies, interviews with industry and health experts, primary data collection, and rigorous statistical-econometric analysis. This study will be of interest to transit agencies, transit employees, and others actively involved in improving health conditions for transit workers.

Health and safety risk factors for transit workers include the sedentary nature of the job, shift work, environmental factors (e.g., noise and air quality in and around the vehicle), constant daily interaction with hundreds of passengers (any of whom might engage in unruly or risky behavior), continual stressful engagement in traffic (performing difficult maneuvers), responsibility for fare collection, and a work schedule that limits the ability to maintain healthy habits such as regular exercise, sufficient sleep, and a healthy diet. Additionally, prior research demonstrates that transit work is associated with higher rates of risky behaviors (including poor diet, smoking, and alcohol use) and chronic conditions (such as diabetes, primarily Type 2; cardiovascular disease; and musculoskeletal disorders). Annual health-related costs are higher for transit workers compared to the average worker, and the excess costs were also observed in the payment types examined (injury, death, absenteeism, workers' compensation, disability [SSDI and SSI], and Medicare). In all cases, the annual costs of these categories for transit workers exceeded the costs for the average worker.

This report examines the reasons for these outcomes and provides potential strategies to improve transit worker health. The study includes a summary of previous research on methods to improve the workplace environment and to establish effective practices for health promotion and wellness programs. To date, there is limited research on the effectiveness of health promotion programs for transit workers. This report provides some additional research on that topic, measured by the reduction of sick or personal days, workers' compensation payments, or health claims.

The report also includes case studies on health and wellness programs at five transit agencies. The report documents the substance of the programs and the resources and

organizational strategies agencies and unions have used to put sustainable programs in place. While no programs address all the chronic conditions most common among transit workers (i.e., few appear to address respiratory health), they do focus on issues that affect transit workers' overall health and work performance. The statistical analysis incorporated in the study is more suggestive than definitive, but it does provide a model that agencies with access to the appropriate data could use to evaluate their programs. In addition, the information provided about the health and wellness programs in the case studies and the implementation strategy chapter offer further assistance to transit agencies currently improving existing or designing new health, wellness, and safety programs.

Overall, the report adds an important layer of research to past studies that explore health and safety outcomes for transit workers and health promotion programs. In particular, the report quantifies the costs of widespread and consistently poor health and safety outcomes and the cost savings, if any, of those health promotion programs. Dangerous and strenuous work environments exact a toll on workers that affects their employers specifically and society in general. A better understanding of that toll, its costs, and potential mitigation measures is a valuable contribution to the literature on the subject.

CONTENTS

SUMMARY

Improving the Health and Safety of Transit Workers with Corresponding Impacts on the Bottom Line

S.1 Background

Transit workers experience more health and safety problems than the general workforce, primarily due to physical demands, environmental factors, and stresses related to their jobs. Finding explanations for these poor health outcomes and identifying potential solutions is the primary focus of this report. To accomplish these objectives, the Econometrica team undertook a multifaceted research project that used diverse sources of information, including case studies, interviews with industry and health experts, primary data collection, and rigorous statistical-econometric analysis.

Health and safety risk factors for transit workers include the sedentary nature of the job, shift work, environmental factors (e.g., noise and air quality in and around the vehicle), constant daily interaction with hundreds of passengers (any of whom might engage in unruly or risky behavior), continual stressful engagement (performing difficult maneuvers) in traffic, responsibility for fare collection, and a work schedule that limits the ability to maintain healthy habits such as regular exercise, sufficient sleep, and a healthy diet. Additionally, prior research has demonstrated that transit work has been associated with higher rates of risky behaviors (including poor diet, smoking, and alcohol use) and chronic conditions (such as diabetes, primarily Type 2; cardiovascular disease; and musculoskeletal disorders).

This report identifies and examines the reasons for these outcomes and provides potential strategies to improve transit worker health. It provides a summary of previous research on methods to improve the workplace environment and establish effective practices for health promotion and wellness programs. Research in this area includes reports previously published by the Transportation Research Board, including *TCRP Report 169: Developing Best-Practice Guidelines for Improving Bus Operator Health and Retention* (Gillespie, Wang, and Brown 2014), *TCRP Report 174: Improving Safety Culture in Public Transportation* (Roberts, Retting, and Webb et al. 2015), and additional public and private sources. To date, there is limited research on the effectiveness of health promotion programs for transit workers as measured by the reduction of sick or personal days, workers' compensation payments, or health claims. Econometrica builds on the scant existing research by estimating the potential beneficial effects of health promotion programs based on data collected from five locations.

The project team gathered data in five locations: Rochester, New York; Louisville, Kentucky; Indianapolis, Indiana; Des Moines, Iowa; and Los Angeles, California. This report contributes to the literature with econometric and statistical analysis, using primary source individual-level data collected from the wellness programs of four metropolitan transit agencies (the exception being Los Angeles, which only provided aggregate data).

The results obtained using these data provide additional information on the participation in and effectiveness of health promotion programs for transit workers. In addition to identifying and examining the reasons for these health outcomes and providing strategies to improve them, the project team completed an investigation of the costs associated with health and safety issues to accurately chronicle the full extent of the problem. These costs include out-of-pocket medical, safety, and other job-related expenditures by transit workers, payments by insurers, costs of covering shifts for workers absent due to sickness and injury, and costs of supporting disabled workers through state workers' compensation or federal disability programs.

S.2 Prevalence and Costs of Health Conditions

The research team identified national estimates of healthcare costs and worker productivity to establish a baseline for the health outcomes discussion and subsequent quantitative analyses. These estimates are presented in relation to transit worker illness and injuries for comparison and eventual evaluation of transit agency health promotion programs. The report reviews studies on the prevalence of health conditions of transit and transportation workers compared to the general population and then develops health cost estimates associated with health conditions relevant to transit/transportation workers.

Table S-1 presents prevalence estimates of six chronic conditions for transit workers identified from government sources or peer-reviewed journals: cardiovascular disease, diabetes, hypertension, musculoskeletal disorders, mental health, and respiratory illness. For comparison purposes, the table also presents the prevalence rate among workers in the general population.

Table S-1 shows that transit workers experience much higher rates of all six of these chronic conditions. For diabetes, musculoskeletal, and respiratory conditions, the rates are at least twice as high for transit workers. For cardiovascular, hypertension, and mental health, the rates for the general worker population are high initially, but occurrence rates for transit workers are still at least 50% greater. The analysis starts from this baseline: Transit workers are in worse health than the general population.

Table S-1. Prevalence of chronic conditions affecting transit workers compared with the general workforce.

Condition	Source	Period	Transit Workers	General Workers
Cardiovascular	Highmark, Inc. (CDC–NIOSH) *, [a]	2002–2005	14.5%	8.1%
Diabetes	Highmark, Inc. (CDC–NIOSH) *, [a]	2002–2005	17.3%	7.8%
Hypertension	Highmark, Inc. (CDC–NIOSH) *, [a]	2002–2005	41.5%	27.6%
Musculoskeletal	Survey of Occupational Injuries and Illnesses [b]	2016	1.7%	0.3%
Mental health	Highmark, Inc. (CDC–NIOSH) *, [a, c]	2002–2005	16.2%	10.5%
Respiratory	Survey of Occupational Injuries and Illnesses [d]	2016	0.04%	0.01%

* Researchers with the Centers for Disease Control–National Institute for Occupational Safety and Health (CDC–NIOSH) worked with Highmark, Inc., to assemble a multi-year database for the purpose of calculating industry-specific, prevalence rates of 15 diseases. Highmark, a BlueCross BlueShield insurer, provides health insurance for the majority of the working population in Western Pennsylvania, plus other areas not covered by these data. The Highmark, Inc., information included in this table was reported in Bushnell, Li, and Landen (2011). The code titles used for the various conditions followed the BLS (2012).

Sources: [a] Bushnell, Li, and Landen (2011); [b] BLS (2017a); [c] Wulsin, Alterman, and Bushnell et al. (2014); and [d] BLS (2019b)

The additional medical expenditure costs as a result of these health differences are high. Table S-2 presents the average annual medical expenditure for a person in the United States by each of these same six conditions as reported in the 2015 Medical Expenditure Panel Survey (MEPS 2015) next to the prevalence rate for the transit worker population from Table S-1. The fifth column in Table S-2 takes the number of transit workers afflicted by this condition and multiplies it by their average per person medical expense amount (e.g., $4,556 for cardiovascular) to provide an estimate of the total annual expenditures for the transit worker population for that particular chronic condition (i.e., approximately $238 million per year for cardiovascular). The fifth column shows the approximated annual costs for transit workers beyond that of the general population given the greater prevalence of these conditions among transit workers (i.e., the costs beyond what they would be if transit workers experienced the conditions at the same level of prevalence as the general population). For example, the annual medical expenditures for transit workers for cardiovascular disease are estimated to be $238 million per year ($4,556 per transit worker per year, multiplied by 14.5%, the prevalence rate for the transit worker population). If transit workers experienced cardiovascular disease at the same prevalence rate as the general population (8.1%), the cost would be considerably lower: $133 million. Consequently, the costs of the greater prevalence of cardiovascular disease among transit workers come to $105 million ($238 million minus $133 million).

This research shows the additional chronic condition medical expenditures of transit workers above that of the general population. The large difference suggests that directing resources toward the alleviation and prevention of transit worker health problems should result in some cost savings in addition to potential improvements in health and quality of life for transit workers themselves. The findings suggest that the higher prevalence of chronic conditions in transit workers relative to the general working population (Table S-1) may translate into considerable expenditures by workers, employers, and

Table S-2. Medical expenditure approximations for the transit worker population.

Condition	U.S. Average Medical Expenditures per Person (2015)	Prevalence: Transit Workers [a] (Table S-1)	Prevalence: General Workers (Table S-1)	Approximated Annual Expenditures for Transit Workers (2015 Dollars) [b]	Approximated Annual Expenditures for Transit Workers Above Those of General Workers (2015 Dollars) [c]
Cardiovascular	$4,556	14.5%	8.1%	$238,000,000	$105,000,000
Diabetes	$3,402	17.3%	7.8%	$212,000,000	$116,000,000
Hypertension	$823	41.5%	27.6%	$123,000,000	$41,000,000
Musculoskeletal	$2,000	1.7%	0.3%	$12,000,000	$10,000,000
Mental health	$1,992	16.2%	10.5%	$116,000,000	$41,000,000
Respiratory	$1,633	0.04%	0.01%	$234,000	$175,500

[a] Calculations are based on a transit worker population base of 359,669 workers (APTA 2018).
[b] Calculated as transit worker population × transit worker prevalence × average medical expenditure per person.
[c] Calculated as transit worker population × (difference between transit worker and general population prevalence) × average medical expenditure per person.
Sources: Highmark, Inc. (CDC–NIOSH) as reported in Bushnell, Li, and Landen (2011); BLS (2017a); Wulsin, Alterman, and Bushnell et al. (2014); and BLS (2019b)

society through out-of-pocket spending, employer-based insurance, and federal insurance sources (Table S-2). Directing resources to prevent or attenuate these conditions could result in savings.

S.3 Additional Costs of Transit Worker Health to Individuals, Employers, and Society

The processes by which health issues convert to expenditures and costs also are examined. The focus is on quantitative estimates of expenditures because those are more easily tracked through the existing data. Examples of expenditures by workers and their families, employers, and state and federal agencies are provided. The research compares transit workers to the general population and estimates the difference between their costs and those of the general population. The costs (payment categories) examined include:

- Injuries;
- Mortality;
- Absenteeism;
- Workers' compensation;
- Social Security Disability Insurance (SSDI), a form of disability payment;
- Supplemental Security Income (SSI), also a form of disability payment; and
- Medicare.

Table S-3 summarizes the results of calculations made in Chapter 5 to understand the costs associated with transit worker health conditions. The research team identified mechanisms through which costs are transmitted from individuals to employers and society, such as workers' compensation and disability payments. A better understanding of these mechanisms can help transit agencies decide which conditions to target to reduce costs. In all the expenditure categories examined, the costs for transit workers were found to exceed the costs for general workers by amounts ranging from tens of millions to hundreds of millions of dollars.

The excess costs for transit workers across six chronic health conditions (cardiovascular, diabetes, hypertension, musculoskeletal, mental health, and respiratory) are related to their excess costs in some of the categories listed in Table S-3. Chronic conditions can lead to higher injury and mortality rates, as well as the necessity of drawing on disability and Medicare at earlier ages. The excess costs found across payment categories result directly from the costs of the conditions examined.

Table S-3. Compilation of annual excess cost estimates (2018 dollars).

Cost (Payment Category)	Transit Worker Cost	Cost per Transit Worker	Excess Cost *	Excess Cost per Transit Worker
Workers				
Injury costs	$853,768,760	$2,374	$403,284,268	$1,121
Mortality costs	$189,174,784	$526	$61,171,511	$170
Employers and society				
Absenteeism	$314,301,144	$874	$25,144,092	$70
Workers' compensation	$261,780,645–$413,826,181	$728–$1,151	$121,139,893–$140,199,032	$337–$390
Disability (SSDI)	$405,770,309	$1,128	$128,342,087	$357
Disability (SSI)	$115,238,954	$320	$36,445,966	$101
Medicare	$315,484,742	$877	$99,780,303	$277

*Excess cost is calculated as the difference between the average transit worker cost and the average general worker cost. Source details about both transit worker costs and general worker costs are provided in Chapter 5.

S.4 Case Studies

These findings on expenditures, health conditions, and costs served as a basis for the case study analysis. Cataloging the degree to which transit agencies target areas where cost savings might be achieved was a key objective. The case studies provide considerable new information on wellness programs and their potential impact on transit worker health. The case studies were selected based on specific criteria. First, using survey results from *TCRP Report 169*, the team created a list of 17 agencies and 5 unions that reported tracking metrics for programs or estimated a past or projected return on investment (ROI). Next, the team sent a query to the APTA's Workforce Development Committee Listserv, asking for interest in the study. This query generated 14 leads, and four sites—agencies in Rochester, New York; Louisville, Kentucky; Indianapolis, Indiana; and Des Moines, Iowa—met the criteria of having both a comprehensive health promotion program *and* individual-level data. A fifth case study site with aggregate data (Los Angeles, California) also was selected.

The case studies help identify scalable and sustainable strategies that have been successfully initiated and implemented in transit agencies. These programs provide multiple features to participants, such as workshops on diet and exercise, biometric screenings, targeted education to avoid common types of injury (e.g., musculoskeletal injuries), financial planning, fitness challenges, and onsite gyms. For four of five of the case studies, the research team conducted a benefit-cost analysis to determine if measurable benefits are associated with participation in these programs.

Baseline data were collected reflecting periods before and after the comprehensive health and wellness programs began. The data included individual records of absenteeism (both sick and personal days taken), workers' compensation payments, and measures of participation (after). Because data were also available on age, gender, race, day of hire/termination, and rates of turnover (in some cases), participants could be compared to non-participants based on their characteristics and tenure in the program.

Each case study location's work organization and environment was unique, and each agency faced different health, wellness, and safety challenges. Commonalities were found across the locations, however: For example, at all five locations, the majority of bus operators work split shifts. This impacts their access to healthy food, affects their sleep patterns, and limits their ability to participate in certain health and wellness program activities.

Comparing the top three health, wellness, and safety concerns expressed by management and labor representatives and insurance claims data, the researchers found that hypertension, musculoskeletal injuries (back and neck pain), and diabetes are the most commonly shared concerns for frontline transit workers across locations. Other issues include sleep apnea, cardiovascular diseases (i.e., heart conditions), injuries from bus accidents, obesity, stress/fatigue, and cholesterol disorders (hyperlipidemia).

Using primary data collected from transit agencies at the employee level, the research team generated informative descriptive statistics that expand on the research available in recent literature on the effectiveness of health promotion programs. These data have not been released publicly and represent a new source of information. Although these case studies produced limited results that could translate into quantifiable cost savings for agencies, the information gathered adds a host of new information on employee absence/sick leave patterns as they relate to health, wellness, and safety program participation among transit employees.

S.5 Study Limitations

The research in this report is subject to several limitations. Some additional cost categories, such as quality of service, could not be itemized (primarily from a lack of available data). Also, cost categories can overlap and are not additive as a function of comorbidities. The research primarily used cross-sectional data because it was the only data readily available for a sufficient number of transit workers to answer the fundamental research questions. Cross-sectional data can yield distorted results because it cannot account for the life trajectories of transit workers who are forced to leave transit work early due to health issues, or transit workers whose lives are shortened by health and safety issues related to their work. The study also could not include controls for differences in gender and age in the data analysis about condition costs and prevalence, as this level of detail was beyond the scope of the research. Exploring differential response patterns affected by gender and age would be worth examining, recognizing that transit workers are disproportionately older and male in comparison to the general population. Last, this study could not account for differences in local regulations. Local agencies are numerous and diverse, and examining how local regulations might affect outcomes could be a fruitful area for future research. The research conclusions recognize and have accommodated these limitations, and they reflect a careful implementation and consideration of the level of detail represented in the original research work plan.

S.6 Wrap-Up

The goal of this study was to identify ways to improve employee health and safety outcomes resulting from work conditions and broader health promotion practices and their impacts on transit agencies' bottom line. The research focused on the prevalence of conditions, costs associated with conditions, and statistical analysis of data on participation in and the results of health and wellness promotion programs. This report documents the chronic conditions that are most prevalent among transit workers (cardiovascular disease, diabetes, hypertension, musculoskeletal disorders, mental health, respiratory disorders) and documents that annual costs are higher for transit workers compared to the average worker. These excess costs also were observed in the payment types examined—injury, death, absenteeism, workers' compensation, disability (SSDI and SSI), and Medicare. In all cases, the annual costs of these categories for transit workers exceeded the costs for the average worker.

The project team extended the initial investigation through case studies on health and wellness programs at five transit agencies, documenting not only the substance of the programs offered to transit workers but the resources and organizational strategies that agencies and unions used to put the programs in place and make them sustainable. Although no programs addressed all of the chronic conditions most common among transit workers (few seemed to address respiratory health, for example), they did focus on issues that affect transit workers' overall health and work performance. Statistical analysis of the four sites that provided individual-level data yielded results that are more suggestive than definitive; however, this analysis provides a model for further analysis that sites with the appropriate data can use to evaluate their own programs.

The implementation strategy discussed in Chapter 7 provides an analysis of how well the programs are doing in terms of following the "roadmap for transit and health safety" provided in *TCRP Report 169*. The information provided about the health and wellness programs in the case studies and the implementation strategy chapter offer detailed information that could guide transit agencies currently designing new health, wellness,

and safety programs or provide guidance on how to improve current programs. In terms of how to use this report to design wellness programs that benefit the health of transit workers, the authors of this report recommend a two-step approach:

1. Review the background research on the types of health issues workers are most likely to experience and the programs that are most effective in addressing them. Although the programs in the case studies were considered beneficial by employees and transit agencies, the research team could not find measurable impacts or detect statistically valid effects.
2. Determine the issues facing the agency's employees, the types of programs they would use, and a means of evaluating the impacts of those programs before initiating them. Over time, assess the programs' ROI and make adjustments as needed. Prior TCRP publications have included resources to help design and track such programs. In particular, the project team recommends a spreadsheet titled "Transit Operator Workplace Health Protection and Promotion Planning, Evaluation, and ROI Template." The spreadsheet file is available for download at no charge from the *TCRP Report 169* webpage at www.trb.org.

This report adds another layer of research to past studies that explored health and safety outcomes for transit workers and health promotion programs by quantifying the costs of widespread and consistently poor health and safety outcomes and the cost savings, if any, that can be attributed to those health promotion programs. Dangerous and strenuous work environments exact a toll on workers that also affects their employers and society. A better understanding of that toll, its costs, and the potential means of mitigating it are valuable contributions to the literature on the subject.

CHAPTER 1

Introduction: How to Read This Report

This report provides a literature review, research design, findings on prevalence and costs, five detailed case studies, and an implementation strategy. This chapter briefly describes the contents of each chapter and explains how they work together.

Chapter 2 presents the research design for the project (see Figure 1). This chapter lays out the authors' analytical approach and contextualizes the research questions, connecting them to the different chapters of the report and explaining how the research team planned to answer the questions. Following this framework, the authors organized the research so that each stage was built on the previous one, emphasizing practical considerations that transit agencies can use to understand the health and safety issues related to transit workers.

Having developed the framework, the research began with a review of literature (as summarized in Chapter 3) to compile a summary of the health and safety issues faced by transit workers. The literature review updates work from previous studies about transit operators. The work builds on prior research, particularly *TCRP Report 169: Developing Best-Practice Guidelines for Improving Bus Operator Health and Retention* (Gillespie, Wang, and Brown 2014) and *TCRP Report 174: Improving Safety Culture in Public Transportation* (Roberts, Retting, and Webb et al. 2015). It refers to both prior reports frequently, and the authors consider the current work to be an extension of those studies. The research team reviewed scholarly literature and other reports to identify the key health issues related to transportation workers and understand how to better focus our research efforts. The literature review contains sections on health and safety outcomes, costs, programs to mitigate negative health and safety outcomes, and the cost-effectiveness of health and safety programs. The most common issues discovered were musculoskeletal pain, acute back pain, and chronic health conditions such as diabetes, which are exacerbated by fatigue and stress. The research team also found that transit operators face safety issues from their own sleep deprivation and unruly passengers. Access to safe and sanitary restrooms was also a common problem. Several examples of workplace interventions, such as encouraging gym use, were found to have limited evidence of effectiveness. Some research on making changes to seating positions suggested that it would be effective in reducing musculoskeletal pain; however, very little of the research reviewed showed a direct link between health and safety programs and improvements in transit workers' actual health and safety.

Chapter 4 presents a description of the key demographic characteristics of the transit worker population to help contextualize the findings. Most transit workers are involved in vehicle operations (72%) and of these, just over 50% are bus operators. Most transit workers are male (63%), over age 45 (66%), and White (63%); however, disproportionately more African Americans are employed in transit than are employed in the general population as a whole, and disproportionately fewer women. The chapter identifies prevalence rates of health

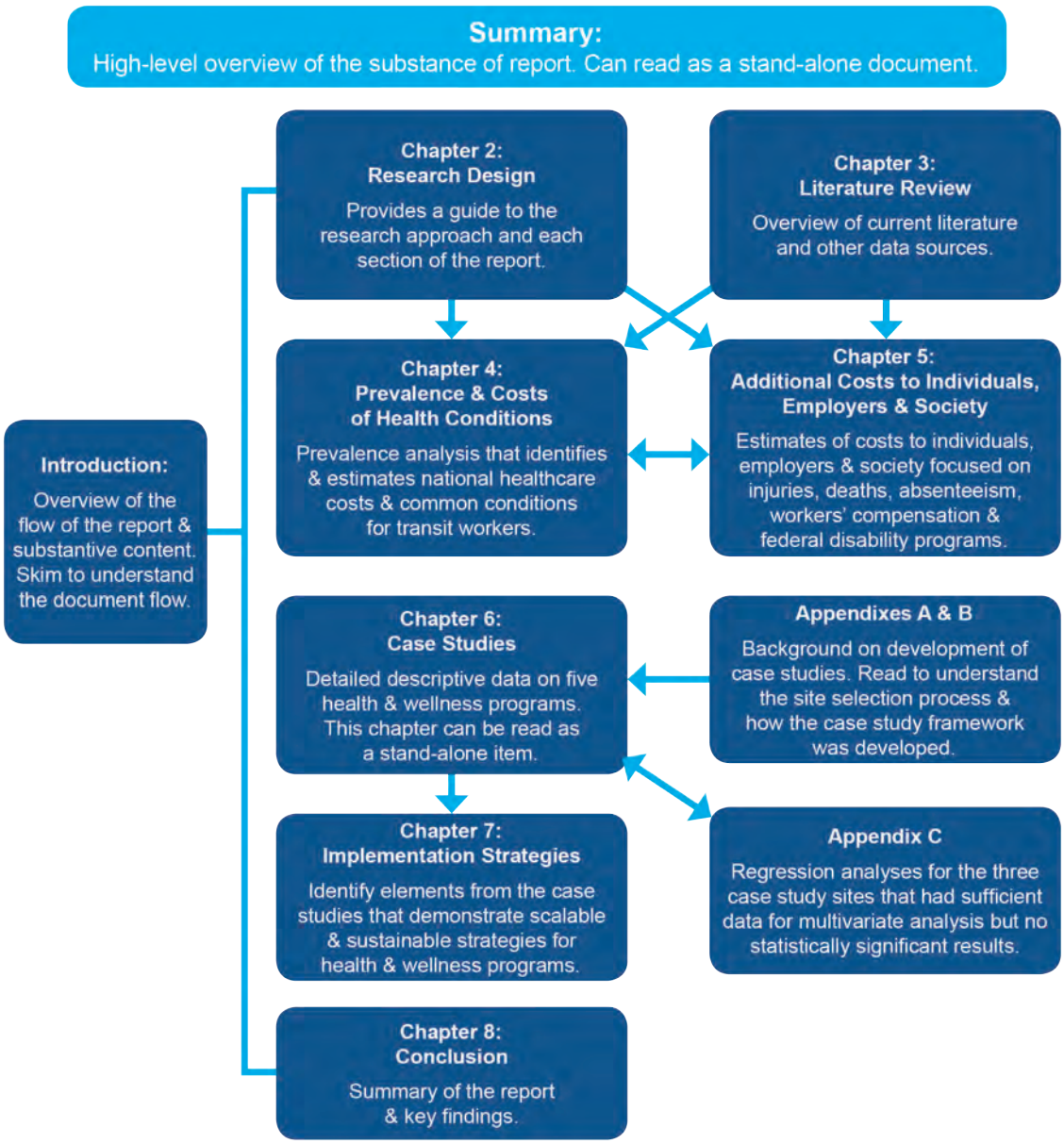

Figure 1. How to read this report.

conditions and risk factors affecting transit workers, in particular six chronic conditions that are more prevalent among transit workers than among the general population: cardiovascular disease, hypertension, diabetes, musculoskeletal conditions, mental health, and respiratory disease. National medical expenditures are estimated as a function of these conditions, which—as expected—are in excess of the expenditures for the general worker. Several secondary national data sources are used for the analysis.

Chapter 5 provides estimates of transit worker health costs to individuals, employers, and society by examining cost estimates for injuries, deaths, absenteeism, workers' compensation, and disability programs. Cost estimates ranged from $115 million for Supplemental Security Income (SSI) to $854 million for injury costs. For each category, the cost attributed to transit workers exceeded that of the general population because the transit worker population had higher incidence rates, claim rates, or disability prevalence.

Chapter 6 details the information the research team obtained about health and wellness programs at five sites. Details about all aspects of program development, organization, and activities are shared, participation rates at all sites are provided, and outcome measures at four sites are discussed. (The process for selecting the sites described in this chapter is provided in Appendices A and B.) The chapter also presents the results of a multivariate data analysis that was conducted for four of the sites. (Appendix C presents the models for the three sites with no statistically significant results.) The most common health issues cited were hypertension, followed by diabetes and musculoskeletal issues, which aligned with the prior findings of the research. The programs offered various benefits, including gym access, healthy snacks, workshops, health screenings, and many more. Although these programs mostly showed no direct impacts on the participants, they did provide useful examples of common health promotion strategies.

Chapter 7 assesses the implementation of programs for each site and provides guidance for transit agencies developing programs to address health problems that face transit workers. While communicating with the agencies during the preparation of the case studies, the research team sought their input to determine transit agency requirements, opportunities, and constraints for implementing potential solutions and tools that promote a healthy workforce and positively impact the bottom line.

Chapter 8 concludes the report and provides an overview of the project, key findings, and suggestions for future research.

CHAPTER 2

Research Design

2.1 Introduction

This chapter presents the key research questions, methodological approach, and specifics of the analytical plan followed for this research. Sections review the research questions this study sought to answer, discuss the overall analysis as informed by an overview of the background research, and detail the quantitative methods for the benefit-cost analysis and the case study design and selection.

2.2 Research Questions

The analysis approached the research questions in two main phases. As outlined in the next section, the first phase relied on extant data to answer the research questions. The questions covered in the first phase were as follows:

1. What are the key health issues faced by transit workers?
   a. What factors contribute to these issues?
   b. What are the related safety concerns?
   c. What key metrics are used to measure these issues and their outcomes, as found in the existing literature and current data sources?
   d. What costs are associated with these issues?
2. What are the current approaches and possible solutions to specific health and safety problems affecting transit employees?
   a. Where and how are they used?
   b. What resources are involved?
   c. What impacts do these approaches and solutions have on health and related safety issues?

The second phase incorporated information pulled from public records or provided by agencies, human resources records, insurance company records, and interviews with administrative, human resources, and health promotion program personnel. Additional research questions addressed during the second phase were:

3. What tools and techniques can be used for measuring program costs, benefits, and effectiveness?
   a. Who benefits and who pays?
   b. What are the costs, and how are they measured?
   c. What are the benefits, and how are they measured?
   d. What is effectiveness, and how is it measured?
4. What potential solutions and tools meet transit agency requirements?
   a. What barriers will agencies face when implementing the tools and solutions suggested by this study?

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b. What steps are proposed to lessen/overcome barriers?
c. What tools and techniques are available to support the allocation of funds and implementation of necessary improvements?
d. What next steps can build on this research?

Research questions 1 and 2 are answered with a review of the literature (Chapter 3), an in-depth analysis of prevalence rates of health conditions for transit workers (Chapter 4), and an exploration of the costs to employers and society of those conditions (Chapter 5). Research Question 3 is addressed via in-depth case studies and an analysis of five health and wellness programs implemented by transit agencies around the United States (Chapter 6).

Discussions with these agencies informed the project team's approach to Research Question 4, particularly as related to identifying and developing suggestions and tools to help agencies overcome barriers to implementing health and wellness programs. Suggestions for developing an implementation strategy and for implementing health and wellness programs are provided in Chapter 7. A standalone implementation document, the TCRP F-26 Implementation Memo, has been made available for download from the *TCRP Research Report 217* webpage at www.trb.org. The Implementation Memo provides additional guidance for agencies that wish to use a suggested tool, the spreadsheet-based "Transit Worksite Health Protection and Promotion Planning, Evaluation, and ROI Template," which is available for download via a link on the *TCRP Research Report 169* web page, also at www.trb.org.

2.3 Analysis of National Safety, Health, and Health Cost Data

The project team identified health and safety issues, current approaches, and possible solutions to research questions regarding key health issues and their costs. The questions were addressed by examining past research about transit workers' health and safety, identifying health issues and the factors that contribute to those issues, and discussing how the issues have been addressed. Figure 2 illustrates the process used to carry out this stage of the research.

This research identifies the key issues faced by transit workers, the factors contributing to these issues, and the related safety concerns by identifying key metrics, such as measures of the benefits to the employee (e.g., health indicators), the employers (e.g., reduced absenteeism, costs), and society (e.g., safety and reliability) consistent with the National Institute for Occupational Safety and Health's (NIOSH) Total Worker Health™ model. The costs associated with transit worker health issues also have been identified as they apply to workers, employers, and society.

The research team contributed original methods for estimating health-related costs for this population. This approach was necessary due to the dearth of data on health conditions and costs specific to transit workers. The approach taken was to approximate costs associated with transit worker health (i.e., illness and injury) by connecting findings from research on transit workers to findings from population estimates of health-related costs in publicly available data. Data sources included the Centers for Disease Control and Prevention (CDC), Medical Expenditure Panel Survey (MEPS), Social Security Disability Insurance (SSDI), and peer-reviewed research findings. For example, the project team was able to approximate the health costs of transit worker obesity using CDC estimates of obesity-related costs for individuals and aggregating those estimates nationally or by state (CDC 2018a). The identification of targets and conditions under which transit worker initiatives are likely to be most beneficial was considered critical. Thus, whenever possible, the project team also examined differences

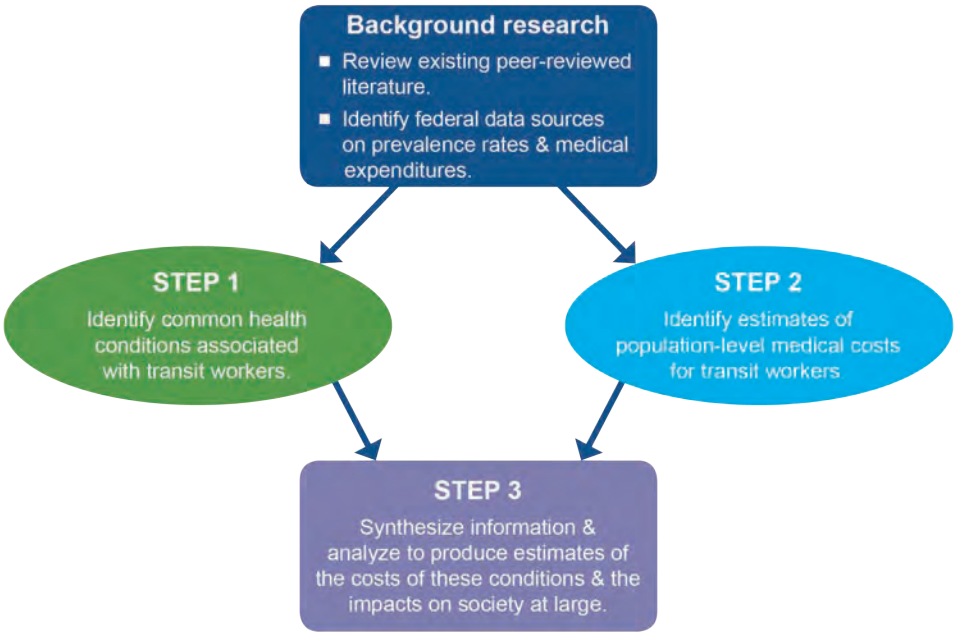

Figure 2. Research design and analytic process for transit worker health condition prevalence and medical expenditures.

in disease and injury prevalence by such factors as worker sociodemographic variables and environmental factors. The resulting approximations were intended to inform the objective of designing data collection and analytical models for evaluating the impact of transit worker health initiatives.

The project team referred to existing peer-reviewed publications on transit workers, databases from PubMed, Google Scholar, Repository & Open Science Access Portal's National Transportation Library, Transport Research International Documentation, and industry organizations to identify common health conditions or work-related health risks for transit workers. Given the prevalence of combining data on transit workers with other transportation areas and the scarcity of more recent data specific to transit workers, a decision was made to include findings from research or datasets that include multiple transportation areas to characterize transit worker health.

The project team approximated costs (e.g., financial, employee productivity) associated with common health conditions or work-related health risks in transit workers using peer-reviewed publications and publicly available national datasets. National datasets provide population-level estimates for average economic and productivity costs associated with health conditions and their treatment, and these population estimates were used to approximate economic and productivity costs in transit workers by health conditions and work-related risks. Given that smoking and obesity are known risk factors for cardiovascular disease, diabetes, cancer, respiratory disease, and arthritis (CDC 2019a; CDC 2018b), the analysis included medical expenditures for disease risk factors and medical conditions in cost approximations. Further, it is understood that as adults age, they are likely to develop more than one chronic condition, which means that medical expenditures are likely to increase at faster rates for older workers relative to younger workers (MEPS 2015). To enable a broader range of cost approximations, the project team included data on healthcare costs, absenteeism, and worker filings for disability benefits. Whenever possible, costs also were broken down by category (e.g., health expenses, lost productivity) and by population characteristics (e.g., age, gender, geographic location)

to identify cost-related contexts that may be most impacted and populations who may benefit the most from health promotion initiatives.

Finally, developing estimates of economic health costs sometimes involved using sources that themselves combined data from other sources. For example, the Council of State and Territorial Epidemiologists uses data from the U.S. Bureau of Labor Statistics (BLS) and state-based occupational safety and health surveillance data to create measures of the health of the working population, including the transit industry.

2.4 Case Study Identification: Local Health Promotion Programs That Measure Cost-Effectiveness

To address the research question about tools and techniques that can be used for measuring program costs, benefits, and effectiveness, the project team conducted a series of case studies that featured a benefit-cost analysis. The case studies, which detail the features of a series of health and safety promotion programs at five transit agencies, include both narratives about the programs and quantitative analyses. Selected sites had either already conducted some form of a benefit-cost analysis or had sufficient data to allow the project team to conduct one. The goal of the benefit-cost analysis was to produce estimates of the impact of programs administered by transit agencies on transit worker health and overall safety. Four of the sites had sufficient data for multivariate regression modeling, though only one produced results with statistical significance. Nevertheless, the qualitative data from all sites provided valuable insights on the types of programs offered and implementation successes and pitfalls. Appendices A and B to this report provide details of the site selection process.

CHAPTER 3

Literature Review and Baseline Data

3.1 Introduction

The literature review conducted for this study builds on past studies, including *TCRP Report 169: Developing Best-Practice Guidelines for Improving Bus Operator Health and Retention* and *TCRP Report 174: Improving Safety Culture in Public Transportation* (Gillespie, Wang, and Brown 2014; Roberts, Retting, and Webb et al. 2015). A large and varied body of literature was reviewed on factors affecting transit workers, their health conditions, health costs, and approaches by agencies to implement health prevention, health promotion, and safety programs. This chapter provides an overview of workforce conditions and health and safety outcomes for transit workers, reviews programs designed to mitigate negative health and safety outcomes, and summarizes the cost-effectiveness of health and safety intervention programs known to date. This study focuses on the conditions of the work environment that impact transit operations and maintenance personnel.

In this literature review, the project team examined the following topics:

- Workforce conditions: health and safety outcomes,
- Workforce conditions: costs,
- Programs to mitigate negative health and safety outcomes, and
- Cost-effectiveness of health and safety intervention programs.

Work conditions for public transit workers bring several unique health-related challenges and safety concerns, for which the associated costs are borne by workers, workers' unions, employers, the government, and the public. Some conditions in the public transit work environment constrain healthy behavior and may result in negative health and safety outcomes. The project team reviewed research on related circumstances and challenges:

- Behaviors and conditions that affect health and safety (e.g., sedentary nature of the job, sleep deprivation, exercise, diet, smoking, alcohol use);
- Chronic diseases (e.g., diabetes, cardiovascular disease, musculoskeletal disease);
- Communicable diseases;
- Labor environment;
- Organizational issues (e.g., safety climate, organizational programs, policies and procedures, support at work);
- Organization of work (e.g., shift work, job discretion, job demands); and
- Access to health-promoting activities and healthcare.

3.2 Workforce Conditions: Health and Safety Outcomes

Vehicle operators face specific challenges in the workplace due to their long shifts and exposure to vehicle and road vibrations. Musculoskeletal injuries can result from a combination of uncomfortable seating and non-optional operator behavior. Research has shown that the

repetitive action of turning the steering wheel of a bus can lead to back problems (Anderson 1992). Bus drivers were shown to exhibit pain at a rate at least one-third higher than that of the general population, with the author concluding that the higher prevalence of spinal problems can be attributed to stresses associated with turning to the left while driving and to the right while loading and unloading passengers. Because vehicle operators often work odd hours and work offsite (i.e., in conditions that may lack the amenities and supports available at a central or fixed workplace), they may suffer from fatigue and high levels of stress.

Inadequate access to restrooms exacerbates worker stress and fatigue. In Washington, D.C., Metro stations have restrooms, but the facilities are sometimes inaccessible due to issues of cleanliness caused by use by the public (Brown 2012). The lack of adequate facilities can increase delays, cause low worker morale, and lead to higher operator turnover rates. Metro Transit in Minneapolis, Minnesota, addressed this by having restrooms in stations and negotiating contracts with convenience stores and gas stations along bus routes to allow transit operators to use their facilities (Brown 2012).

In addition to chronic conditions and health risks, transit workers face several safety challenges. As discussed in *TCRP Report 174,* many transit agencies are trying to improve their safety culture (Roberts, Retting, and Webb et al. 2015). Safety concerns include unruly or aggressive passengers, other driver and pedestrian error, and the risk of accidents due to fatigue from long, irregular, or split shifts or to fatigue associated with health conditions such as sleep apnea (Petrie 2014). A report on the causes of bus crashes in New Jersey (a state with a large number of transit services) found that more than one-third of bus crashes (15 out of 40 crashes from 2005 to 2006) were attributed to driver inattention or inadequate surveillance of traffic and pedestrians (U.S. DOT 2010).

Health and Safety Issues Faced by Transit Workers:

- Stress related to long, irregular, and split shifts;
- Lack of access to nutritious food;
- Lack of regular access to restroom facilities;
- Repetitive-motion musculoskeletal injuries; and
- Sleep disorders.

Evidence suggests that the mental and physical stresses of long hours spent in a vehicle can have cumulative health effects. In a 2012 survey of workers in various occupations, transportation workers reported the highest rates of chronic health problems and the lowest well-being (Witters 2013). Various studies have documented that transit workers suffer from back problems and pain, cancer (lung, stomach, and rectal), diabetes, and hearing loss at higher rates than the general population (Hansen, Raaschou-Nielsen, and Olsen 1998; Morikawa, Nakagawa, and Ishizaki et al. 1997; Centre for Exploitation of Science and Technology 1993; Gubéran, Usel, and Raymond et al. 1992; Siemiatycki, Gerin, and Stewart et al. 1988).

The NIOSH tracks safety for more than 7 million workers in the transportation, warehousing, and utilities sector, which includes public transit workers. Workers in these industries are disproportionately at risk of vehicular accidents and exposure to emissions, as well as environmental and occupational hazards such as electrocution, overexertion, and falls. Irregular shifts or long-term overnight work and daytime sleep have a negative impact on rest and awareness, which can create a higher risk of crashes. Between 2003 and 2006, workers in the transportation, warehousing, and utilities sector—particularly truck drivers—made up 15% of workplace fatalities, but only comprised 5% of the U.S. workforce (CDC 2014). In 2006, costs related to fatal occupational injuries to transit and ground transportation workers were estimated at more than $200 million per year (CDC 2014).

Workers in the transit and ground transportation industry are disproportionately at risk of exposure to emissions (CDC 2014). In 2010, an estimated 13.9% of transportation workers were exposed to secondhand smoking, and an estimated 40.4% were exposed to noxious fumes and vapors (CDC 2013b). Compared to all U.S. workers, transit and ground transportation workers are twice as likely to be exposed to hazards from outdoor work and one and one-half times as likely to be exposed to vapors, gas, dust, and fumes (CDC 2013b). Such environmental exposures are associated with an increased risk for developing various types of cancer

(e.g., lung cancer, mesothelioma). For the 18.1 million people projected to survive cancer in 2020, the cost of their cancer care has been estimated at $8,716 per survivor, or $157.77 billion in 2010 dollars (Mariotto, Yabroff, Shao, Feuer, and Brown 2011).

It is important to note that chronic conditions, health risks, and safety risks can have bidirectional effects: Poor health may exacerbate driver distraction and increase the risk of a work-related injury; likewise, work-related injuries may exacerbate or increase the risk of chronic conditions.

3.3 Workforce Conditions: Costs

Chronic illnesses such as hearing loss, diabetes, and some cancers can carry large medical and economic costs: People who have been diagnosed with diabetes, for example, incur an estimated average of $7,900 per year in diabetes-related medical expenditures (American Diabetes Association 2013). Depending on the type of cancer, treatment protocol, insurance agreements, and other factors, a patient's direct medical costs associated with long-term cancer treatment can range from hundreds of dollars to thousands of dollars per month (Yabroff, Lund, Kepka, and Mariotto 2011).

A review of health findings for bus drivers revealed various conditions and issues, including the following (Tse, Flin, and Mearns 2006):

- Physical conditions (cardiovascular disease, gastrointestinal disorders, musculoskeletal disorders, fatigue);
- Psychological conditions (depression, anxiety);
- Risky behaviors (alcohol use, smoking); and
- Productivity losses (absenteeism, turnover, accidents).

Studies have shown a high prevalence of health risk factors such as obesity and smoking among transit workers. The highest age-adjusted prevalence of obesity (i.e., a body mass index[BMI] ≥ 30) from 2008 to 2011 was found in transportation and material moving workers, especially motor vehicle operators, ranging from 36.5% for White women to 73.9% for Black women, and from 36.5% for White men to 39.6% for Hispanic men (Gu, Charles, and Bang et al. 2014). Cunradi, Lipton, and Banerjee (2007) found that, over 10 years, 22.6% (N = 1,016) of San Francisco railway transit operators had initiated, increased, or maintained smoking. Findings from a subsample of this population (n = 654) showed that the odds of initiating, increasing, or maintaining smoking were increased for Black operators and operators with job-related stress (Cunradi, Lipton, and Banerjee 2007).

Costs related to fatal occupational injuries in transit and ground transportation workers were estimated to amount to more than $200 million per year in 2006 (CDC 2014). According to the *Motor Carrier Safety Progress Report,* the number of bus crashes from January through December 2017 was 16,931, and the number of bus injuries was 18,105 (FMCSA 2018). In 2013, the costs to employers for on-the-job non-fatal injuries amounted to $64,981 for each employee injured, whereas the estimated costs to employers of on-the-job crashes of local and interurban transportation vehicles were $2,272 per employee (Network of Employers for Traffic Safety n.d.).

Injuries and the development of chronic illness in transit workers can create large economic losses from reduced workdays, shortened career spans, and the costs of clinical care. These costs accrue to the government in the form of paying for replacement workers when transit workers call in sick. As illustrated in Table 1, public transit workers have three times higher rates of nonfatal occupational injuries and illnesses than workers in all industries. As seen in the table, urban transit workers experience 4.9 cases of illness with days away from work, job

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Table 1. Incidents involving days away from work, job transfers/restrictions, and other cases, 2015.

	Cases (Incidents Involving Days Away from Work, Job Transfers, or Restrictions)*				
Industry and NAICS Code **	Days Away from Work	Job Transfers or Restrictions	Subtotal	Other Cases	Total (all cases)
All industries, including state and local government (N/A)	1	0.7	1.7	1.6	3.3
Transportation and warehousing (48-49)	2.0	1.2	3.2	1.3	4.5
Urban transit systems (4851)	3.6	1.3	4.9	1.8	6.7
Support activities for rail transportation (4882)	3.2	1.7	4.9	1.6	6.5
Support activities for road transportation (4884)	1.8	0.7	2.4	0.6	3.0

* Incidence rates represent the number of injuries and illnesses per 100 full-time workers.
** NAICS = North American Industry Classification System.

Source: BLS (2016a)

transfer, or restriction per year per 100 full-time workers, compared to 1.7 cases for workers in all industries. Estimates for lost days for those who exited the industry for health reasons could not be included in Table 1 because the research used cross-sectional data. Panel data that focused specifically on transit workers, which might have allowed for such an analysis, was unavailable.

Although many public transit workers who become sick or are injured on the job receive workers' compensation, only the most egregious health issues may be compensated through workers' compensation. Public transit workers may be sufficiently sick or disabled that they can no longer operate a vehicle but not qualify to receive workers' compensation benefits or social security income, and they may not yet qualify for a pension. Health problems also can result in lower wages for public transit workers due to associated declines in performance or time spent out of the labor force. People who face the most common health issues that affect public transit workers also may have a shortened life span compared to the general public. Given these effects, improvements in work conditions may offer multiple benefits to drivers, including a reduction in chronic health problems, increased earnings, and improvements in the length or long-term quality of life.

Direct costs to society of public transit worker health and safety issues include lower quality service (e.g., delays), the costs of healthcare provided to public transit workers through public insurance programs, and the costs of accidents that can be at least partially attributed to transit worker health problems.

Indirect or secondary impacts of improved transit worker health include reducing the costs to society. Transit service quality may improve if a system is better able to retain experienced operators. Reductions in absenteeism may contribute to more consistent and better service to the public, and workers in better health may operate transit vehicles more safely. In areas where rapid transit is of high quality, rents and property values could increase, as could the availability of investment dollars or financing for development.

3.4 Programs to Mitigate Negative Health and Safety Outcomes

Research on workplace wellness and safety interventions is still relatively new, and the findings are mixed. Many workplaces have wellness programs that are not well supported, funded, or targeted to the needs of transit operators. Based on the findings of *TCRP Report 169*, these

health and wellness programs may have limited participation due partly to the nature of transit bus operator work schedules. That report demonstrated, in part, that successful wellness programs can lead to long-term healthier behaviors, reduce accidents, and reduce absenteeism. Best practices in transit worker health can benefit from a comprehensive, occupation-specific program that management and employees alike support, which is readily available for the participation of the entire workforce. This section presents examples of some successful approaches and identifies systemic barriers to health promotion success.

At the core of the NIOSH guidelines for improving workplace well-being is the importance of regarding wellness and safety as a top priority in the organization. Treatment of medical issues related to transit operation may be costly, especially the implementation of new programs. An organizational culture that prioritizes health and wellness will treat the cost of the programs as a secondary consideration.

Using some form of competition to incentivize fitness and nutrition has become a popular strategy in the corporate world due to its relatively low-cost and built-in incentive structure. Veolia Transportation (now TransDev) ran a "Biggest Loser" challenge to engage employees in wellness efforts (Petrie 2014). Agencies use competitions to encourage healthy behaviors such as smoking cessation, exercise, and healthy eating habits. Increasingly, insurance plans available to employees offer lower premiums for participation in wellness programs. These schemes have become common among large employers; however, the overall efficacy of these programs in increasing employee health and lowering costs is unclear (Tu and Mayrell 2010). Competitions for weight loss or smoking cessation are reportedly effective for increasing program participation, but not necessarily effective for fostering long-term change (Tu and Mayrell 2010). Consequently, metrics that gauge the success of a health promotion program based on participation rate may have limited value in measuring health outcomes.

Research shows that incentives combined with supportive practices (e.g., increasing access to care, thorough screenings, onsite treatment, and assistance with early risk identification) can lead to longer-term benefits. Preventive screenings and treatment are key to minimizing the damage of potentially life-threatening illnesses like cancer, cardiovascular disease, and diabetes. Hiring an outside wellness coordinator can lead to the success of innovative practices, as it reduces concerns about confidentiality and may allow flexibility in scheduling activities around drivers' schedules.

Interventions must be well-designed to be effective. Sleep apnea is one of the most common medical causes of fatigue, which is one of the largest contributors to vehicular crashes. For several years, the Southeastern Pennsylvania Transportation Authority in Philadelphia, Pennsylvania, has had a program that encourages awareness and treatment of sleep apnea. The agency regularly screens transit bus operators to test for and treat sleep apnea (Petrie 2014). The agency does not have a separate budget for a wellness program, however, which means that agency employees also serve as wellness coordinators. Additionally, no financial incentives are in place to participate in the screening, and drivers who test positive may lose their jobs if there are no interventions in place.

Programs or practices that promote a culture of safety can mitigate risks that transit workers face, including aggressive passengers and road accidents. A survey reported in *TCRP Report 174* yielded the finding that training programs that address accidents should do so from the standpoint of preventing future accidents rather than assigning blame for past accidents (Roberts, Retting, and Webb et al. 2015). The survey also identified the following characteristics of developing or improving safety culture: providing adequate training to workers, having open and frequent communication on safety, and establishing a high level of trust between management and frontline staff, among other goals.

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3.5 Cost-Effectiveness of Health and Safety Intervention Programs

An actuarial study conducted by Bolnick, Millard, and Dugas (2013) concluded that wellness programs could potentially affect approximately 25% of healthcare costs for working populations. The study used data from the *Global Burden of Disease* study (Murray and Lopez 1996) and the MEPS to estimate the savings that would result from lowering risk factors typically managed by healthcare promotion programs to their theoretical minimums. According to a 2015 estimate from the CDC, 86% of the nation's $2.7 trillion annual healthcare expenditures are for people with chronic and mental health conditions, and these costs can be greatly reduced (CDC 2017). Among other illnesses that health promotion programs target, cardiovascular diseases cost an average of $316 billion annually in the United States from 2012 to 2014. The total estimated cost of diagnosed diabetes in 2012 was $245 billion; of this, $69 billion represented decreased productivity associated with people being absent from work, less productive at work, or unable to work at all (CDC 2017).

After the introduction of wellness programs in many workplaces across the United States, an increasing number of employers want to know if they are effective. Programs are adding measures of outcomes, including behavioral, clinical, and health outcomes. Some research authors go so far as to say that "there is a brewing controversy about whether workplace health promotion programs in the United States work or do not work" (Goetzel, Henke, and Tabrizi et al. 2014). In analyzing studies of cost-effectiveness of health promotion programs for transit workers, the Econometrica team grouped the studies into three categories:

- Research on the effects of wellness programs for employees and organizations in any industry,
- Guidance to the transit industry on measuring cost-effectiveness, and
- Studies providing analysis of return on investment (ROI) and other cost-effectiveness measures of transit programs.

Extensive literature is available on the cost-effectiveness of workplace health promotion programs (Bolnick, Millard, and Dugas 2013). In 2010, a comprehensive review of more than 100 studies of health promotion programs summarized the ROI from 22 health promotion programs that met study criteria (Baicker, Cutler, and Song 2010). The authors found that the average return on $1.00 of investment in the 22 programs was $3.27 when measuring savings in health costs and $2.73 when measuring savings from reduced absenteeism. Individual studies also have shown positive ROIs for wellness programs: One study showed a ROI of $2.53 for every dollar spent on a wellness program taking place over 7 years (2005–2011) for 3,800 cohorts; however, it should be noted that this study focused on workers in an academic workplace, which has different physical demands than a transit environment (Dement, Epling, Joyner, and Cavanaugh 2015).

A 2014 study by RAND examined the cost impacts of PepsiCo's workplace wellness programs, which offered both lifestyle and disease management components. The lifestyle management programs did not reduce costs among employees, but the disease management components resulted in a 29% reduction in hospital admissions and an annual reduction in health care costs of $136 per member per month (Caloyeras, Liu, and Exum et al. 2014). Another study examined workers' hospitalizations in the BJC Healthcare hospital system in St. Louis, Missouri (Gowrisankaran et al. 2013). In the latter study, the wellness program reduced the number of hospitalizations but did not reduce costs when comparing those workers who participated in the wellness program with those who did not.

The studies discussed suggest that health promotion programs may have a meaningful financial benefit to transit agencies. However, other research demonstrates that wellness programs may not affect the bottom line. One example is a study of approximately 33,000 workers

at retailer BJ's Wholesale Club over a period of 18 months (Song and Baicker 2019). Some of the BJ's locations offered the wellness program and others did not. The employees at the sites with the programs reported an increase in regular exercise (8.3%) and weight management (13.6%) as compared to employees in the non-participating sites, but their health and employment outcomes were not statistically significantly different than the employees in the sites without wellness programs. They had no improvements in self-reported health measures; clinical markers of health, such as lower blood pressure or sugar levels; health care spending or utilization; or absenteeism, tenure, and job performance (Song and Baicker 2019; Abelson 2019). Another study of 4,800 university employees showed statistically insignificant differences between the employees who participated in an incentivized wellness program and those who did not, as measured by sick days and healthcare spending (Jones, Molitor, and Reif 2019).

The project team's review of the literature identified a limited number of studies of the cost-effectiveness of programs specific to transit agencies. The successful programs examined in the literature review were provided adequate resources and were of a type that could easily start small and be scaled up. Of the six case studies of effective health promotion programs in *TCRP Report 169*, the Capital Metropolitan Transportation Authority (Capital Metro) health and wellness program in Austin, Texas, achieved returns of $2.43, $3.95, and $2.88 for each dollar in the years 2007, 2009, and 2010, respectively. The program included two onsite 24-hour fitness centers with free personal training/health assessments; annual cash incentives for health promotion activity; and improved access to healthy food, health education, and health and wellness outreach events. Since 2003, Capital Metro has done an annual benefit-cost analysis of the workforce wellness program. After initial increases in healthcare costs in 2007, the program saw a 4% decrease in costs and a decline in driver absenteeism from 10% to 7.6%. Overall, the program achieved a greater than 200% ROI for each year after 2007. The Denver Regional Transportation District also has more than 12 years of data showing a positive ROI for the physical therapy program it began in 2000 (Jacobsen 2018).

Additional studies on truck drivers and bus drivers also showed cost savings. Trucks, Inc., employs a doctor and physician assistant to perform annual health screenings of drivers onsite. These screenings include routine bloodwork screenings and a check of prostate-specific antigen (PSA) levels in male workers. The company claims that early detections from the screening program have saved them $250,000 in medical costs and led to the early identification of five pre-heart disease conditions, two cancer cases, and many instances of prediabetic conditions (Krueger, Brewster, Dick, Inderbitzen, and Staplin 2007).

Schneider National, another trucking company, took a different approach to sleep apnea intervention. The company identified drivers who could potentially suffer from sleep apnea, then paid for a third-party vendor to test the drivers and sent drivers who were diagnosed with sleep apnea home with a Continuous Positive Air Pressure (CPAP) machine. The company followed up with drivers quarterly to ensure that the intervention was still working. Per the company's statistics, this program saved an average of $500 per driver per month in healthcare costs and increased retention by more than 50% (Krueger, Brewster, Dick, Inderbitzen, and Staplin 2007).

Studies on ergonomic improvements suggest that this is one area of program intervention that can alleviate musculoskeletal disorders among bus operators, reduce healthcare costs, and increase worker productivity. In one study, an ergonomist interviewed a sample of bus operators, observed driver habits, and synthesized data into a training program. The ergonomist's consulting team subsequently trained and tested the entire bus operating force on the seating and found that the behavioral training alone reduced work-related musculoskeletal disorders by almost 30% (OSHA 2003). Although changing drivers' seating can be costly, at least one company—Schneider National—has reported a decrease

in lost time injuries, discomfort complaints, and workers' compensation injuries by 47% (Krueger, Brewster, Dick, Inderbitzen, and Staplin 2007).

3.6 Conclusions

3.6.1 Health and Safety Outcomes

The work of operating vehicles (e.g., buses, light rail, or heavy rail vehicles) can lead to negative occupational health outcomes such as musculoskeletal pain, acute back pain, and chronic health conditions such as diabetes, which are exacerbated by fatigue and stress levels. Operators may face safety challenges in the form of unruly or aggressive passengers, and they are also at risk of vehicle accidents by operating with occupational health injuries or chronic conditions, including insufficient sleep. Both vehicle operators and other transit workers face health issues due to exposure to exhaust fumes and other environmental hazards. Transit workers are three times more likely than the general public to have an injury that results in days away from work (absenteeism) and job transfer or restriction (turnover). Poor health may exacerbate driver distraction and increase the risk of work injury; likewise, work-related injuries may exacerbate or increase the risk of chronic conditions.

3.6.2 Costs of Chronic Illnesses and Injuries

Transit workers have high prevalence rates of smoking and obesity, which are associated with higher medical costs. The chronic illnesses from which transit workers suffer disproportionately (e.g., diabetes, cancer, and hearing loss) carry medical and economic costs. For example, people with diabetes incur an estimated average of $7,900 per year in diabetes-related medical expenditures (American Diabetes Association 2013). Direct medical costs associated with some cancer treatments can range from hundreds to thousands of dollars per month (Yabroff, Lund, Kepka, and Mariotto, 2011). Costs related to fatal occupational injuries in transit and ground transportation workers were estimated to amount to more than $200 million per year in 2006 (CDC 2014). Injuries and the development of chronic illness in transit workers can create meaningful economic losses from reduced workdays, shortened career spans, and the costs of clinical care.

3.6.3 Programs to Mitigate Negative Health and Safety Outcomes

Research on workplace wellness and safety interventions is still relatively new and the findings are mixed. At the core of the NIOSH guidelines for improving workplace well-being is the importance of regarding wellness and safety as a top priority in the organization. Many agencies use some form of competition to incentivize fitness and nutrition. This strategy has become popular in the corporate world due to its relatively low-cost and built-in incentive structure. Research shows that incentives combined with supportive practices (e.g., increasing access to care, thorough screenings, onsite treatment, and assistance with early risk identification) can lead to longer-term benefits. To be effective, interventions must have an understandable structure and goals that are communicated clearly to workers. Programs or practices that promote a culture of safety can mitigate risks that transit workers face, including aggressive passengers and road accidents.

3.6.4 Cost-Effectiveness of Health and Safety Intervention Programs

The literature provides evidence of the direct costs of chronic health conditions, including absenteeism and turnover, and how wellness intervention programs function to mitigate

these costs. Relatively few studies measure the indirect costs of occupational health injuries for transit workers, however, and very little data provide evidence for the effectiveness of wellness intervention programs for the transit worker population. In the existing literature on transit worker wellness programs reviewed by the project team, two studies included a review of six transit agencies that included one case with a twofold ROI and health intervention program for truck drivers that resulted in increased retention. Overall, the literature is largely inconclusive on the effectiveness of wellness programs to reduce costs, both in general and specifically for transit agencies. Most programs are not well supported, funded, or targeted to the unique challenges transit workers face. This research sought to close several gaps in the research on transit worker wellness and safety programs. Chapter 6 of this report presents an assessment of the cost-effectiveness of methods that agencies have used, describes the benefit-cost analysis conducted by the project team, and identifies ways to incorporate scalable and sustainable cost-effectiveness strategies into health promotion programs.

CHAPTER 4

Prevalence and Costs of Health Conditions

4.1 Introduction

This chapter aims to identify and estimate national healthcare costs and worker productivity as a function of transit worker illness and injury. The estimates provided are generally for the entire population of transit workers and are used to inform evaluations of transit agency health promotion programs. As Figure 3 shows, the costs of the harms related to worker illness and injury are paid by workers, employers, and society, which underscores the need to identify ways to increase the effectiveness of transit agency wellness programs for preventing and reducing the burden of transit worker chronic illness and injuries (Asay, Roy, Lang Payne, and Howard 2016; MEPS 2014). Recognition is growing of the importance of adopting an approach to improving worker health that includes facets of both physical and mental health (CDC 2018c). This recognition is particularly true for transit workers, who face many work-related challenges that can have deleterious effects on their health (Tse, Flin, and Mearns 2006; Greiner, Krause, Ragland, and Fisher 1998).

Figure 3 shows the relationships between the costs to society, employers, and workers related to worker illness and injury. The top box shows examples of costs of worker illness and injury paid by workers, which include lost wages from lost days of work, out-of-pocket medical costs, and the employees' share (if any) of health and disability insurance premiums, as well as diminished quality of life. The lower right-hand box shows examples of costs paid by employers, which include costs associated with worker absenteeism and turnover, as well as the (typically greater) share of costs for employer-based health insurance. Examples of costs shared between workers and employers include disability insurance and lost productivity in terms of worker and employer output of quality and effective services. The lower left-hand box shows examples of costs paid by society, which include costs to state resources (e.g., workers' compensation, Medicaid) and costs to federal resources (e.g., disability, Medicare, Tricare). Examples of shared costs between society and employers include losses in the labor force and costs to workers' compensation programs that are supported by employers and states. Examples of shared costs between workers and society are fewer public services, reduced public safety, and detrimental health and financial spillover to families of workers. Overlaps across categories also can make it difficult to establish precise divisions or counts; for example, if the employer covers all or most of the cost to provide health insurance, this benefit to workers often comes at a cost to employees in the form of lower wages.

Using publicly available data and empirical findings on worker populations, the project team approximated some of the costs of transit worker health and injury paid by different stakeholders, as seen in Table 2.

This chapter describes the data sources and metrics used to determine the national prevalence of worker illness and work-related injuries, as well as their associated costs. Where possible,

Figure 3. Examples of costs of transit worker illness and injury paid by workers, employers, and society.

comparisons of costs of transit worker illness and injury to costs of the general working population have been included to illustrate potential risk factors that may contribute to transit worker illness and injury. Levels of data describing the transit worker population vary, as do the definitions of conditions and injuries. Because the sources used to estimate costs draw from various data sources and peer-reviewed findings, the national estimates for medical and productivity costs associated with transit worker illness and injury are approximations. Medical

Table 2. Cost categories, transit workers' chronic illness and injury risks by type of stakeholder.

Category of Cost/Stakeholder	Expenditures and Losses
Medical expenditures related to worker chronic illness or illness risk factors	
Transit workers	Out-of-pocket spending (e.g., copays) Employee share of health care insurance spending (i.e., share of premiums, if any)
Employers and unions	Employer or union health care insurance spending
Society (federal programs)	Medicare spending Medicaid spending Disability spending
Medical expenditures related to work-related injury	
Transit workers	Out-of-pocket spending (e.g., copays)
Employers	Employer health care insurance spending (i.e., employer- or union-paid premiums) Workers' compensation insurance spending
Society (federal and state programs)	State workers' compensation payments Medicare spending Medicaid spending Disability spending
Productivity losses from worker illness and/or injury	
Employers	Absenteeism Turnover

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care costs include those paid by both transit workers and their employers. Because of data confidentiality restrictions and differences in cost measurement, it is not always possible to differentiate costs among transit workers, employers, and state/federal entities. Cost estimates from national data sources often combine multiple cost domains to provide a single estimate. Further, cost estimates based on claims data may be limited to only certain types of claims.

For this project, the different sources of costs were used to arrive at approximations to further identify potential areas of focus for transit worker health promotion programs and their evaluations. First, the prevalence of illness and injury in transit workers was identified by reviewing existing peer-reviewed literature and national data sources, including survey and claims-based data. The information given in this report specifies whether the estimate for the transit worker population was based on the general transportation population or the narrower transit worker population. Next, costs (i.e., economic, productivity) associated with illness and injury in transit workers were identified by reviewing existing peer-reviewed literature and national data sources such as APTA, the MEPS from the Agency for Healthcare Research and Quality, and the Survey of Occupational Injuries and Illnesses (SOII) from the BLS. The research examined the prevalence and associated medical costs for smoking and obesity, which are known risk factors for cardiovascular disease, diabetes, cancer, respiratory disease, and arthritis (CDC 2019a; CDC 2018b). To allow for a broader range of cost approximations, data were included on both medical expenditures and productivity costs (e.g., absenteeism, turnover). Finally, medical expenditures were approximated for certain conditions using MEPS public use data selected for respondents who work in the transportation and utilities industry and who share similar work environments and demographic composition with transit workers. It should be noted that the cost estimates obtained from the MEPS do not indicate which expenditures are covered by workers' compensation.

These cost estimates can help inform the design of health promotion, prevention, and safety programs. Targeting the conditions that are the most prevalent can help reduce medical and other costs and improve the health and safety conditions of transit workers. For example, cost estimates can reveal the costliest conditions, identifying what may be good targets for health intervention programs. Alternatively, they can reveal other areas of emphasis: For example, if costs associated with injuries or workers' compensation programs are high, this may indicate the need for emphasis on safety or on the management of the workers' compensation system and rehabilitating workers.

A limitation of this research, which is common to all work on prevalence, is that information could not be included about the prevalence and costs of workers who had to leave transit work as a result of deteriorating health caused by the nature of their work. Life-course and longitudinal studies are an excellent approach to answering this type of question but were not feasible for the current study. The estimates of incremental costs over and above the "average" also could not adjust for demographic characteristics of the average worker (e.g., age and gender) relative to the transit worker because most of the data sources did not allow for this type of adjustment. Adjusting for demographic factors would add an important perspective to research on health outcomes because transportation workers are disproportionately male and older. If possible, these elements should be included in surveys that gather occupational data.

4.2 Key Characteristics of Transit Workforce

This section summarizes some important characteristics of the transit workforce and establishes baseline data describing the population of interest. As Table 3 shows, vehicle operations and vehicle maintenance personnel represent most of the transit industry workforce (72% and 17% respectively).

Table 3. Total and percentage of total employees by transit mode and function, 2015: bus, heavy rail, and light rail.

Statistical Category	Bus	Demand-Response	Commuter Rail	Heavy Rail	Light Rail	Total	Percent
Employees, vehicle operations	132,076	91,983	10,953	20,387	5,242	260,641	**72%**
Employees, vehicle maintenance	32,989	8,729	8,751	9,570	2,339	62,378	**17%**
Employees, non-vehicle maintenance	7,064	2,484	7,059	17,559	2,484	36,650	**10%**
Total employees	**172,129**	**103,196**	**26,763**	**47,516**	**10,065**	**359,669**	**100%**

Source: APTA (2018)

In Table 3, vehicle operations refers to all activities associated with vehicle operations, including transportation administration and support, revenue vehicle movement control, scheduling of transportation operations, revenue vehicle operation, ticketing and fare collection, and system security. Vehicle maintenance refers to all activities associated with revenue and non-revenue (service) vehicle maintenance, including administration, inspection and maintenance, and servicing (e.g., cleaning, fueling) vehicles. Non-vehicle maintenance refers to all activities associated with facility maintenance, including administration; the repair of buildings, grounds, and equipment as a result of accidents or vandalism; and the maintenance of power facilities, roadways and tracks, and other facilities and systems. APTA also lists a fourth category, "general administration," which was left out of the population totals for this project as it consists of administrative activities associated with the general or business management of the transit agency that generally involve fewer physical demands.

As Table 3 illustrates, most transit workers are involved in vehicle operations and, of these, the majority are bus operators. Bus operator employment is projected to grow by 6% from 2016 to 2026; by contrast, rail operator employment is projected to decrease by 3% (BLS 2018i; BLS 2018j).

Table 4 shows the mean hourly wages for workers using NAICS codes from the 2010 *Standard Occupational Classification (SOC) Manual.* The NAICS codes were used throughout this project for cost estimates.

The 48-49 NAICS codes are related to those in the 2010 SOC Manual, including the codes for transportation and material moving occupations (53-0000) and the occupation bus drivers, transit and intercity (53-3021). When designations for transit workers were

Table 4. Mean hourly wages for cost estimates.

Code	Occupation	Source	Total Employment	Mean Hourly Wage	Mean Annual Wage
NAICS 48-49 [a]	Transportation and warehousing	BLS (2017) [b]	5,792,400	$22.94	$47,200
NAICS 485	Transit and ground passenger transportation	BLS (2017) [c]	494,700 (Mar. 2018)	$18.90 (Feb. 2018)	$39,305
NAICS 4851	Urban transit systems	BLS (2017) [d]	47,000 (May 2017)	$20.51 (May 2017)	$42,660
NAICS 4852	Interurban and rural bus transportation	BLS (2017) [e]	17,690	$18.56	$38,600
SOC 53-3021	Bus drivers, transit and intercity	BLS (2017) [f]	176,140	$20.81	$43,290
SOC 53-4099	Rail transportation workers, all other	BLS (2017) [g]	2,780	$28.82	$59,950

Sources: [a] NAICS codes 48 and 49, grouped as 48-49 for transportation and warehousing; [b] BLS (2018f); [c] BLS (2018c); [d] BLS (2018d); [e] BLS (2018e); [f] BLS (2018g); [g] BLS (2018h)

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Table 5. Demographic characteristics, general employed population and population employed in the bus service and urban transit industry.

Demographic Characteristic	Employed Persons, Ages 16 Years and Older	
	General Population	Bus Service and Urban Transit Industry*
Full-time	82.2%	N/A
Male	53.1%	62.9%
Aged 40+	54.3%	66.2% (45+)
White	78.4%	62.6%
Black/African-American	12.1%	29.3%
Asian	6.2%	6.0%
Other race	3.3%	2.1%
Hispanic or Latino ethnicity	16.9%	15.9%

* The bus service and urban transit industry classification represents NAICS codes 4851, 4852, 4854, 4855, and 4859.
Source: BLS (2019a) and 2002 Census

available by occupation codes instead of by four-digit NAICS codes, the project team used the relevant occupation codes.

For calculating industry-wide costs for transit workers, APTA's base figure of 359,669 transit workers was used. It should be noted, however, that costs have not been reported specifically for this population. Costs typically are reported for the transportation and warehousing sector (NAICS 48-49), which has a count of 5,279,300 people. When categories more specific to transit workers were used, costs were calculated for codes 4851 and 4852, which had counts of 47,000 and 17,690 people, respectively (a total of 64,690 people). The 4851 and 4852 codes were preferred, but data were not always available at this level.

The project team felt most confident in attributing data to transit workers when the available data covered transit-specific work categories. In accordance with the classification system, however, the project team also was confident that—in comparison with data for workers in general—data from the "transportation workers" category likely reflected the conditions and experiences of workers who have traits and experiences in common with transit workers. Accordingly, when it was the only category available, the general category "transportation workers" was used. When presenting data from studies and government sources that reflect cost estimates for health conditions and risks associated with transit workers, this report indicates whether the reference applies to a general category (e.g., "transportation workers") or specifically to transit workers.

Other key data characterizing the transit worker population relate to demographics. Table 5 displays demographic characteristics of workers in the bus service and urban transit industry (NAICS codes 4851, 4852, 4854, 4855, and 4859).

As Table 5 displays, compared to the general worker population the transit worker population is disproportionately Black/African-American, older (over the age of 45), and male. Each demographic characteristic has associations with health risks and health costs that must be factored into economic modeling of cost savings from health promotion programs (Choi et al. 2017).

4.3 Identify Common Health Conditions Associated With Transit Workers

The project team used PubMed, Google Scholar, and the U.S. DOT Library to review the available literature on health conditions associated with transit workers to better understand which types of conditions are prevalent. National data and findings from the MEPS, the National Health Interview Survey (NHIS), and the SOII also were used.

In a 2012 Gallup Poll, transportation workers reported the highest rates of chronic health problems and the lowest well-being among different occupation types (Witters 2013). Based on these and other findings from a review of health conditions of urban bus drivers, a report of morbidity and disability in the transportation, warehousing, and utilities sector, and findings for local and interurban passenger transit workers from employer insurance claims data, the following were identified as important targets for transit worker health promotion efforts (Lee et al. 2012; Bushnell, Li, and Landen 2011; Tse, Flin, and Mearns 2006):

- Cardiovascular disease,
- Hypertension,
- Diabetes,
- Musculoskeletal disorders,
- Mental health, and
- Respiratory conditions (e.g., asthma).

Findings from employer insurance claims indicate that local and interurban passenger transit workers have hypertension, depression, cardiovascular disease, and diabetes at rates that are more than 120% of the general population rate (CDC 2014). Findings also indicate that more than one-quarter of workers in the transportation, warehousing, and utilities sector report smoking and obesity (U.S. DOT 2010).

Transit worker health promotion efforts often focus on:


Cardiovascular disease


Hypertension


Diabetes


Musculoskeletal conditions


Mental health conditions


Respiratory conditions (e.g., asthma).

4.3.1 Locating Prevalence Estimates of Chronic Conditions and Risk Factors in Transit Workers

Given the scarcity of data specific to transit and ground transportation workers, it was decided to include findings from research or datasets that provide prevalence findings for more general industry codes corresponding to the greater transportation workforce (e.g., persons working in the transportation, warehousing, and utilities sector). Health data were based on self-reports from interviews and surveys of adults ages 18 and older (e.g., from the NHIS), worker and employer self-reports (e.g., from the SOII), or employer insurance claims data (e.g., from regional health insurance providers) (CDC 2019d; Aizcorbe et al. 2012; Bushnell, Li, and Landen 2011).

Society defines and measures *illness* according to concepts and conventions that can be referred to as *illness constructs.* The project team found that illness constructs are defined and queried in varying ways across data sources. For example, the MEPS (2018) asks respondents whether they have been diagnosed with certain conditions and includes questions about the following conditions:

- Arthritis,
- Asthma,
- Attention deficit hyperactivity disorder/attention deficit disorder,
- Cancer,
- Chronic bronchitis,
- Diabetes,
- Emphysema,
- Heart disease (including coronary heart disease, angina, myocardial infarction, and "other unspecified heart disease"),
- High blood pressure,
- High cholesterol,
- Joint pain, and
- Stroke.

These conditions are included in the MEPS because of their known prevalence and because generally accepted clinical treatments are available for these conditions. The SOII asks

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employers for information about worker injury and illness, which is processed and reported by state agencies via the BLS (e.g., BLS 2017b). Illnesses included in the SOII refer to abnormal conditions or disorders that can be attributed to exposure to work-related conditions (Tse, Flin, and Mearns 2006). Examples of these illnesses include disorders of major organ systems such as the nervous system and sense organs, and skin, musculoskeletal, respiratory, and/or cardiovascular conditions (BLS 2012).

Illness constructs in claims data are based on the International Classification of Diseases associated with patient diagnoses. One advantage of claims-based illness prevalence data is that it is not subject to recall biases and underreporting, which often affects self-reporting measures. However, claims-based illness prevalence data are often limited to employer insurance providers within certain regions or to larger, self-selected employers who agree to share health insurance data (Mariotto, Yabroff, Shao, Feuer, and Brown 2011). Thus, although claims-based data provide more clinically exact information about illness diagnoses, prevalence estimates may not be nationally representative. Further, confidentiality concerns limit the sociodemographic information available for analyses using claims data. The project team prioritized prevalence estimates for transit workers, then reported the prevalence rates based on broader illness categories (e.g., cardiovascular disease was favored over coronary artery disease, which can be thought of as a subset of cardiovascular disease). The prevalence rates reported were based on both survey and claims data.

4.3.2 Findings for Prevalence Estimates of Chronic Conditions and Risk Factors in Transit Workers from Literature and Data Sources

Table 6 displays the most recent data for prevalence estimates of documented conditions in transit workers, identified as "Standard Industrial Classification Group 41—Local and Interurban Passenger Transit." The data available under this category is more specific than the data available for the transportation and utilities sector. The data in Table 6 are based on Tim Bushnell's 2018 study of more than 700,000 claims from 2006 to 2008 for Highmark, Inc., an independent insurance carrier, across 66 2-digit industry categories (Bushnell 2018). The table shows the percentages by which the prevalence rates for transit workers exceeded the prevalence rates for the general population in the database pool.

As Table 6 indicates, estimates for the difference in prevalence of chronic conditions in transit workers compared to the general population range from 18% for cardiovascular disease to 57% for diabetes, with a heightened elevation of prevalence over the general population of 51% for chronic obstructive pulmonary disease (COPD). Publicly available data from the MEPS are available at the transportation and utilities industry level, but not at the transit worker occupational level.

Table 6. Prevalence of chronic conditions affecting transit workers.

Condition	Difference in Transit Worker Rate Over General Population Rate
Cardiovascular disease	18%
Diabetes	57%
Hypertension	23%
Musculoskeletal	20%
Mental health (e.g., depression)	22%
Respiratory (i.e., chronic obstructive pulmonary disease [COPD])	51%

Source: Adapted from Bushnell (2018)

Bushnell's findings can be compared to a study by Gillespie, Watt, and Landsbergis et al. (2009) that compared the prevalence rates of disease among retired male New York City transit workers to those of male retirees throughout the United States. Using NHIS data from 2006, the earlier study had found that transit workers had an elevated rate of disease, but the magnitudes were quite different from what Bushnell found in 2018. For example, the 2009 study found that, compared to all male retirees in the United States, bus operators had a 30.9% higher rate of cardiovascular disease, a 27.3% higher rate of diabetes, and a 65.5% higher rate of hypertension (Gillespie, Watt, and Landsbergis et al. 2009).

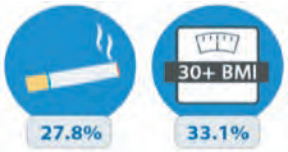
Top three conditions by prevalence:

Transit workers may experience these chronic conditions at rates 1.5 to 4 times higher than the general working population.

Table 7 displays prevalence estimates for current smoking and obesity for workers in the transportation, warehousing, and utilities sector (NAICS 48-49, 22). Compared to the general worker population, workers across these industries are prone to higher levels of psychosocial stressors such as work-family imbalance, lack of control over shift scheduling, and hostile work environments (e.g., aggressive customers) (CDC 2013b).

As Table 7 shows, more than one-quarter of transportation workers reported currently smoking and having a BMI that meets the classification for obesity (BMI ≥ 30). The prevalence rates for health risks for chronic conditions among workers in the transportation, warehousing, and utilities industry sector also are higher than the prevalence rates in the general worker population. Such differences in illness risk factors between transportation workers and the general worker population could help explain the disparities in health conditions between transit workers and the general worker population seen in Table 6. Disparities in the prevalence of current smoking and obesity between transit workers and the general worker population can further compound the detrimental effects of the work environment on transit worker health. At the same time, challenges in the work environment may also exacerbate illness risk factors such as current smoking and obesity. In combination with the findings from Table 6 regarding the estimated prevalence of health conditions in transit workers, findings from Table 7 underscore the need for continued research on transit worker populations to better identify targets for tailored health promotion efforts.

More than 25% of transportation workers currently smoke and/or are obese.



Studies have further shown that mental and physical health burdens disproportionately affect women and Black or Hispanic/Latino workers in terms of obesity, job-related stressors, and smoking (Gu, Charles, and Bang et al. 2014; Cunradi, Lipton, and Banerjee 2007). Similar morbidity and mortality disparities are present in the general population for arthritis, cardiovascular disease,depression, and diabetes (CDC 2013a; CDC 2015; CDC 2019b; CDC 2019c). Workers with lower education and income levels (i.e., lower socioeconomic status) have been found to experience poorer health than their more educated and more financially well-off counterparts (Braveman, Cubbin, and Egerter et al. 2010). African Americans, men, and

Table 7. Comparing the prevalence of two health risks between transportation workers and workers in general.

Risk	Transportation Workers*	Workers in General
Current smoking [a]	27.8%	18.8%
Obesity [b]	33.1%	27.6%

*Transportation workers = workers in the transportation, warehousing, and utilities sector.

Sources: [a] Syamlal, Mazurek, Hendricks, and Jamal (2014); [b] Luckhaupt, Cohen, Li, and Calvert (2014)

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people over age 45 are represented in higher numbers within the transit worker population than the general worker population. As such, the prevalence of health conditions and risk factors among transit and transportation workers as listed in Table 6 and Table 7 likely also varies by sociodemographic variables, with some groups experiencing higher rates of health conditions and risk factors than others. Developing a better understanding of such health disparities may help identify worker populations and their potential interactions with work environmental factors as targets for health promotion efforts.

Prevalence rates for various conditions were obtained from interviews and through data collected from insurance provider annual reports for transit agencies in Louisville, Kentucky; Rochester, New York; and Los Angeles, California (see Figure 4). The prevalence rates for the top illnesses or conditions identified by transit agencies often exceeded those of the general population of claimants covered by the insurance company.

According to the Transit Authority of River City (TARC) in Louisville, from February 2017 through January 2018 the top five diseases among transit workers were hypertension (37.8%), hyperlipidemia (26.5%), back pain (22.7%), osteoarthritis (15.6%), and diabetes (15.3%). Specific comparison data were not available for the general population in this area, but the rates of disease prevalence were similar to those observed for transit workers in other areas.

Per the Rochester Regional Transit Service (RTS), between April 1, 2017, and March 31, 2018, the top five categories of claims were for hypertension, cholesterol disorders, back and neck problems, diabetes, and depression and anxiety. These claims data were measured by the insurer Excellus BlueCross BlueShield (Excellus) for 729 subscribers, inclusive of maintenance, operations, and administrative workers, who participated in the agency's workplace wellness program and made up approximately 25% of the transit agency's insurance subscribers (Excellus 2018). In the category of cholesterol disorders, RTS subscribers had a prevalence rate of 29%, compared to 18.9% in the general Excellus population; for hypertension, the subscribers had a rate of 41.9%, compared to 23.2%. For diabetes, subscribers had a prevalence rate of 16.7%, compared to 8.1% in the general population. In the case of back or neck problems and depression and anxiety, the reported prevalence rates for RTS employees were lower than those for the general claimant population: 12.9% compared to 14.9%, respectively, for back and neck problems, and 5.9% compared to 9.6%, respectively, for depression and anxiety.

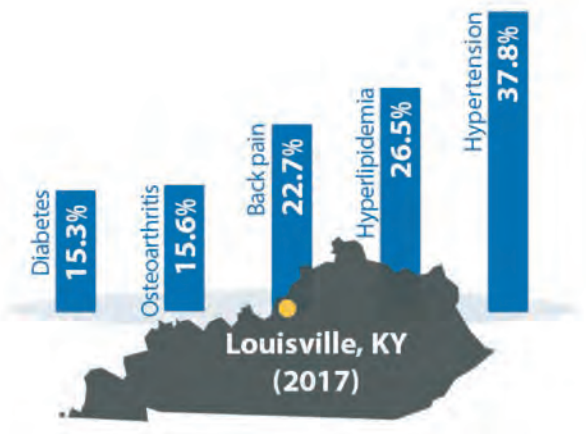

Figure 4. Example of prevalence data, conditions affecting transit workers in Louisville, Kentucky, in 2017.

During the fourth quarter of 2017, 76.8% of 3,780 rail and bus operators, mechanics, and clerks who belonged to the Los Angeles County Metropolitan Transportation Authority (MTA) and subscribed to the union's health coverage made clinical visits at which the recorded BMI for 62.2% of the workers classified them as obese (Calvin, personal communication, 2019). Examining prevalence rates across several illness categories, the prevalence rates among workers at the LACMTA exceeded the average prevalence rates among general insurance subscribers (Wormley, personal communication, 2019):

Of the 3,780 LACMTA employees insured through the SMART-MTA-UTU Trust Fund, 62.2% had a BMI that qualified them as obese, compared to 49.6% of the general population insured by Kaiser Permanente.

- Obesity (62.2% in the transportation group, compared to 49.6% for general subscribers);
- Depression or anxiety (4.5%, compared to 3.1%);
- One major chronic condition (22.0%, compared to 17.3%); and
- Two or more major chronic conditions (5.4%, as compared to 4.0%).

4.4 Identify Estimates of Costs for Health Conditions

Chronic conditions carry substantial medical and economic costs. For example, people with diabetes incur an estimated average of $7,900 per year in diabetes-related medical expenditures (American Diabetes Association, 2013). Obesity is associated with multiple chronic conditions, and the estimated annual medical cost of obesity was calculated at $147 billion in 2008, or $1,429 more per individual than the comparable costs for persons categorized as having a normal weight (CDC 2018a).

4.4.1 Locating Medical Expenditure Estimates for Chronic Conditions and Risk Factors in Transit Workers

Data on medical expenditures from chronic conditions and risk factors specific to transit workers are limited. Findings from claims data provide information on the prevalence of chronic conditions in U.S. workers, but they do not provide information about payments for healthcare services (Gu, Charles, and Bang et al. 2014; Cunradi, Lipton, and Banerjee 2007). To provide approximations of individual costs associated with conditions prevalent in transit workers, the project team referred to U.S. population-level estimates from the MEPS for average medical expenditures from the treatment of chronic conditions per person. The MEPS files that are available for public use have high-level condensed industry code categories that prohibit investigation of estimated illness prevalence and health costs specific to transit workers. Access to MEPS data that use U.S. Census industry codes at the four-digit level (i.e., 6180 for bus service and urban transit) is restricted and requires an application, application fee, and data use agreement with the Agency for Healthcare Research and Quality. Communication with the MEPS data team did reveal that sample sizes for respondents with the bus service or urban transit U.S. Census industry code ranged from 59 to 76 between 2005 and 2015 (Carroll, personal communication, 2018).

In this report, medical expenditures from the MEPS are based on national medical expenditure data for the mean expenses per person for any medical service in the United States in 2015 (e.g., office-based provider visits, inpatient hospital stays, prescription medications) (MEPS 2019). Medical expenditures in the MEPS are the sum of direct payments for care provided during the year, including individuals' out-of-pocket payments and payments made by private insurance companies, Medicaid, Medicare, and other sources. Payments for over-the-counter drugs are not included in the MEPS. Indirect payments not related to specific medical events such as Medicaid Disproportionate Share and Medicare Direct Medical Education subsidies also are not included (MEPS 2017). Expenditures information is based on respondent self-reporting as well as on reports from medical providers. Thus, expenditures from the MEPS reflect costs to the individual and employers, and costs to the greater society through the benefit programs of Medicaid and Medicare.

4.4.2 Findings for Medical Expenditure Estimates of Chronic Conditions and Risk Factors in Transit Workers From the Literature and Data Sources

Differences in the prevalence rates of certain conditions among transit workers beyond those of the general population were presented in Table 6.

Table 8 displays average annual medical expenditures per person by condition based on the 2015 MEPS data. The expenditures have been inflated to 2018 dollars using the Medical Care Index of the Consumer Price Index. Assuming a transit worker population base of 359,669 workers, the excess prevalence rates for transit workers were multiplied by the average annual cost per person in the United States to calculate the estimated annual excess expenditures for the transit worker population in 2018 dollars.

As Table 8 shows, based on higher prevalence rates, the difference in approximated medical expenditures for the transit worker population over that of the general population ranges from about $44 million to about $757 million. The top three excess medical expenditures are associated with diabetes, cardiovascular disease, and mental health. From a financial perspective, preventing the development of diabetes and cardiovascular disease or helping transit workers better manage these conditions could yield meaningful cost savings.

The expenditure approximations in Table 8 do not include the costs of lost productivity. Further, even the direct estimated expenditures for each condition can vary by level of illness severity: Asthma and COPD are both chronic conditions requiring regular management, but for workers who develop pneumonia, which is a more acute respiratory condition, the costs are higher. U.S. population estimates suggest that the average annual expenditures on acute respiratory conditions could have been as high as $7,248 per person in 2015 (Suls, Green, and Davidson 2016). Medical expenditures incurred by transit workers with more than one chronic condition are not necessarily independent of each other. Treatments for one condition may affect treatments and costs for other conditions, or may affect the risk of developing other conditions. Lifestyle factors (e.g., diet, exercise) also affect the cumulative risks and expenditures for the conditions listed in Table 6 (Suls, Green, and Davidson, 2016).

Table 8. Medical expenditure excess approximations for transit worker population over general population.

Condition	U.S. Average Medical Expenditures per Person ($2018) (A)	Percentage Difference Transit Worker Prevalence Over Population Prevalence (B) [a]	Approximated Excess Expenditures Transit Workers Over General Population ($2018) (A × B × 359,669) [b]
Cardiovascular	$4,943	18%	$320,011,896
Diabetes	$3,691	57%	$756,696,819
Hypertension	$893	14%	$44,965,818
Musculoskeletal	$2,170 [c]	18%	$140,486,711
Mental health	$2,161 [d]	22%	$170,993,836
Respiratory	$1,772 [e]	20%	$127,466,694

[a] Prevalence rates for all conditions except hypertension are based on claims data from 2014 (presented in Table 6); prevalence rates for hypertension are based on employer claims data from 2002–2005.
[b] Population-weighted estimates for medical expenditures are calculations based on a transit worker population base of 359,669.
[c] Estimated for "Osteoarthritis and other non-traumatic joint disorders."
[d] Estimated for "Mental disorders."
[e] Estimated for "COPD, Asthma."

Sources: [a] Bushnell, Li, and Landen et al. (2011); [b] the MEPS (2015); APTA (2018)

Tobacco use and obesity have wide-ranging public health impacts through the exacerbation of illness symptoms and illness risks. These illness risk factors have been associated with higher medical spending. The estimated annual medical cost of obesity in 2008 was $147 billion, with estimated medical costs per obese individual averaging $1,429 more than the comparable costs per normal-weight individual (CDC 2018a). Further, from 2006 to 2010, smoking accounted for an estimated 3.2% of total healthcare spending, 5.4% of private insurance, 9.6% of Medicare spending, 15.2% of Medicaid spending, and 32.8% of spending by other federal programs (e.g., Tricare, Indian Health Service) (Xu, Bishop, Kennedy, Simpson, and Pechacek 2015). Given the higher prevalence rates of obesity and smoking in transportation workers (as shown in Table 7), the associated costs are expected to be proportionately higher for this population than for the general population.

4.5 Conclusions

This chapter discussed the prevalence rates for the most common health conditions affecting transit workers, followed by the costs for those conditions and additional medical expenditures. It also provided a summary of the key characteristics of the transit worker population. Most transit workers are involved in vehicle operations (72%) and of these, just over 50% are bus operators. Most are male (63%), over 45 years of age (66%), and White (63%). Even though the majority of transit workers are White, Black workers make up a higher percentage of the transit worker population (29%) than the general workforce (12.1%). Women, however, are underrepresented at 37% of the transit industry, compared to 47% of the overall workforce.

The most common health conditions associated with transit workers were identified, together with the magnitude and prevalence of those conditions. The conditions identified were cardiovascular disease, hypertension, diabetes, musculoskeletal disorders, mental health, and respiratory conditions (e.g., COPD, asthma). Another finding was that rates of smoking and obesity are higher in the transit worker population than in the general population. Next, appropriate estimates were determined for the costs of each of these conditions, based on information available from journal articles and other sources. An important observation was that the costs associated with each condition are not necessarily additive, due to comorbidities. After establishing prevalence rates and the associated costs for the most common health conditions, the costs and rates associated with transit workers were compared with those associated with the general population. Using the general population as a baseline, estimates of the health condition costs to transit workers over and above the same costs to the general population were determined. The costs for transit workers were found to be consistently in excess of those for the general worker population, by amounts ranging from tens of millions to hundreds of millions of dollars. The findings suggest where resources might be most effectively allocated to lessen the costs of transit worker health problems.

CHAPTER 5

Additional Costs to Individuals, Employers, and Society

5.1 Introduction

This chapter provides cost estimates for injuries, deaths, absenteeism, workers' compensation, and federal government disability programs that demonstrate the distribution of health costs among individuals, employers, and society. The chapter highlights areas in which health costs are elevated and potential areas transit workers and agencies can target to improve health outcomes and costs.

In the chapter, estimated costs are provided for transit workers, and comparisons of those figures with the costs for the general population. Given these numbers, the difference or "excess" costs associated with transit work are calculated. Although a total cost can be calculated by adding up the different cost areas, it is important to note that the constituent costs are not necessarily additive, and some cost categories may overlap. For example, workers' compensation and SSDI are separate programs that provide wage replacement to workers who are unable to work due to injury. If a worker draws benefits from both, the amount received from SSDI is reduced so that the total amount from workers' compensation and SSDI is no greater than 80% of the amount earned when fully employed. Workers' compensation and absenteeism both include measures of lost wages due to time off from work.

Where possible, the cost calculations in this research used data based on the industry codes for urban transit systems (NAICS 4851) and interurban and rural bus transportation (NAICS 4852). When data at that level were not available, the project team used data from a broader industry code, such as transportation and warehousing or the transportation and material moving occupation. Table 9 summarizes the populations on which the calculations were based for each cost category.

5.2 The Individual Transit Worker: Fatalities and Injuries

In addition to chronic conditions and health risks, transit workers face many safety challenges, including unruly or aggressive passengers, other driver and pedestrian errors, and the risk of vehicular accidents due to driver fatigue from long, irregular, or split shifts or health conditions such as sleep apnea (Petrie 2014).

The rate of occupational injuries among transit workers is almost twice that of other industries on average.

According to the BLS, from 2013 to 2017, the average incidence rate of nonfatal occupational injuries per 100 full-time equivalent (FTE) workers in urban transit systems (5.87) was nearly double the rate of such injuries by FTE workers in all industries (3.10). Table 10 presents the incidence rates for the transportation and warehousing, transit and ground passenger transportation, and urban transit systems sectors. From 2013 to 2016, the average incidence rate of nonfatal injuries for interurban and rural bus transportation

Table 9. Populations represented by each cost category.

Cost Category	Populations on Which the Data Are Based
Workers	
Injury costs	Urban transit systems (NAICS 4851); truck drivers (Biddle 2013)
Mortality costs	Bus service and urban transit (NAICS 485, excluding NAICS 4853)
Employers and society	
Absenteeism	Transportation and warehousing (NAICS 48-49)
Workers' compensation (premiums)	Trade, transport, and utilities industry (NAICS 22, 42, 44-45, 48-49)
Workers' compensation (claims)	Urban transit systems and interurban and rural bus transportation (NAICS 4851, 4852); transit and intercity bus drivers (SOC 53-3052)
Disability (SSDI)	Transportation and material moving (SOC 53-0000)
Disability (SSI)	Transportation and material moving (SOC 53-0000)
Medicare	Transportation and material moving (SOC 53-0000)

workers was roughly similar to that of urban transit systems workers, at 5.80 per 100 FTE workers. However, during the same period, the annual number of cases and annual incidence rates for interurban and rural bus transportation workers showed greater variation than did the cases and incidence rates among urban transit workers (BLS 2019b).

Injury and fatality costs (or cost-of-illness studies) are commonly estimated using discounted future earnings. Costs in the future are scaled to a base year using a discount rate, on the premise that the cost today is not equivalent to that same amount days, months, or years from now. Cost-of-illness estimates often are broken into direct costs and indirect costs, which are additive. Direct costs represent medical expenditures to treat a condition. Indirect costs conceptually represent economic products not produced due to impairment, and they generally are measured by lost earnings. Prevalence methods estimate only the direct and indirect costs of injuries and diseases incurred during a given year, even if the injury or disease began or occurred in previous years, and mortality costs are assigned to the year of death. In contrast, the incidence approach assigns and discounts direct and indirect costs to the year in which the condition first appears (Hartunian, Smart, and Thompson 1980).

The value of a statistical life (VSL) is a measure of risk formally defined as the additional cost that individuals would be willing to pay for improvements in safety (a reduction of risk) that would collectively reduce the expected number of fatalities by one. The "willingness to pay" approach provides an alternative to the discounted future earnings approach, which may underestimate indirect or mortality costs because the value that some place on life is not solely measured by one's earning capacity (U.S. DOT 2016b).

Table 10. Incidence rates, nonfatal occupational injuries in transit workers per 100 FTE workers, 2013–2017.

Industry	NAICS Code	Average Incidence Rate (per 100 FTE workers)	Average Number of Annual Cases (thousands)	Employment (May 2017)
All industries, private and public (e.g., state and local government)	All	3.10	3,433,600	142,549,250
Transportation and warehousing	48-49	4.47	196,580	5,792,400
Transit and ground passenger transportation	485	4.26	14,400	496,120
Urban transit systems	4851	5.87	2,460	47,000

Source: Categories and data drawn from BLS (2019b), Table SNR05, Incidence rate and number of nonfatal occupational injuries by industry and ownership, 2013–2017

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Estimates of willingness to pay are derived from responses in real markets based on consumer purchase or employment decisions (revealed preferences), or in hypothetical markets (stated preferences). In revealed preference studies, the value of safety cannot be measured directly, as people make purchases or employment decisions for various factors in addition to safety. The relative influence of safety in the purchasing or employment decision must be determined through statistical techniques. Stated preference studies evaluate more alternatives than those for which market data are available, but there is no guarantee that an individual would carry out the stated preference when faced with the scenario in real life (U.S. DOT 2016b).

The U.S. DOT uses VSL estimates in its analyses to quantify the benefits of preventing or reducing injuries, illnesses, and deaths from regulations. The U.S. DOT's 2016 VSL was based on nine revealed-preferences studies on employment decisions. The 2016 VSL estimate of $9.6 million represents the average VSL from the nine studies, scaled to 2016 dollars; it is the single nationwide value associated with the prevention of an expected fatality for all population groups. The VSL scaled to 2018 dollars is $10.04 million.

Transit and ground transportation workers experienced a fatality rate of 9.9 deaths per 100,000 workers between 2003 and 2006; by comparison, the overall U.S. workforce had a fatality rate of 3.9 deaths per 100,000 workers (CDC 2014). Transit workers have some of the highest rates of nonfatal occupational injury and illnesses associated with lost productivity and job transfers in the United States (BLS 2019b).

From 2013 to 2017, an average of 15.6 fatal injuries took place per year among bus service and urban transit workers (NAICS 485, excluding NAICS 4853) (BLS 2018a). Based on the number of fatal injuries and hours worked, the fatal injury rate for 2013–2017 for bus service and urban transit workers per 100,000 FTE workers was 5.24. Applying this fatal injury rate to the transit worker population of 359,669 results in an estimated 18.83 fatalities. Based on the given VSL, the cost of these 18.83 fatalities was $189,174,784 in 2018 dollars.

Table 11 presents the calculation of the fatality cost.

Table 12 provides the fatality costs of transit workers at the general population fatal injury rate, the excess costs of transit worker fatalities (based on their higher fatality rate), and the fatality cost per transit worker (adjusted to 2018 dollars). For all workers from 2013–2017, the average annual number of fatal injuries was 4,628 and the fatal injury rate per 100,000 FTE workers was 3.54. Applying the "all workers" injury rate to the transit worker population results in an estimated 12.74 fatalities per 100,000 workers and a total fatality cost of $128,003,273. Compared to the cost of fatal injuries among general workers, the fatality cost

Table 11. Estimated cost of fatalities for transit workers using VSL (2018 dollars).

Factor Description	Factor	Notes
Fatalities	15.6	Average number of fatalities among urban transit systems/bus service workers (NAICS 4851 and 4852), 2013–2017
Fatality rate per 100,000 FTE workers	5.24	Fatal injury rate per 100,000 FTE workers based proportionally on the number of fatal injuries from 2013–2017 to total hours worked from 2013–2017
Transit worker population	359,669	Transit worker population based on data from APTA (2018)
Estimated fatalities	18.83	Fatality rate divided by 100,000, multiplied by transit worker population
VSL	$10,043,987	VSL in 2018 dollars
Cost of fatalities	$189,174,784	Estimated fatalities multiplied by the VSL

Sources: BLS (2019b); BLS (2018a); U.S. DOT (2016b); CDC (2014); Hartunian, Smart, and Thompson (1980).

Table 12. Fatality costs for transit workers and costs per transit worker (2018 dollars).

Factor Description	Fatality Rate	Fatality Cost	Fatality Cost per Transit Worker
Transit workers (A)*	5.24	$189,174,784	$526
Transit workers at fatality rate of general population (B)	3.54	$128,003,273	$356
Excess cost of transit worker fatalities (A – B)		$61,171,511	$170

*See Table 11.

of transit workers represents an excess cost of $61.17 million. Given the higher prevalence of chronic conditions as discussed in Chapter 4, it also is interesting to consider that post-retirement or industry departure, fatality rates for transit workers might continue to be higher than those of the general public.

The U.S. DOT has developed an alternative method to estimate the costs of nonfatal injuries because detailed "willingness to pay" estimates on the entire spectrum of possible disabilities often are unavailable. Generally, estimates are available for an average injury resulting in a lost workday and not for a range of injuries varying in severity. Per the U.S. DOT, "[e]ach type of accidental injury is rated . . . in comparison with the alternative of perfect health. These scores are grouped according to the Maximum Abbreviated Injury Scale (MAIS), yielding coefficients that can be applied to VSL to assign each injury class a value corresponding to a fraction of a fatality" (U.S. DOT 2016a). The MAIS indicates the highest level of injury severity that a patient sustains.

Table 13 shows the MAIS levels and corresponding values of injuries prevented, in 2018 dollars. On average, from 2013–2017 the 2,460 injuries in the urban transit system workers sector (NAICS 4851) compare to a base of 1,298 injuries in the general population, following an incident ratio of 3.10/5.87 (see Table 10). The project team could not locate a distribution of injuries focused solely on transit workers; however, because truck drivers encounter some of the same work conditions as transit bus drivers, a usable scale (based on injuries to truck drivers) was found in Decker, Otte, and Muller et al. (2016). Work conditions common to truck drivers and transit workers include sedentary work, sitting upright, and long shifts. Table 13 shows the distribution of truck driver injuries as classified by MAIS level. The distribution of truck driver injuries is skewed more toward minor injuries, corresponding to the lowest level on the MAIS scale.

Table 13. Estimated cost of injuries to transit workers (2018 dollars).

MAIS Level	Fraction of VSL	Value	Distribution of Truck Driver Injuries by MAIS	Total General Population Cost (n = 1,298)	Total Transit Worker Cost (n = 2,460)
MAIS 1 (minor)	0.003	$30,132	75.68%	$29,597,730	$56,094,310
MAIS 2 (moderate)	0.047	$472,067	14.86%	$91,083,489	$172,623,562
MAIS 3 (serious)	0.105	$1,054,619	5.41%	$73,994,324	$140,235,776
MAIS 4 (severe)	0.266	$2,671,701	1.35%	$46,863,072	$88,815,991
MAIS 5 (critical)	0.593	$5,956,084	2.70%	$208,945,877	$395,999,120
MAIS 6 (unsurvivable)	1	$10,043,987	0.00%	--	--
Total			**100.00%**	**$450,484,492**	**$853,768,760**

Urban transit system (NAICS 4851) injuries averaged 2,460 annually from 2013–2017. Based on a ratio of incidence rates of urban transit system workers to all workers, annual injuries for the general population averaged about 1,298. Total cost for each respective population equals the value of injury level, the distribution of injuries by MAIS based on a study of truck driver injuries, and the total number of injuries of the respective population. The value column equals the VSL in 2018 dollars ($10.04 million) multiplied by the fraction of the VSL. Totals reflect rounding (e.g., $853,768,760).

Source: U.S. DOT (2016a)

Table 14. Injury costs for transit workers and costs per transit worker (2018 dollars).

Factor	Average Injury Rate 2013–2017	Injury Cost	Injury Cost per Transit Worker
Transit workers (A) *	5.87	$853,768,760	$2,374
Transit workers at injury rate of general population (B)	3.10	$450,484,492	$1,252
Excess cost of transit worker (A – B)		$403,284,268	$1,121

* See Table 10 and Table 13.

As Table 13 shows, the estimated 5-year cost of injuries for transit workers is $853.77 million. The difference in cost for injuries for transit workers, based on their higher rates of injury compared to the general population, is $403.28 million. Table 14 provides the injury cost of transit workers at the general population injury rate, excess costs, and costs per worker.

The estimates for fatalities and injuries rely on the use of VSL, which is commonly used in U.S. DOT and U.S. EPA analyses. As this analysis pertained to transit workers, the project team also used the VSL. Studies in the literature with estimates of fatalities and injuries have relied on different methods to calculate estimated costs, some of which are presented in Table 15. For example, estimates of fatality costs are derived using the cost-of-illness method,

Table 15. Estimates of fatality and injury costs found in literature.

Source	Population	Estimate (total cost unless otherwise noted)
Fatalities		
NIOSH (2017)	All workers in the United States	(2010 dollars) 2003: $5.84 billion 2004: $6.16 billion 2005: $6.05 billion 2006: $6.31 billion 2007: $5.65 billion 2008: $5.23 billion 2009: $4.42 billion 2010: $4.63 billion 2003–2010 average cost of fatality: $1.05 million
Biddle (2013)	Production, transport, and material moving occupation	(2006 dollars) 2003–2006: $2.97 billion, 3,238 fatalities 2003–2006 average cost of fatality: $916,000
CDC (2014)	Transit and ground transportation (NAICS 485)	(2006 dollars) 2003: $54 million, 75 fatalities 2004: $53 million, 80 fatalities 2005: $48 million, 75 fatalities 2006: $50 million, 66 fatalities 2003–2006 average cost of fatality: $692,000
Injuries		
Leigh (2011)	All workers in the United States	(2007 dollars) 2007: 8.56 million occupation injuries, $185.84 billion (includes medical costs of $45.95 billion and indirect costs of $139.89 billion)
National Safety Council (n.d.)	All workers in the United States	(2017 dollars) 2017: $161.50 billion (includes wage and productivity losses of $50.7 billion, medical expenses of $34.3 billion, and administrative expenses of $52.0 billion); $39,000 per medically consulted injury

which combines medical expenses and indirect costs such as discounted earnings and the present value of lost household production. Leigh's injury estimates are derived from medical costs and indirect costs including discounted earnings, fringe benefits, and home production (Leigh 2011). National Safety Council estimates of injury costs are based on medical expenses, wage and productivity losses, and administrative costs of insurance (National Safety Council n.d.). Among the studies listed in Table 15, average estimates for the costs of fatalities between 2003 and 2010 ranged from approximately $700,000 to $1,045,000 for the various worker populations, amounts much smaller than the $10.04 million VSL. Similarly, average estimates for injury costs from the sources cited in Table 15 are in the tens of thousands, whereas the injury estimates in this research, based on fractions of the VSL, estimated injuries at the lowest level of severity to cost $30,132.

5.3 Cost to Employers and Society

5.3.1 Absenteeism

Injuries and chronic illnesses in transit workers can create large economic losses to workers and employers through reduced workdays and job disruptions. When workers are sick, it exacts a cost not only to the individual but also to the employer (e.g., the transit agency) and the public. To accommodate worker productivity losses, employers may need to add shifts to the existing workforce or hire new workers. These adjustments can come at a cost to employers in terms of lost productivity from diversion of resources to recruit, hire, and train new staff and increased spending for these activities (Blatter, Mühlemann, and Schenker 2012). Employers also must cover the absent worker's wages and potential overtime for other employees to replace the absent worker's shifts.

Absenteeism is the habitual absence of an employee, which can occur as a result of an illness or injury. For employers, the costs associated with absenteeism include the wages paid to the absent worker, potential overtime paid to other employees, and lost productivity.

Public and private transit workers' (split between the transit and ground passenger transportation and urban transit systems industries) rate of days away from work ranks in the top 10 among the highest rate industries, and is higher than the all-industry incidence rate of 1.0 per 100 full-time workers. BLS data for 2016 listed 26 of the highest rate industries, defined as those with the highest incidence rate of injury and illness cases with days away from work and at least 500 total recordable cases. Table 16 shows the incidence rate per 100 employees for the 10 industries with the highest rates, including

Table 16. Highest incidence rates of nonfatal occupational injury and illness cases with days away from work, 2016 (reproduced from BLS).

Industry	NAICS Code	Incidence Rate per 100 Full-Time Workers
All industries, including state and local government		**1.0**
Nursing and residential care facilities (state government)	623	7.2
Fire protection (local government)	92216	5.2
Police protection (local government)	92212	4.3
Heavy and civil engineering construction (local government)	237	4.2
Scheduled passenger air transportation (private industry)	481,111	4.1
Transit and ground passenger transportation (local government)	485	3.7
Urban transit systems (private industry)	4851	3.6
Correctional institutions (state government)	92214	3.5
Framing contractors (private industry)	23813	3.3
Marine cargo handling (private industry)	48832	3.3

Source: BLS (2019b)

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transit and ground passenger transportation (ranked sixth) and urban transit systems (ranked seventh), as found by the BLS.

Table 17 shows how the incidence rate of cases with days away from work compares to the total amount of wages lost based on the assumption that the employer must pay someone in the same wage category to fill the shift. Compared to employers in some other industries, transit employers cannot go as easily without a transit worker's services for a day. Often the employer is required to replace the worker on his or her operating or maintenance shift.

The cost estimate of absenteeism per worker is the product of the total hourly compensation, the lost worktime rate, and the annual number of hours worked per year for an FTE position. The total hourly compensation is the product of the mean hourly wage and a loaded wage factor that accounts for non-wage benefits provided to employees. In this estimate, the mean hourly wage is the weighted average of the means for urban transit system workers and interurban and rural bus transportation workers (NAICS 4851 and 4852) in 2018 dollars, or $20.46. The loaded wage factor of 1.42 is the average for years 2014–2018 for the trade, transportation, and utilities industry and is based on the ratio of total compensation to wages and salaries. The lost worktime rate is a percentage of the hours absent out of the hours usually worked, which for the transportation and warehousing industry averaged 1.50% from 2014–2018 (BLS 2018b). Annual compensation lost per worker is multiplied by the transit worker population of 359,669, resulting in the total cost of absenteeism. These calculations are shown in Table 17.

Table 17 shows that the total costs for transit workers during this period amounted to approximately $314 million, based on the calculation of lost wages based on the mean hourly wage, a loaded wage factor representing benefits paid by the employer on top of wages paid to the employee, and working 2,000 hours annually. The 1.5% average lost worktime rate for transit workers exceeds the 1.38% average lost worktime rate for the general population. Consequently, the estimated total cost and total cost per transit worker also are greater than the costs for the general population. As Table 18 shows, using the same calculation at the lower lost worktime rate for the general population (rounded to 1.4%) results in total costs of about $289 million. Table 18 shows the difference in injury-related costs attributable to

Table 17. Estimation of total wages lost annually from absenteeism due to injury/illness for transit workers, 2014–2018 (2018 dollars).

Factor Description	Factor	Notes
Mean hourly wage	$20.46	2018 dollars; weighted average of the mean hourly wages for urban transit systems workers (NAICS 4851) and interurban and rural bus transportation workers (NAICS 4852)
Loaded wage factor	1.42	Average ratio of total compensation to wages and salaries for private-industry trade, transportation, and utility workers, as provided by 2014–2018 employer cost for employee compensation data from the BLS
Lost worktime rate [a]	1.5%	Lost worktime rate, defined as hours absent as a percentage of hours usually worked, based on 50 work weeks at 40 hours per week (one FTE position); 1.5% is the average lost worktime rate for transportation and warehousing workers from 2014–2018
Employer cost for lost compensation (hourly)	$0.44	Product of the mean hourly wage, loaded wage factor, and lost worktime rate
Annual compensation lost per transit worker	$874	Product of hourly lost compensation and the number of hours worked annually, based on 2,000 hours (one FTE position)
Absenteeism cost	$314,301,144	2018 dollars; annual compensation lost per transit worker multiplied by the transit worker population of 359,669

[a] BLS (2018b)

Table 18. Estimated excess absenteeism costs for transit workers compared to the general population of workers, 2014–2018 (2018 dollars).

Factor	Lost Worktime Rate	Injury Cost	Injury Cost per Transit Worker
Transit workers at lost worktime rate of transit workers (A) *	1.5%	$314,301,144	$874
Transit workers at lost worktime rate of general population (B)	1.4%	$289,157,053	$804
Excess cost of transit worker absenteeism (A – B)		$25,144,091	$70

* See Table 17.

lost worktime for transit workers at the rate estimated for transit workers (1.5%) and at the rate estimated for general workers (1.4%). The difference reveals the excess costs that can be attributed to the higher rate of lost worktime among transit workers.

As Table 18 shows, when based on the lost worktime rate of the general population (1.4%), the estimated total costs of absenteeism for transit workers exceeded the costs of absenteeism for the same population of general workers by $25.14 million. This translates to an estimated excess cost of $70 per transit worker compared to the average worker.

For some perspective on the number of days that individual illnesses contribute to absenteeism, a study by Asay, Roy, Lang, Payne, and Howard (2016) used MEPS and MarketScan data to show how four major chronic conditions/risk factors—hypertension, diabetes, obesity, and smoking—contributed to absenteeism. Table 19 reproduces the data from the study without calculations or adjustments.

As illustrated in Table 19, workers with hypertension, diabetes, or obesity miss on average 1 day more of work per year than do workers without these conditions. Workers who currently smoke miss half a day more of work. The costs per employee associated with absenteeism appear to vary by condition. The cost of absenteeism per employee attributed to hypertension is nearly twice that of the cost of absenteeism attributed to smoking. Additionally, absenteeism associated with obesity appears to have higher costs at a national level in comparison to the other three conditions. Given that an estimated 10% of transportation workers have diabetes and nearly one-third of transportation workers have obesity and are currently smoking, these findings suggest that efforts to help transit workers decrease their risk of disease may have important implications for worker productivity and employer costs.

Absenteeism estimates from other studies, presented in Table 20, indicate that the project team's estimate for absenteeism was conservative. Stewart, Ricci, Chee, and Morganstein

Table 19. Absenteeism and related cost estimates for chronic conditions or risk factors for U.S. workers aged 18–64 years, 2008–2011 (2015 dollars).

Chronic Condition/ Risk Factor	Number of Excess Missed Work Days (number of days/year relative to workers without conditions/risk factors) [a]	Estimated Cost to Employer per Employee per Year [b]	Total Cost per Year (billions)
Hypertension	1.13 (95% CI: 0.84, 1.42)	$298	$10.3
Diabetes	1.03 (95% CI: 0.63, 1.42)	$272	$2.2
Obesity	1.02 (95% CI: 0.70, 1.33)	$269	$11.2
Smoking	0.58 (95% CI: 0.25, 0.92)	$153	$3.6

[a] Data from MarketScan and the MEPS. For consistency across other findings, estimates based on MEPS by single condition or risk factor.
[b] Assumes an average employment cost of $33.00 per hour and an 8-hour work day (in 2015 dollars).

Source: Reproduced from Asay, Roy, Lang, Payne, and Howard (2016)

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Table 20. Absenteeism cost estimates found in relevant literature.

Source	Description of Estimate	Notes
Stewart, Ricci, Chee, and Morganstein (2002)	Lost productive time due to absenteeism and "presenteeism" (health-related reduced performance on days at work)	• Health-related lost productive time in 2002 cost employers $225.8 billion, or $1,685 per employee; • For the transportation and moving occupation (SOC 53), the total cost was $12.0 billion.
Integrated Benefits Institute (n.d.)	Absenteeism costs (involving wages and benefits, missed revenues, costs of hiring substitutes, and overtime costs)	• Of the $530 billion estimated annual cost to U.S. employers due to poor health, at least $260 billion is due to absences (including $178 billion in wages and benefits and $82 billion in opportunity costs, such as missed revenues, costs of hiring substitutes, and overtime).
Circadian (n.d.)	Absenteeism costs (per worker)	• Absenteeism costs employers $2,660 per shift worker annually, in 2014 dollars.
BLS (2017c)	Incidence rate of nonfatal occupational injury and illness cases with days away from work, 2017, per 100 FTE workers	• The listed rate of absenteeism for urban transit systems (NAICS 4851) is one of the highest (2.9), contrasting with the incidence rate for "all industries" (1.0). • The 1,320 cases with days away from work resulted in a median number of 25 days away from work.

(2002) estimated health-related lost productive time due to absenteeism and presenteeism cost employers $225.8 billion in 2012, or $1,685 per employee annually. Other studies have estimated an absenteeism cost of at least $260 billion in terms of wages, benefits, and opportunity costs (Integrated Benefits Institute n.d.) and calculated absenteeism costs of $2,660 per shift worker per year (Circadian n.d.). Statistics from 2017 recorded the urban transit systems industry as having one of the highest incidence rates of occupational injuries and illness cases with days away from work, with a median of 25 days away from work compared to a median of 8 days for all industries (BLS 2017c).

5.3.2 Workers' Compensation

Workers' compensation provides wage replacement and medical benefits to workers that have suffered injuries or illnesses directly as a result of employment.

Workers' compensation provides wage replacement and medical benefits to workers that have suffered injuries or illnesses directly as a result of their employment. In return for benefits, recipients waive their right to sue their employer for negligence. Unlike disability, which requires a longer employment history, workers' compensation is available to an employee from the first day of his or her employment. Workers' compensation covers medical care from the injury or illness, replacement income, costs for retraining, compensation for any permanent injuries, and benefits to survivors of workers who are killed on the job. Workers' compensation pays 100% of injury-related medical costs for injured workers. Wage replacement rates vary by state but are, on average, approximately two-thirds of a worker's pre-injury gross wage. As was noted in Chapter 4, the MEPS data used for estimates and calculations in this report do not indicate which expenditures are covered by workers' compensation.

Workers' compensation is financed exclusively by employers except in three states (Washington State, Oregon, and New Mexico) where workers pay part of the cost of workers' compensation benefits and services directly through payroll deductions or charges. Typically, employers purchase workers' compensation insurance from private insurers or a state insurance fund, although large employers may choose to self-insure (National Academy of Social Insurance 2018).

Workers' compensation costs are estimated using two methods wherein the results provide a range for the estimate. The first method is based on the workers' compensation premiums

Table 21. Estimation of workers' compensation costs based on employers' premiums (2018 dollars).

Factor Description	Factor for Transit Workers	Notes
Mean hourly wage	$20.46	Weighted average of the mean hourly wages for urban transit systems workers (NAICS 4851) and interurban and rural bus transportation workers (NAICS 4852)
Loaded wage factor	1.42	Average ratio of total compensation to wages and salaries for private-industry trade, transportation, and utility workers, as provided by years 2014–2018 employer cost for employee compensation data from the BLS
Workers' compensation as a percentage of total compensation	2.0%	Average ratio from 2014–2018 of workers' compensation cost per hour to employers over total compensation for trade, transport, and utility workers
Annual hours per FTE worker	2,000	Based on 50 weeks per year and a 40-hour workweek
Workers' compensation cost	$413,826,181	Product of mean hourly wage, loaded wage factor, workers' compensation as a percentage of the total compensation, annual hours worked per worker, and transit worker population of 359,669 (APTA 2018)

paid by employers. Using the premium method, the cost of workers' compensation is calculated as the product of the mean hourly wage (weighted average of the mean hourly wage for urban transit systems and interurban and rural bus transportation workers), loaded wage factor (ratio of total compensation to wages and salaries), average workers' compensation cost as a percentage of total compensation, annual hours, and the transit worker population. This results in a workers' compensation cost to employers of $413,826,181 annually. Using quarterly historical data from BLS, from 2014–2018, the average proportion of workers' compensation cost to total hourly compensation for trade, transport, and utility workers was 2.0% (BLS n.d.). The project team assumed that this same ratio would apply to transit workers. Table 21 provides the results of this analysis.

For all private industry workers, the average proportion of workers' compensation cost to total hourly compensation from 2014–2018 was 1.4% (BLS n.d.). Accounting for the lower general population's workers' compensation as a percentage of total compensation results in an estimated cost of $292,686,289 for the general population and an excess cost of $121,139,893 for the transit worker population. Table 22 displays a summary of the costs of workers' compensation, the excess costs for transit workers, and the costs per transit worker as estimated using the premium method.

Table 22. Estimation of workers' compensation costs for transit workers and costs per transit worker using the premium method (2018 dollars).

Factor Description	Workers' Compensation as a Percentage of Total Compensation	Workers' Compensation Cost	Cost per Transit Worker
Transit workers (A)*	2.0%	$413,826,181	$1,151
Transit workers at workers' compensation percentage to total compensation of general population (B)	1.4%	$292,686,289	$814
Excess cost of transit worker (A – B)		$121,139,892	$337

* See Table 21.

Musculoskeletal disorders were the most common injury type in the Washington State Fund from 2002–2010, making up 108,225 of the total 267,420 injuries.

The second method estimates workers' compensation costs through beneficiary claims. Using Washington State Fund claims data. From 2002–2010, the urban transit systems and interurban and rural bus transportation industries (NAICS codes 4851 and 4852) had a claim rate of 411.5 per 10,000 FTE positions (Anderson, Bonauto, and Adams 2014). Assuming that the population of transit workers in Washington State exhibits similar characteristics to the transit worker population nationwide and that regulatory conditions are similar, applying that claim rate to the transit worker population of 359,669 (APTA 2018) would result in 14,799 workers' compensation claims. For the Washington State Fund, the average incurred cost for claims among the transit and intercity bus drivers SOC code for fiscal years 2014–2018, adjusted to 2018 dollars, was $17,689 per claim (Washington State Department of Labor & Industries n.d.). By comparison, in Des Moines, IA, the average incurred costs for claims among fixed-route operators, maintenance employees, and paratransit operators was $10,867 from August 21, 2014, to July 3, 2018.

Fiscal years 2014–2018 were selected to provide the 5 most recent years of claims data. Washington State Fund claims data lists occupations by SOC 2000, without listing the numeric code of the occupation. The project team was unable to match the claims data occupations with the numeric SOC 2000 code for the transportation worker occupations; thus, only the transit and intercity bus driver injuries were included in the calculation of the average incurred claim cost. The product of the average cost per claim and the estimated number of claims results in a workers' compensation claims cost of $261,780,645. Table 23 describes these calculations further.

Washington State Fund data from 2002–2010 indicate that the workers' compensation claim rate for all workers was 191.1 per 10,000 FTE positions (Anderson, Bonauto, & Adams, 2014). Applying the all workers claim rate to the transit worker population would result in 6,873 workers' compensation claims and an estimated claims cost of $121,581,613. Table 24 displays a summary of the costs of workers' compensation, the excess costs for transit workers, and the cost per transit worker using the claims method.

Table 25 summarizes the costs of workers' compensation for transit workers and the general population through the estimation of employers' premiums and claim costs, as presented in Table 22 and Table 24.

Table 23. Estimation of costs based on workers' compensation claims (2018 dollars).

Factor Description	Factor for Transit Workers	Notes
Claim rate per 10,000 FTE positions	411.5	Transit worker claim rate based on weighted average from Washington State Fund data on NAICS codes 4851, Urban Transit Systems (106 claims and 5,370 FTE positions), and 4852, Interurban and Rural Bus Transportation (655 claims and 13,125 FTE positions)
Estimated annual claims	14,799	Number of estimated claims equals the product of the claim rate and transit worker population of 359,669 (APTA 2018), divided by 10,000
Average claim cost	$17,689	Average cost of all transit and intercity bus driver claims from fiscal years 2014–2018 for Washington State
Total annual workers' compensation cost	$261,780,645	Product of estimated claims and the average claim cost

Table 24. Estimation of workers' compensation costs for transit workers and costs per transit worker using the premium method (2018 dollars).

Factor Description	Workers' Compensation Claim Rate per 10,000 FTE Positions	Workers' Compensation Cost	Workers' Compensation Cost per Transit Worker
Transit workers (A) *	411.5	$261,780,645	$728
Transit workers at workers' compensation claim rate of general population (B)	191.1	$121,581,613	$338
Excess cost of transit worker (A – B)		$140,199,032	$390

* See Table 23.

5.3.3 Federal Disability Programs

Workers whose illnesses prevent their full participation in the workforce may become eligible for safety net programs. Two of the larger federal programs covering disability benefits are SSDI and SSI.

5.3.3.1 SSDI

SSDI provides benefits for persons who are totally disabled, which is defined as the inability to engage in "substantial gainful activity" due to any medically determined physical or mental health impairment that is either expected to result in death or has lasted or can be expected to last continuously for no less than 12 months. Funded as an insurance program through workers' contributions to the social security trust fund (via "FICA" payments that are deducted from workers' paychecks), SSDI benefits also apply to individuals who are age 55, blind, and unable to carry on gainful activity, and may be granted to eligible dependents (SSA 2017; SSA n.d.-a; SSA n.d.-b). SSDI benefits are available to workers whether or not their disability is associated with a work-related injury, but SSDI benefits are not payable for partial or for short-term disability (SSA 2017).

Social Security Disability Insurance (SSDI) provides benefits for total disability. A worker who is totally disabled is unable to continue or return to the work he or she did before the onset of a medically determined physical or mental health impairment, and is unable to adjust to other work because of the medical condition (SSA n.d.-a).

5.3.3.2 SSI

SSI provides cash assistance to persons (including children) who are aged, blind, or disabled and who have little or no income or resources to meet necessities (SSA n.d.-b; SSA n.d.-c). SSI is funded by the federal government using general tax revenues. Some states also fund their own supplemental assistance programs. Eligible persons may receive assistance from state and federal SSI programs either separately or as a combined amount, and some eligible persons may receive both SSDI benefits and SSI assistance (SSA n.d.-b).

The Supplemental Security Income Program (SSI) provides cash assistance to persons who are aged, blind, or disabled and who have little or no income or resources to meet necessities. Some states also operate SSI programs. Eligible persons may receive both state and federal SSI assistance, and some persons may qualify to receive both SSDI benefits and SSI assistance (SSA n.d.-b).

Table 25. Summary of workers' compensation costs by estimation method (2018 dollars).

Estimated Costs	Premium Estimation Method	Claims Estimation Method
Transit worker cost	$413,826,181	$261,780,645
General population cost	$292,686,289	$121,581,613
Excess cost of transit workers	$121,139,892	$140,199,032
Transit worker cost per transit worker	$1,151	$728
General population cost per transit worker	$814	$338
Excess cost per transit worker	$337	$390

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5.3.3.3 Estimating Costs for SSDI and SSI

Estimates for the costs of SSDI and SSI were calculated separately, but a similar method was used for both, and the results were similar. To determine the cost of SSDI, the project team estimated the percentage of recipients who were or had been in the transit worker industry and multiplied that population by the average annual benefit.

Based on 2018 data from the National Beneficiary Survey, 9.9% of SSDI beneficiaries and 6.0% of SSDI beneficiaries who also received SSI assistance had been employed in the transportation and material moving occupation (SSA 2018a). Taking a weighted average of these percentages, the project team determined that 0.090666 (about 9.1%) of SSDI recipients had been employed in the transportation and material moving occupation. To further restrict the SSDI population in the transportation and material moving occupation, the project team then took a ratio of the size of the transit worker population relative to the transit and material moving population. As of May 2017, total employment in the transit and material moving population was 9,978,390 million, compared to a transit worker population of 359,669 (APTA 2018). Applying the ratio (359,669/9,978,390, or 0.036045) to calculate the subset of SSDI recipients belonging to the transit worker population yielded 28,148 workers (rounded), which was then multiplied by the average yearly benefit. The average yearly benefit is simply the monthly benefit for disabled workers ($1,201.30 in 2018) multiplied by 12, or $14,415.60 (SSA 2018c). The calculations can be shown as:

Estimated annual cost of SSDI (transit workers) in 2018*

= *Average monthly SSDI beneficiaries*	= 8,613,167
× *proportion of SSDI beneficiaries in the transportation and material moving occupation*	× 0.090666 (rounded)
× *ratio of transit worker population to the transportation and material moving population*	× 359,669/9,978,390 (a ratio of 0.036045, which yields 28,148 recipients)
× *average monthly benefit × 12*	× $1,201.30 × 12 ($14,415.60)
= *estimated annual cost (number of workers × annual cost)*	= $405,770,309 (rounded)

* Rounding decisions at each step can affect the final number, but for purposes of estimation the differences are fairly minor. In estimating the SSDI costs, the numbers used in the final step of the calculation used by the project were 28,148 × $14,415.60 = $405,770,309.

To arrive at an estimated annual cost of SSI among recipients who had been transit workers (number of recipients × annual cost of SSI per recipient), several calculations were necessary. First, the project team estimated the percentage of recipients who had been employed in the transit worker industry. According to the 2018 National Beneficiary Survey data, 7.1% of SSI recipients and 6.0% of combined SSDI/SSI recipients had been employed in the transportation and material moving occupation (SSA 2018a). Taking a weighted average of these percentages determined that 0.066620% (about 6.7%) of SSI recipients had been employed in the transportation and material moving occupation. This percentage was roughly in line with the proportion of transportation and material moving employment in the total workforce in 2018. The project team then estimated the proportion of SSI recipients in the transportation and material moving occupation who had been transit workers. This was done by multiplying it by the ratio of the transit worker population to the transit and material moving population (359,669/9,978,390, or 0.036045). The resulting subset of SSI recipients, rounded to the nearest whole number, was then multiplied by the average annual benefit. The average monthly SSI benefit in 2018 for blind and disabled recipients was $571.01, making the annual benefit $6,852,12 (SSA 2018b). Using the data from the 2018 National Beneficiary Survey, the calculations can be shown as:

Estimated annual cost of SSI (transit workers) in 2018*

= *Average monthly SSI recipients*	= 7,003,750
× *proportion of SSI recipients in the transportation and material moving occupation*	× 0.066620 (rounded)
× *ratio of transit worker population to transportation and material moving population*	× 359,669/9,978,390 (a ratio of 0.036045, which yields 16,818 recipients)
× *average monthly benefit × 12*	× $571.01 × 12 ($6,852.12)
= *estimated annual cost (number of workers × annual cost)*	= $115,238,954 (rounded)

*Rounding decisions at each step can affect the final number, but for purposes of estimation the differences are fairly minor. In estimating the SSI costs, the numbers used in the final step of the calculation used by the project were 16,818 × $6,852.12 = $115,238,954.

5.3.3.4 Medicare

Persons under the age of 65 are eligible for Medicare coverage after 24 consecutive months of receiving SSDI. Persons under age 65 who have been diagnosed with end-stage renal disease or amyotrophic lateral sclerosis do not have to undergo the 24-month waiting period to qualify for Medicare (Cubanski, Neuman, and Damico 2016). Medicare recipients under age 65 qualifying through disability can enroll in hospital and medical insurance and prescription drug coverage (Parts A, B, and D). Like SSDI, Medicare pays benefits whether or not the injury is work-related.

Medicare is the federal program that provides hospital and medical insurance for people age 65 and older. Medicare also is available to persons with disabilities under age 65 under certain conditions.
Source: Centers for Medicare and Medicaid Services

To calculate the Medicare costs attributed to the transit worker population, the project team assumed that the proportion of Medicare beneficiaries under age 65 who had been transit workers was the same as the proportion of transit workers to the total workforce. According to the U.S. Department of Health and Human Services, in 2016 the average monthly number of disabled Medicare beneficiaries equaled 9 million people. The project team adjusted this number to reflect the number of beneficiaries who had been transit workers, then multiplied this figure by the average Medicare costs per capita. A 2016 study published by the Henry J. Kaiser Family Foundation showed that costs associated with Medicare beneficiaries under age 65 were higher than those for beneficiaries over age 65 (Cubanski, Neuman, and Damico 2016). According to Cubanski, Neuman, and Damico, per capita Medicare spending for the under-65 group in 2014 was $13,098, whereas per capita spending for the 65-and-over group was $9,972. Adjusting the 2014 dollars to 2018 dollars, the per capita annual Medicare spending for beneficiaries under age 65 was about $13,893. Applying the data from the Kaiser Foundation study, the resulting estimate of the Medicare costs that could be attributed to transit workers was calculated as $315,484,742, using the following formula:

Estimated annual cost of Medicare (transit workers, adjusted to 2018 dollars)*

= *Population of Medicare beneficiaries under age 65*	= 9,000,000
× *proportion of transit workers in the total workforce (assumed the same for disabled workers)*	× 359,669/142,549,250 (a ratio of 0.002523, which yields 22,708 beneficiaries [rounded])
× *annual per capita spending on Medicare beneficiaries under age 65*	× $13,893.11
= *estimated annual cost (number of workers × annual cost)*	= $315,484,742 (rounded)

*Rounding decisions at each step can affect the final number, but for purposes of estimation the differences are fairly minor. In estimating the Medicare costs, the numbers used in the final step of the calculation used by the project were 22,708 × $13,893.11 = $315,485,742.

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To calculate excess and general population disability costs, the disability prevalence ratios of transit workers were compared to those of the general population. Statistics from the U.S. Department of Labor in 2012 projected that bus drivers and subway, streetcar, and other rail transportation worker occupations experienced disability prevalence rates of 8.1% and 5.9%, respectively (or a weighted average of 8.0%). The disability prevalence among all occupations was 5.5% (U.S. Department of Labor n.d.). Using the ratio of 5.5% to 8.0% to determine the number of disability assistance beneficiaries under an all-occupations disability prevalence rate, the project team developed cost projections for the general population. The ratio of 5.5% to 8.0% was an added term to be multiplied for each of the cost equations for SSDI, SSI, and Medicare. For example, the cost of Medicare for the general population was calculated by multiplying the number of Medicare beneficiaries under age 65, the proportion of transit workers to the total workforce, the ratio of 5.5% to 8.0% (rounded to the nearest whole number, or beneficiary), and the per capita spending on Medicare beneficiaries under age 65. Similarly, the annual cost of SSDI or SSI for the general population was calculated by multiplying the SSDI or SSI beneficiary population, the proportion of beneficiaries in the transportation and material moving occupation, the ratio of the transit worker population to the transportation and material moving population, the ratio of 5.5% to 8.0% (rounded to the nearest whole number, or beneficiary), the average monthly benefit, and 12. Table 26 provides a summary of the disability costs and the cost per transit worker.

The excess costs calculated for transit workers likely understate the total payments to transit workers with disabilities, given that transit workers are more prone to illness and injury. (Table 10 showed that the incidence rate for nonfatal occupational injuries was 5.9 per 100 full-time workers for urban transit systems.) The kinds of health conditions associated with disability also are frequently associated with transit workers. For example, nearly three-quarters of persons filing claims for disability benefits in 2016 had a primary diagnosis of a disease of the musculoskeletal system and connective tissue (SSA 2017). Table 27, which reflects statistics for 2016 from SSA, displays the numbers and percentage of disabled workers receiving SSDI by diagnostic group without adjustments.

As shown in Table 27, in 2016 more than one-quarter of disabled workers had an eligible disability related to mental health, and nearly one-third of disabled workers had an eligible

Table 26. Disability costs for the transit worker population and general population (2018 dollars).

Factor	SSDI	SSI	Medicare	Notes
Transit workers cost (A)	$405,770,309	$115,238,954	$315,484,742	Calculated costs of SSDI, SSI, and Medicare for transit workers in 2018 dollars
Transit worker cost at disability rate of general population (B)	$277,428,222	$78,792,988	$215,704,439	Uses the disability prevalence ratios of all occupations to public transit workers (5.5 to 8.1%) to estimate disability beneficiaries under the all occupations rate of 5.5%
Excess cost of transit workers	$128,342,087	$36,445,966	$99,780,303	(A – B)
Cost per transit worker	$1,128	$320	$877	(A) divided by transit worker population of 359,669
Cost at disability rate of the general population per transit worker	$771	$219	$600	(B) divided by transit worker population of 359,669
Excess cost per transit worker	$357	$101	$277	(A – B) divided by transit worker population of 359,669

Table 27. Disabled worker recipients of SSDI by diagnostic group, 2016.

Diagnostic Group	Number and Percentage of Disabled Workers
Circulatory system	716,119 (8.1%)
Endocrine, nutritional, and metabolic diseases (e.g., diabetes)	269,065 (3.1%)
Injuries	337,772 (3.8%)
Mental health (nonintellectual disability)	2,315,807 (26.3%)
Musculoskeletal system and connective tissue	2,342,133 (32.3%)
Respiratory system	243,896 (2.8%)

Source: Reproduced from SSA (2017)

disability related to the musculoskeletal system and connective tissue. Given the prevalence of mental health and musculoskeletal disorders in transit workers, these findings illustrate the potential societal impacts related to federal resources.

5.4 Additional Costs to Society

In addition to the disability and Medicare payments associated with the health conditions and risks of transit workers, some costs are qualitative, unquantifiable, or simply more difficult to quantify.

Unquantifiable costs include costs to commuters and other travelers on the transit system. Inferior service that leads to delays and irregularities in the schedule will cost travelers in terms of the value of their time. If travelers switch to alternative methods of travel, revenues for the transit system or mode will be affected. Lower revenues can reinforce a cycle of inferior service, as fewer resources will be available to allocate toward workers and infrastructure improvements, particularly in the face of decreasing ridership.

Another cost not quantified in this chapter is the cost to families. A 2012 study by Asfaw, Pana-Cryan, and Bushnell found that among families of workers' compensation recipients, the odds of another family member being hospitalized were 31% higher in the 3 months after the occupational injury than in the 3 months that preceded the injury. If the worker's occupational injury was severe, the odds for family members were 56% higher in the 3 months after the injury. Occupational injuries can diminish family income, cause family members to undertake greater physical burdens to care for the injured family member, and trigger psychological stress (Asfaw, Pana-Cryan, and Bushnell 2012).

Other costs not quantified in this chapter include fatalities and injuries to those outside the transit vehicles (e.g., on the road, rail, or in other vehicles). Costs related to turnover include safety costs due to inexperienced drivers and training costs when transit workers are absent due to illness or injury, are disabled, or seek early retirement.

5.5 Conclusions

The purpose of this chapter was to present monetized estimates of the costs due to the health risks and conditions faced by transit workers and to highlight areas for transit workers and agencies where costs are elevated. For example, health and wellness programs may improve the health conditions of workers, thus reducing costs across multiple categories. Further improvements in on-the-job safety may decrease disability and injury costs. Estimates have been provided to better understand the health costs of transit workers that are paid by employers, society, and individuals in terms of injury and mortality costs. The costs estimated

Table 28. Compilation of cost estimates (2018 dollars).

Cost Category	Transit Worker Cost	Cost per Transit Worker	Excess Cost	Excess Cost per Transit Worker
Workers				
Injury Costs	$853,768,760	$2,374	$403,284,268	$1,121
Mortality Costs	$189,174,784	$526	$61,171,511	$170
Employers and Society				
Absenteeism	$314,301,144	$874	$25,144,092	$70
Workers' Compensation	$261,780,645–$413,826,181	$728–$1,151	$121,139,893–$140,199,032	$337–$390
Disability (SSDI)	$405,770,309	$1,128	$128,342,087	$357
Disability (SSI)	$115,238,954	$320	$36,445,966	$101
Medicare	$315,484,742	$877	$99,780,303	$277

in this chapter are not an exhaustive list of employer and societal costs, and many additional costs cannot be itemized, such as quality of service. Costs presented are not additive, and the cost categories overlap.

Table 28 compiles the estimates that were computed in this chapter. Cost estimates ranged from $115 million on the low end for SSI to $854 million on the high end for injury costs. For each category, the cost attributed to transit workers exceeded that of the general population because the transit worker population had higher incidence rates, claim rates, or disability prevalence.

CHAPTER 6

Case Studies: Health Promotion Programs

6.1 Introduction

The case studies and analyses presented in this chapter introduce primary source employee demographic and wellness program participation data collected from five major metropolitan transit agencies:

- The Indianapolis Public Transportation Corporation (IndyGo), in Indianapolis, Indiana;
- The Regional Transit Service (RTS), in Rochester, New York;
- The Transit Authority of River City (TARC), in Louisville, Kentucky;
- The Des Moines Area Regional Transit Authority (DART), in Des Moines, Iowa; and
- The Los Angeles Metropolitan Transit Agency (LA Metro), in Los Angeles, California.

The analysis involved a review of descriptive literature publicly available from agencies or provided to the project team by the agencies, human resources records, insurance company records, and interviews with administrative, human resources, and health promotion program personnel. The director of human resources administration at IndyGo and the manager of wellness and benefits at RTS also participated in interviews and provided information for these case studies. In some cases, members of agency staff joined a conversation and/or provided data. Details on the project team's selection method for the sites included in the study are available in Appendices A and B.

In the case of IndyGo, RTS, TARC, and DART, the project team conducted an analysis based on individual-level data to determine if statistically measurable benefits were associated with program participation. LA Metro did not provide individual-level data, so regression modeling was not possible for this location.

For the analyses, baseline data were collected from before the comprehensive health and health promotion programs began. Also collected before, during, and after the program were individual records of absenteeism (both sick and personal days taken) and workers' compensation payments. Measures of participation were collected as well. Specifically, the project team examined the relationship between wellness/health promotion programs (screenings, 5K runs, diet) and improved health outcomes (less absenteeism, fewer sick days) in four sites using linear regression analysis. The results for three sites showed no statistically significant measurable benefit, a finding broadly consistent with past studies. In one location (Des Moines) the participation effect was statistically significant at the 95% level; it was estimated that participation in the program resulted in a 4-hour decrease in absentee hours. This result was reasonably larger, but based on a small sample so it is unclear if it could be replicated or should be used to generalize about effective wellness program interventions.

The analyses for TARC (Louisville) and DART (Des Moines) were structured somewhat differently from those for IndyGo (Indianapolis) and RTS (Rochester). For IndyGo and RTS,

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the control/non-participatory group was based on a structural factor, such as whether an employee was insured or not (IndyGo) or worked at a remote location as opposed to working onsite (RTS). By contrast, the participants at TARC and DART volunteered to take part in wellness activities and wellness screenings. In these two studies, the records on voluntary participation were used to measure the correlations between outcomes and wellness programs. For IndyGo, RTS, TARC, and DART, the data were tracked so that pre- and post-analysis of effects of participation on absenteeism could be properly conducted. Because data were available on gender, race, and day of hire/termination, participation in these programs could be analyzed, as could rates of turnover and other research questions. The LA Metro case study provided information on the prevalence of health conditions from its insurance companies and detailed aggregate data on wellness program participation records. Individual-level data were not made available on absenteeism or workers' compensation, however, so a multivariate statistical analysis was not possible.

This chapter discusses process-based and data-driven benefits, though the two are not always mutually exclusive. Process-based benefits can include the diversity of the wellness committee, the array of programs, and the flexibility of the schedule. Data-driven benefits can include reduced absenteeism or workers' compensation claims. This chapter begins with the description of the programs and more process-based benefits of the programs and follows with a discussion of estimated data-driven benefits. The case studies include scalable and sustainable strategies that have been implemented by the transit agencies. The programs have multiple features, including workshops on diet and exercise, biometric screenings, targeted education to avoid common injury types (e.g., musculoskeletal), financial planning, fitness challenges, and onsite gyms.

6.2 IndyGo

This case study was developed through emails and discussions with the president of Amalgamated Transit Union (ATU) Local 1070, and the director of employee services for IndyGo.

6.2.1 Background

IndyGo is a municipal corporation providing public transportation to the city of Indianapolis and surrounding Marion County, Indiana. The agency operates 31 bus routes throughout the county (IndyGo n.d.). As of 2018, it has approximately 680 employees, of whom more than 500 are members of ATU Local 1070 (Russell 2018).

6.2.2 Program Startup and Development

The onsite clinic and wellness program were started on January 1, 2010, as part of a binding arbitration award between IndyGo and ATU Local 1070 in response to a pending premium increase of 46% from IndyGo's health insurer. The steep increase was the provider's response to the high cost of IndyGo's medical claims. To control the increase, IndyGo management (together with the agency's benefits consultant and with agreement from ATU Local 1070) proposed an onsite clinic and wellness program. Given the agreement to offer the onsite clinic and wellness program, the insurance provider dropped the premium increase from the pending 46% to approximately 20%. The overall savings captured by reducing the increases in insurance premiums benefited the program in two ways. As an incentive to participation, the agency used some of the savings to reduce the portion of the insurance premiums paid by participating employees, and additional savings helped fund the program itself.

6.2.3 Work Organization/Work Environment

Like many other agencies, the majority of operators (approximately 55%) at IndyGo work split shifts. For many operators, this arrangement has a negative impact on their quality of life. Unless operators invest the time and expense to acquire, transport, and store their own food, having access to healthier food choices can be challenging. Onsite vending machines available in the break rooms were not stocked with healthy options.

One of the top priorities of ATU Local 1070 has been to provide adequate restroom access for operators. This quality of life issue can have meaningful consequences, both short- and long-term. Before implementing the wellness program, management and union leaders worked together to address this issue.

6.2.4 Health, Wellness, and Safety Concerns

From the perspective of IndyGo management, the main health concerns concerning workers' compensation are musculoskeletal injuries; slips, trips, and falls; and vehicle accidents. According to the aggregate data from claims reports and onsite clinic data, the top health issues on the personal health side are obesity, hypertension, diabetes, prediabetes, and asthma. To address the work-related incidents and injuries, IndyGo has been incorporating ergonomics and prevention of injury into onboarding and in-service training. The union president expressed that diabetes, sleep apnea, and hypertension are the top health and wellness issues of the represented employees. Obesity is also on the rise among frontline employees, according to the local president.

6.2.5 Program Activities/Elements

The IndyGo health and wellness program was made available to employees who have insurance through IndyGo. In 2016, approximately 88% of all IndyGo employees were covered under group health insurance. Participation was voluntary but incentivized: If employees participated in the program, they paid half of the premium (15% of the total insurance premium) compared with employees who did not participate (30% of the total insurance premium). Because of the incentive, IndyGo reported that 97% of the employees covered under the group health insurance plan elected to participate in the program (Russell 2018).

To maintain their discounts on the health premiums, employees must complete the following annually: a physical, a health risk assessment, a biometric screening, a minimum of four coaching sessions, and a health activity. Some of the physical and educational activities include gardening, a Weight Watchers program, onsite exercise classes, walk–run groups, basketball tournaments, a 5K event for runners and walkers, and financial and nutrition classes.

> "It's a great program. I suffer from a lot of ailments and gain weight very easily. The doctor and nurses at the Activate clinic are very personal. They helped me so much and I have seen real progress. They understand how demanding the job is and our eating habits. They define different alternatives. We have good results; people are getting more conscious about fitness. That's what you'll hear from most members."
>
> —ATU Local 1070 Financial Secretary

Union leadership stated that the approach has been effective because even though participants have to complete the requirements, the focus is on self-help and learning how to properly care for your health on your own. The union has been particularly pleased with the level of involvement of the onsite clinic provider because they understand the nature of the jobs performed and have developed relationships with the employees. Participants can get advice and care based specifically on the demands of their jobs.

Participation in the program primarily occurs while employees are on the clock. According to the agency, getting employees to participate outside of their shifts is difficult. Efforts have been made to hold events and wellness opportunities in the community, but these activities were not well attended.

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6.2.6 Organization

The human resources department oversees the onsite clinic and wellness program and all activities related to health program initiatives. IndyGo contracts with a third party that is staffed with two nurse practitioners, a part-time doctor, and medical assistants, and has a wellness committee composed of union and non-union employees that help design new activities and promote the program and initiatives. The program is funded through the IndyGo operating budget, which incorporates funding obtained through agreements with the union and the healthcare insurance provider. The 3-year contract with the current onsite clinic provider costs the transit system approximately $500,000 a year, including staff costs, clinic services (primary and urgent care), and expenses for some prescription drugs (as a one-time fill) (Russell 2018).

6.2.7 Qualitative Program Benefits

Although the program did not have strong internal support from frontline workers initially, the president and financial secretary of ATU Local 1070 promoted the program and helped assure workers that information disclosed in the clinic would remain confidential (Russell 2018). Now, agency and union leaders report that there is total support for the program among the employees. Many employees have shared their positive experiences, including being screened for prediabetes or sleep apnea and having access to information about how to improve eating habits and lose weight.

6.2.8 Reported Metrics

From 2010–2013, the average cost for health insurance per employee fell from $12,790 to $10,244. Between 2014 and 2017, the insurance provider changed and insurance costs fluctuated. In 2017 (under the new provider) the average insurance cost per employee was $13,004.

As shown in Table 29, health claims rose from 2016 to 2017 (fourth column, percentage change) and appeared to be increasing at a similar rate in 2018 (sixth column, percentage change).

Additional detailed information on medical claims (e.g., claims broken down by condition or claims dating back before 2015, before the wellness program began) was not received.

6.2.9 Method

On June 15, 2018, after preliminary conversations, the project team provided IndyGo with a data use agreement stating that all data—including human resources, payroll, and program participation and other related data—would be used only for the research project, would be handled and protected according to the requirements of the Federal Information Security Management Act (FISMA), and would be destroyed at the end of the research period.

Table 29. Claims and prescriptions reported for IndyGo, 2016–2017.

Claim Type	2016 [a]	2017 [a]	Percentage Change	January 1–June 30, 2018	Projected Percentage Change [b]
Medical-paid claims	$4,257,969	$5,078,484	19.27%	$2,538,382	20.0%
Prescription-paid claims	$1,091,018	$1,494,763	37.01%	$791,502	27.1%

[a] Table not adjusted for inflation. The Consumer Price Index (CPI) in 2017 was 1.6% per the U.S. Inflation Calculator; in 2018 it was 1.9%.
[b] Numbers in this column are based on the assumption that the monthly rate in the second half of the year is the same as the monthly rate during the first 6 months of the year.

On June 21, 2018, after a follow-up call with personnel at IndyGo, the project team sent an email requesting the following data:

- Excel files (or tab-delimited files) with downloads of the number of personal days and number of sick days with employee names, gender, date of birth, occupational code, and date of hire for 2009–2018 (or whichever historical years were available) for all employees;
- Excel files (or tab-delimited files) with downloads of workers' compensation payments for 2009–2018 with employee names for all employees;
- Excel files (or tab-delimited files) with race and employee names for all employees;
- Names of participants by year in the health insurance program; and
- Names of participants by year in the health wellness program, among those eligible for the health insurance program.

IndyGo provided payroll data with individual-level data from 2009 to 2018 on absences, including sick leave, personal leave, family medical leave, and leave without pay, as well as workers' compensation data from 2012 to 2018. Because IndyGo introduced the health program in 2011, 2010 was established as the baseline year for the analysis, and all requests for data referenced 2010 as the first year. (Based on the initial interview, some early requests were made for 2009 data, but the agency later clarified that the program began in March 2011.)

IndyGo further provided insurance information for employees from 2011 to 2018. Using the 97% participation rate in the program among those who carried insurance as a basis, the project team assumed that if employees carried insurance, they participated in the program. No other data were available on participation among those insured. The insurance information was merged with the absentee data based on the employee's name and birthdate.

The data provided 36 categories of job descriptions, with several categories referring to different types of operators (e.g., full-time, part-time), as well as jobs with maintenance, and administrative roles. Employees were categorized as operators, mechanics, and administrative staff based on their job descriptions in the leave data; for example, fixed-route–coach operator and flexible services coach operator were defined as operators. Administrative roles were removed from the analysis because the focus was on the outcomes for frontline employees, which consisted of operators and maintenance staff.

For the models, the project team analyzed the full-program effects: comparison of absenteeism and workers' compensation measures for 2010 (the baseline year) with measures for 2017 (the last full year of program data) or with the last full year that the employee was at IndyGo before 2017, if the individual's employment was terminated in 2017 or before. Regression models were run using ordinary least squares to detect any potential correlation between participation in the health program and lower absenteeism. The dependent variable in the models was an overall absentee variable capturing total days of leave, and the independent variables were participation/insurance (the key explanatory variables) and control variables, including age, race, tenure, gender, and occupation. The regression model was run using alternative dependent variables to measure the robustness of the model and results to different specifications. Two of those alternatives were workers' compensation dollars and the difference of absenteeism and workers' compensation before and after the introduction of the health program.

6.2.10 Workforce Characteristics

To be included in the analysis, employees had to have been employed with IndyGo for at least 1 full calendar year in 2010 and for 1 full calendar year after the wellness program began in 2011. This qualification applied to 252 records. The workforce under observation was smaller than the total workforce due primarily to missing data and high turnover. In 2010,

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Table 30. Demographics of IndyGo frontline population, 2010.

Demographic Characteristic	Operator			Maintenance			All		
	Count	Percent	Age [a]	Count	Percent	Age [a]	Count	Percent	Age [a]
African American	191	85.7%	53.9	7	24.1%	50.0	198	78.6%	53.6
White	31	13.9%	59.7	22	75.9%	61.2	53	21.0%	60.1
Other race	1	0.4%	60.0	0	0%	N/A	1	0.3%	60.0
Female	87	39.0%	52.5	2	6.9%	48.9	89	35.3%	52.2
Male	136	60.9%	56.2	27	93.1%	59.2	163	64.7%	56.5
Total	223	100.0%	54.7	29	100.0%	58.5	252	100.0%	55.0

[a] All ages are averages.

IndyGo had 333 frontline employees. Twenty-one employees were excluded for missing data required in the regression analysis, and 60 employees were excluded because their employment was terminated before the first complete year of the program. This left 252 records available for the analysis. Table 30 presents race, age, and gender breakdowns for the two employee types (operator and maintenance, separate and combined) considered in the analysis.

The White population was substantially older than the African-American population: The average age for the 53 White workers was 60.1 years, compared with an average age of 53.6 years for the 220 African-American workers. The men were slightly older than the women, averaging 56.5 years of age for men compared with 52.2 years for women. The maintenance workers were older than the operators, with an average age of 58.5 years compared to 54.7 years, and maintenance workers tended to be male at a higher rate (93.1%) than did operators (56.2%).

The analysis examined if outcomes related to absenteeism were related to participation in the program. Thus, the analysis divided the population of frontline employees into two groups: "ever in program" and "never in program." Table 31 displays the characteristics of these two groups.

Based on employees having insurance through IndyGo, the average age of participants in the program was slightly younger (53.7 years) than the average age of non-participants (57.0 years). As Table 31 shows, participants in the program were overwhelmingly operators (only one maintenance worker had been in the program).

6.2.11 Absentee Hours After Program Initiation

The data generated from the IndyGo health promotion program provided a wealth of new information in an area where data have been sorely lacking. Figure 5 presents the average annual absentee hours for frontline employees for the 8 years from 2010–2017. The figure illustrates the trend in absentee days, starting with the year before the program began (2010) and extending through the last full calendar year in which data were provided. The graph presents absentee hours over time for all employees (orange line), women (purple), and men

Table 31. Program participation and age by job category, IndyGo.

Demographic	Operator			Maintenance			All		
	Count	Percent	Age *	Count	Percent	Age *	Count	Percent	Age *
Ever in program	153	68.6%	53.9	1	3.4%	38.6	154	61.1%	53.7
Never in program	70	31.4%	56.4	28	96.6%	59.2	98	38.9%	57.0
Total	**223**	**100.0%**	**54.7**	**29**	**100.0%**	**58.5**	**252**	**100.0%**	**55.0**

*All ages are averages.

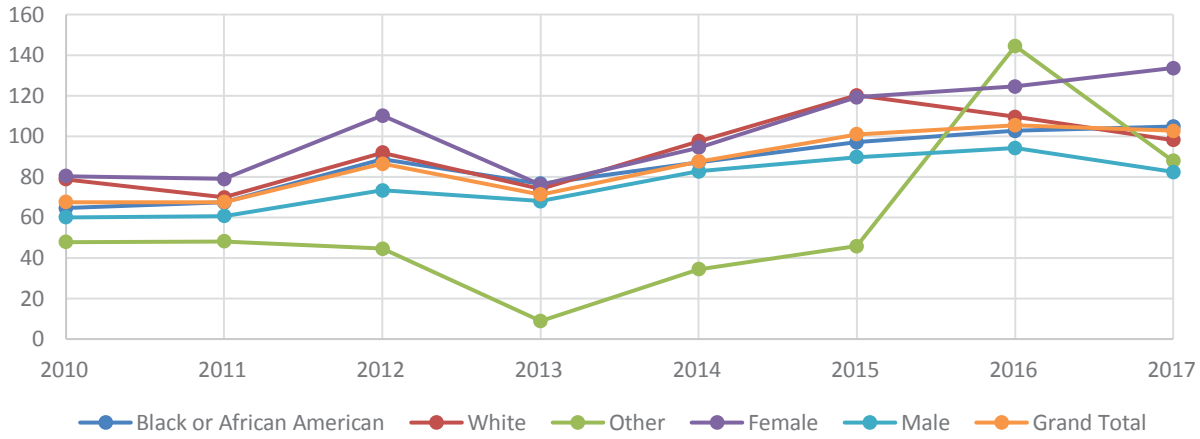

Figure 5. Average annual absentee hours, IndyGo frontline employees by race and sex, 2010–2017.

(teal), and for African Americans (blue) and Whites (red). Absentee hours were defined as total hours of sick leave, personal leave, and sick unpaid leave.

Although year-to-year fluctuations occurred for all six groups, the general trend does not demonstrate much variation. Beginning with an average of 70 hours in 2010, there was a slight increase over the 8-year period to approximately 100 hours at the end (2017), which might reflect an aging workforce. Women on average have slightly higher amount of sick leave than men, which was a trend evident among all the case study populations. Figure 6 shows the trends as plotted for the median annual absentee hours.

Figure 7 presents the average annual absentee hours for frontline employees for the eight years from 2010–2017. The graph shows maintenance employees (blue), operator employees (red), and total frontline employees (orange).

6.2.12 Workers' Compensation

Table 32 shows the number of indemnity claims for the years the agency provided—specifically, annual data for frontline employees from 2013 through 2017. These claims could not be matched with individual employees (participants or non-participants). The table

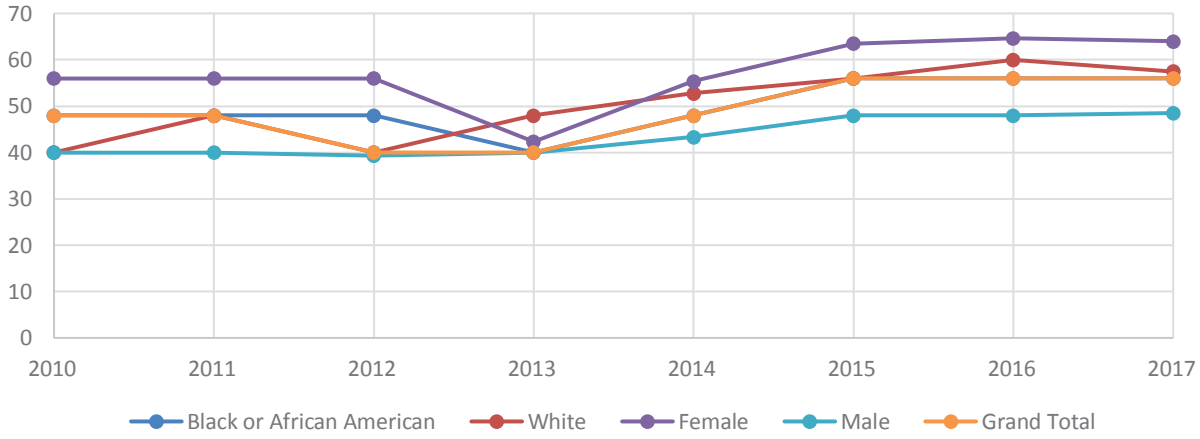

Figure 6. Median annual absentee hours, IndyGo frontline employees by race and sex, 2010–2017.

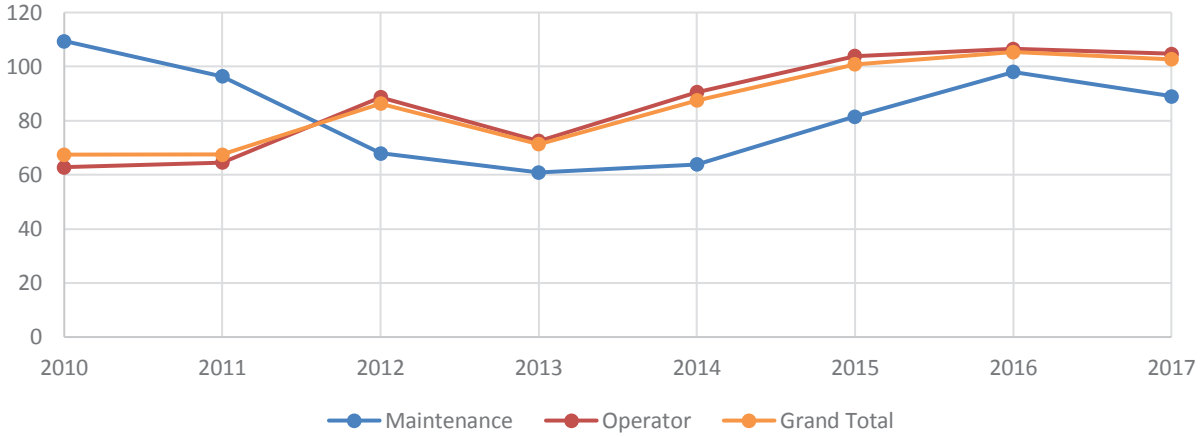

Figure 7. Average annual absentee hours, IndyGo frontline employees by job classification, 2010–2017.

illustrates the variation from year to year in both the number of claims and the average dollar-amount per claim.

Figure 8 shows the percentage of (frontline) employees with indemnity claims from 2013 through 2018, including the total of employees with claims (orange), and the percentages for various demographic groups. As discussed above, data on claims before 2013 were not available. The percentage of claims increased over the observed period; thus, there was no evidence of a reduction in claims attributable to the program during this period. The program may have caused a reduction, but other (unobserved) factors would have had to offset that reduction, causing the overall rate to rise. Note that women filed the highest percentage of claims consistently throughout the period.

6.2.13 Results

Using regression analysis, the project team investigated using several model specifications. The analyses varied the dependent variable, changed the mix of independent variables, and tested several interaction terms. The interaction terms tested how program participation varied by some of the demographic variables. In no case was the coefficient on the effect of program participation statistically significantly different from zero—that is, in no case did participation have a statistically significant effect on health, measured as the change in number of days absent. Variables also were included for operators and maintenance, which would have shown if one occupational group was more likely to have reduced absenteeism days associated with the program than the other group. However, variables in those regressions did not have any statistically significant effects either.

Table 32. Workers' compensation indemnity claims by year, frontline IndyGo employees, 2013–2017.

Year	Sum of Claims	Unique Claims	Average per Claim
2013	$122,890	125	$983
2014	$228,239	336	$679
2015	$426,234	125	$3,409
2016	$956,551	336	$2,847
2017	$49,534	64	$774

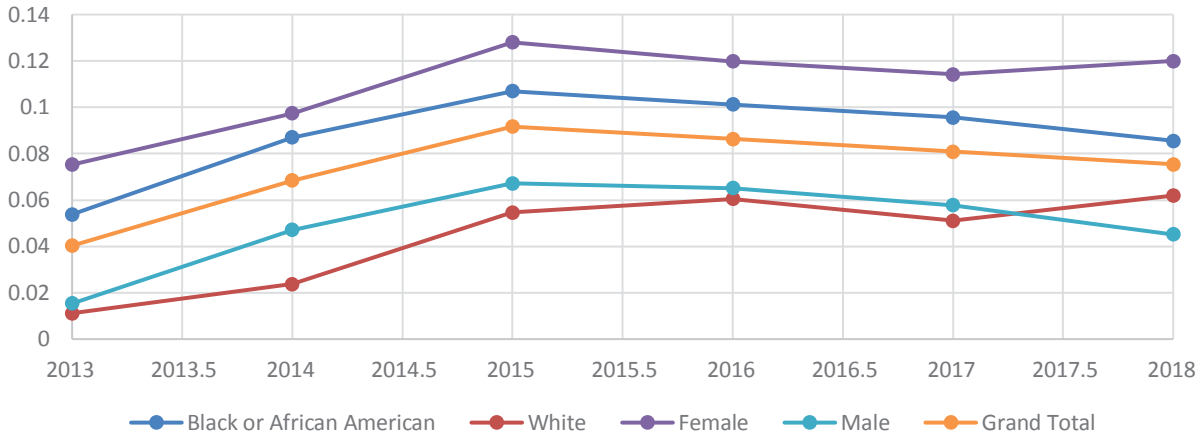

Figure 8. Percentage of employees with workers' compensation indemnity claims, by demographic group, IndyGo frontline employees, 2013–2017.

Appendix C outlines some of the potential reasons for the lack of significance for the participation variables. In particular, Tables C-1 and C-2 present two regressions that are representative of the variations that were tested, and the corresponding text includes a discussion of the analysis.

6.3 RTS

This case study was developed with input from the director of well-being and inclusion and the director of people, performance, and development at RTS, and the president of ATU Local 282.

6.3.1 Background

RTS is the public transportation agency that provides service to the counties of Monroe, Genesee, Livingston, Ontario, Orleans, Seneca, Wayne, and Wyoming in New York State. The agency serves more than 17 million customers annually and employs more than 900 individuals, of whom approximately 75% are operators and maintenance employees. As the largest subsidiary of the Rochester–Genesee Regional Transportation Authority, RTS has a fleet of 216 buses (of the authority's total fleet of 404) and has built a reputation for on-time performance and innovative performance management (Rochester–Genesee Regional Transportation Authority n.d.-c).

Approximately two-thirds of RTS employees are based at the agency's Monroe campus, which is the location of an onsite gym and the hub of the agency's health promotion activities. The other employees are based at nine offsite locations remote from the Monroe campus and do not have immediate access to the gym. The employees based at the offsite locations have limited access to the agency's health promotion activities. The data provided by RTS and the Rochester–Genesee Regional Transportation Authority used codes to represent employees at the main locations, including the nine offsite locations: Lift Line, BBS, STS, WATS, WYTS, OTS, CATS, GTC, and LTS.

6.3.2 Program Startup and Development

RTS's health and wellness program, dubbed Healthy U, started in 2011 as a modest and loosely defined program with a focus primarily on physical fitness. It became a more

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developed wellness program in 2013 and 2014, addressing a comprehensive set of goals that were defined in 2014. With healthcare costs skyrocketing and premiums rising both for the agency and the covered employees, RTS understood that it had an opportunity and an obligation to help employees. The agency hired a full-time health and wellness coordinator to oversee the newly expanded program. As the program was developed, medical claims data were examined to understand the most prevalent and costly medical conditions. Combining this knowledge with information about the demographics of the frontline employees, RTS staff members crafted the initial focus of the program.

The agency conducted a survey in 2014 to understand the needs of transit employees, the types of programs they would be most likely to participate in and benefit from, and the most convenient times to hold events. The agency received 153 responses to the survey. In 2018, RTS conducted a similar survey to gather feedback on the wellness program. The latter survey asked respondents whether they had participated in wellness activities in the past and asked respondents to identify what would motivate them to participate in the future and whether there were any barriers that prevented their participation. This survey found that 52 respondents had participated in previous health promotion activities (RTS 2018).

6.3.3 Work Organization/Work Environment

At RTS, almost all operators work split shifts (either two or three shifts). Generally, employees are on the clock between 9 hours and 12 hours, including breaks between runs. The maximum amount of time behind the wheel is 12 hours, however, and the maximum shift time is 15 hours. Bus maintenance requires coverage 24 hours a day, 7 days a week. Approximately 10% of bus technicians work split shifts—two sets of scheduled times within a 7-day span. A technician may work, for example, from 11:00 a.m. to 7:00 p.m. for three days, then from 3:00 p.m. to 11:00 p.m. for the remaining days of the work week.

Vacation time is based on accrued personal time, and vacation leave is approved and scheduled for the entire upcoming year. Every employee also is allowed nine sick time and/or unapproved absences per year. If the number of unapproved absences exceeds nine, employees enter disciplinary action. Operators can apply for approved time off by putting in their name and the requested date(s). As long as the employee has sufficient accrued time to cover the requested leave, approved time off does not count as an unapproved absence (RTS 2018).

Shift work and varied schedules have an impact on workers' access to healthy food and sleep patterns. Employees working overnight shifts have access to vending machines onsite, but due to the hours, the availability of alternative healthy food options is limited in the community. Sleep schedules also can be impacted by working overnights. Many bus cleaners who work overnight shifts also work a second job during the daytime, which can result in added stress, limited access to healthy food and healthcare services or support, and irregular meal times.

RTS's health insurance provider issues annual data showing the prevalence of health conditions. The top three conditions for 2017–2018 were hypertension (affecting 25.1% of the insured population), cholesterol disorders (16.8%), and back and neck problems (10.2%). The union president considers sleep apnea, diabetes, hypertension, and muscular issues (primarily back and shoulder) as the primary reasons leading to potential medical disqualification among operators (Chapman, personal communication, 2018). The union also cited anxiety and stress and poor nutrition as the top health and wellness concerns.

6.3.4 Program Activities/Elements

Example of Sustainable, Successfully Implemented Strategy

- Connecting around food:
- Fresh fruit in breakrooms and common areas;
- Snack of the month;
- Short workshops on nutrition and cooking;
- Healthier vending machine choices;
- Catered employee events featuring "good-for-you" options;
- Voucher program for local farmer's market and other onsite experiences.

Healthy U has promoted healthier behavior and habits among RTS employees by providing a comprehensive set of new offerings and services and changing existing services to align with the goals of the program. Many of the adjustments have focused on food because this is an accessible way to build relationships with employees. The new programs and offerings were designed to be convenient and fun to encourage participation (e.g., short workshops in the break room, bowls of fresh fruit, team activities). The program also prompted changes to regular events and services that employees engage with (e.g., by providing healthier choices in vending machines and at employee events).

RTS has made efforts to provide services that fit into the daily schedule of its employees. Agency employees have 24/7 access to a wellness center that includes a gym. Employees also can make individual appointments with a health and wellness coordinator. The health and wellness coordinator works full time, which provides some flexibility for operators and other employees with off-hour shifts. The program also offers vouchers that employees can use to obtain produce from a local farmer's market at their convenience.

Employees' schedules, which are characterized by working shifts around the clock and on weekends, inhibit their participation in various parts of the wellness program. The wellness team and coordinator have tried to create programs that can be used at any time, with the hope of making it as easy as possible to engage all employees, regardless of what shifts or days they work. There is no feasible way to make the program accessible to everyone all the time, however.

RTS promotes the Healthy U program through newsletters, posters and flyers, email blasts, paycheck attachments, and home mailings. Employees also can find information on the agency's intranet (*Rochester Business Journal* 2016). One of the most effective ways of promotion is through the support and engagement of the agency's Wellness Committee, whose members keep their coworkers and teams up to date on activities and events—and encourage their coworkers to participate. From each regional property, the RTS regional manager selects one employee (who may have a personal interest in wellness or be interested in a development opportunity) to participate as a wellness champion. Wellness champions participate in a monthly conference call to share ideas and collaborate on wellness-related topics, outreach, and events. Wellness champions do not receive extra compensation for their participation. The president of ATU Local 282 helps communicate information about the program to the union's members.

6.3.5 Organization

The People Department (Human Resources Department) manages RTS's health and wellness program, which employs the full-time wellness coordinator. The Wellness Committee is staffed by representatives from every division and meets once a month to oversee the program. This committee is made up of 16 employees, including one ATU member, and two representatives from the agency's health insurance provider. Participation in the Wellness Committee is voluntary and members are not compensated extra. The President of ATU Local 282 also is personally involved in many health and wellness events organized by the agency.

RTS has recently enacted a "Commitment to Diversity and Inclusion," which the agency posits will impact the overall health and well-being of the organization and all employees by creating a more inclusive atmosphere that favors respect and relationships. A council of 16 employees, of whom 7 are frontline workers and ATU members, is responsible for carrying out the new effort, working in tandem with the wellness committee.

6.3.6 Resources

The Healthy U program relies on third-party providers and community partners for many of the services offered. RTS funds the program through its operating budget. In fiscal year 2017–2018, the program budget was $24,320, not including the salary for the wellness coordinator (Rochester–Genesee Regional Transportation Authority n.d.-a). The budget covers these key categories: blood pressure kiosks onsite; equipment and supplies for the wellness center (onsite fitness facility); health screenings; food for events; promotional items; wellness initiatives linked to claims management; and other wellness initiatives and employee engagement. For fiscal year 2018–2019, the budget was increased by $17,000 (a substantial 70%) to $41,320.

6.3.7 Qualitative Program Benefits

"RTS wants our employees to thrive and live the healthiest lives they can. The RTS Healthy U wellness program fosters a culture of health and well-being within our organization and community by empowering our employees to make healthy lifestyle choices. The strategic initiatives we are implementing for the wellness program will support employees by providing education, resources, support, and access to programs and services that are fun, engaging, and sustainable. Healthy U brings employees together on their wellness journey and celebrates their successes."

—Renee Ellwood, Director of Well-Being and Inclusion

From the perspective of the agency, the wellness program has been a successful endeavor. It has brought the organization together and fostered greater employee engagement. Despite the lack of financial incentives for participation, program engagement and utilization have increased. According to the director of well-being and inclusion, one of the greatest difficulties regarding the participation of operators is scheduling. The majority of RTS bus operators work in shifts with prolonged breaks in between, but the breaks seldom align with planned wellness events. Some success has resulted from efforts to encourage supervisors to communicate with operators and promote the program by word of mouth.

According to the union president, operators that have schedules consisting of three shifts participate in wellness events to a lesser extent because of the length of their workdays. Employees with irregular work schedules find it easier to participate in events that are scheduled on weekends or programs that are available to employees at their discretion (including the produce voucher program).

Increased physical activity due to the availability of the gym is the most apparent benefit of the program, though only employees that work at the Rochester campus use it regularly due to the proximity.

6.3.8 Reported Metrics

The project team examined statistics from RTS's health insurance provider (Table 33). As seen in the table, the prevalence rates of most of the major disorders that occur in the transit worker population showed slight increases among RTS's insured population. Because the aggregate figures provided included administrative workers and covered dependents as well as frontline workers, it was not possible to isolate the effects of participation in the wellness program. Participation in the wellness program may have mitigated increases in prevalence

Table 33. Comparison of rates of major health disorders, RTS insured population to general population, 2012–2017.

Disorder	4 Years Prior	Current	Change	General Population (Excellus)
Cholesterol disorder	30.2%	29.0%	–1.2%	18.9%
Hypertension	38.8%	41.9%	3.1%	23.2%
Diabetes	15.4%	16.7%	1.3%	8.1%
Back and neck problems	8.5%	12.9%	4.4%	14.9%
Depression and anxiety	5.3%	5.9%	0.6%	9.6%

Source: Table as provided by RTS via personal communication (Excellus 2018).

among the frontline workers that were part of a more general health trend; however, lacking the necessary granularity in the data, that hypothesis could not be assessed. RTS continues to conduct ongoing review and analysis of the health claims data and monitor wellness initiatives against claims data (Rochester–Genesee Regional Transportation Authority n.d.-b).

In addition to health claims data, new conditions are identified through free, onsite health screenings. RTS seeks to educate and bring awareness to employees about potential health risks and to prevent or manage them. The focus on prevention has resulted in the identification of more employees with health risks, but this identification has also made it possible for employees to help manage those risks, using the Healthy U wellness program to make healthy lifestyle choices. The program also has focused on the importance of managing health conditions and prescriptions, as well as actively using the comprehensive health and wellness benefits provided to employees (e.g., insurance coverage for medical, dental, and vision services, and other employee benefits related to financial wellness and retirement planning).

6.3.9 Method

The project team provided RTS with a data use agreement, and data received from RTS associated individuals with their employee ID numbers, thereby protecting their identities. Following conversations with relevant staff members, the project team emailed a list of the absenteeism, workers' compensation, and demographic data requested. In August 2018, RTS began providing the project team with individual-level payroll data on absences and workers' compensation.

RTS provided absenteeism and workers' compensation data from 2011 to 2018 for both onsite and offsite employees. Files of employees' demographic information were provided, as well as hire and termination dates. This information was merged with the absentee data based on the employee ID. Because RTS had indicated that it introduced the health program as a comprehensive program in 2014, 2013 was used as the baseline year for the analysis.

Payroll information was made available for more than 1,000 employees who had worked for RTS over the 2010–2017 period. Approximately 650 employees were onsite and had the easiest access to the health program. The entity code "RTS" was used to identify employees who were onsite and had access to the health program, whereas the rest of the employees were combined into a control group of "offsite" employees who were assumed to have limited-to-no-participation in the program.

The data provided 282 categories of job descriptions, with several categories referring to different types of operators, maintenance, and administrative roles. Employees were categorized using the "Assignment Title" provided with their demographic information. For example, employees with the title *bus operator* were defined as operators, whereas an employee with the title *workforce development manager* was defined as administrative. Employees often had multiple assignment titles without a date-of-job change. To determine the job description, the project team selected the last available job title that was not *retiree. Trainee* was selected as the job title only if it was the only title available. Administrative roles were removed from the analysis, which focused on the outcomes for frontline employees (consisting of operators and maintenance staff).

Multiple variables of interest were compared, including use of sick days, unpaid leave, and personal days. At RTS, employees acquire sick leave and personal leave at varying rates based on seniority; up to 120 days of sick leave can be accumulated (Hall, personal communication, 2018). For each variable, the difference in use before and after the introduction of the health program was examined. Multiple regression and other statistical analyses were run to find a relationship between participation in the health program and lower absenteeism.

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In the model, the dependent variable was a total of sick days, unpaid leave, and personal days. The key independent variable was participation in the health program. The other independent variables controlled for age, race, tenure, gender, and occupation. The regression model also was run using the difference of the dependent variable before and after the introduction of the health program as the dependent variable. No statistically significant results were found. Details of the analysis are provided in Appendix A.

6.3.10 Workforce Characteristics

In 2011, a limited version of the program was introduced, but the comprehensive version of the program was not rolled out until 2014, so the project team chose 2013 to be the baseline year for this analysis. Of the 574 frontline workers (operators and maintenance) who were employed in 2013, 389 workers (approximately 68%) were based at the main location where the gym and wellness programs were held, whereas 185 workers (32%) were based at remote locations. The project team designated the 389 workers at the main location as the *participants* because they had greater exposure to the program's core elements. The 185 offsite employees were considered the control group of *non-participants.*

Table 34 presents the averages for the total population of frontline employees, broken down separately for operators and maintenance employees.

The first demographic detail that stands out is the same as for IndyGo: The White population is substantially older than the African-American population. The average age for the 300 White workers that were operators or in maintenance was 60.2 years, compared with the average age of 53.0 years for African-American workers. Men were slightly older than women, with an average age of 57.1 years compared with 54.3 years. As in Indianapolis, the population of maintenance workers was almost all male (106 out of 108 workers).

The analysis method was to examine how outcomes related to absenteeism were related to program participation. Thus, the analysis divided the population of frontline employees into two groups: *onsite* and *offsite*. These groups represented the workers who participated in the program and those who did not. The characteristics of the two groups are displayed in Table 35.

The average age of offsite operators (61.0 years) exceeded that of onsite operators (54.3 years). The average age of offsite maintenance workers (55.0 years) was only slightly lower than that of onsite maintenance workers (55.8 years); however, the vast majority of maintenance workers were onsite, with 101 of the 108 workers on location at the main campus. Calculating the total

Table 34. Demographics of RTS frontline population, 2013.

Demographic Characteristic	Operator			Maintenance			All		
	Count	Percent	Age*	Count	Percent	Age*	Count	Percent	Age*
White	237	50.9%	61.0	63	58.3%	57.3	300	52.3%	60.2
African American	183	39.3%	53.1	36	33.3%	52.4	219	38.2%	53.0
Hispanic and Latino	2	0.4%	60.5	0	0.0%	0.0	2	0.3%	60.5
Two or more races	2	0.4%	66.0	0	0.0%	0.0	2	0.3%	66.0
Native American	1	0.2%	41.0	2	1.9%	52.0	3	0.5%	48.3
Asian	41	8.8%	48.6	7	6.5%	58.3	48	8.4%	50.0
Female	117	25.1%	54.3	2	1.9%	53.0	119	20.7%	54.3
Male	349	74.9%	57.6	106	98.1%	55.7	455	79.3%	57.1
All	**466**	**100.0%**	**56.8**	**108**	**100.0%**	**55.6**	**574**	**100.0%**	**56.5**

*All ages are averages.

Table 35. Program status and age of RTS frontline population, 2013.

Factor	Operator		Maintenance	
	Offsite	Onsite	Offsite	Onsite
Number	178	288	7	101
Percentage	38.2%	61.8%	6.5%	93.5%
Average age	61.0 years	54.3 years	55.0 years	55.8 years

populations of offsite workers (non-participants) and onsite workers (participants), the offsite workers were older (60.8 years) than the onsite workers (54.7 years). (The calculated numbers do not appear in the table.)

6.3.11 The Program Over Time

As with IndyGo, data generated from RTS's health promotion program has provided new information to assess the patterns of absenteeism of transit workers. Absenteeism days are defined as total hours of sick leave, unpaid sick leave, and paid and unpaid personal leave. Between 2011 and 2017, the total hours taken increased from approximately 40 to 60 hours per year. Figure 9 presents the average annual absentee hours for frontline employees for a 7-year period (2011–2017). The baseline in this analysis is 2013 and the comprehensive program began in 2014, but this case study includes some available data from 2011 when the health promotion program was introduced in a limited form. Figure 9 includes absenteeism data from the early years of the program, before it was fully established (2011–2013), and from the subsequent years (2014–2017) that reflect absenteeism after the program was fully developed.

The data in Figure 9 show that Whites had higher rates of absenteeism than did African Americans and that the rate of absenteeism among women was similar to that of men (not greater, as was the case at IndyGo). The data in Figure 9 have not been controlled for age.

Figure 10 shows trends related to absenteeism by job category for operations, maintenance and all workers. As seen in the figure, during the period examined (2011–2017), maintenance workers had a higher average number of hours absent than did operators.

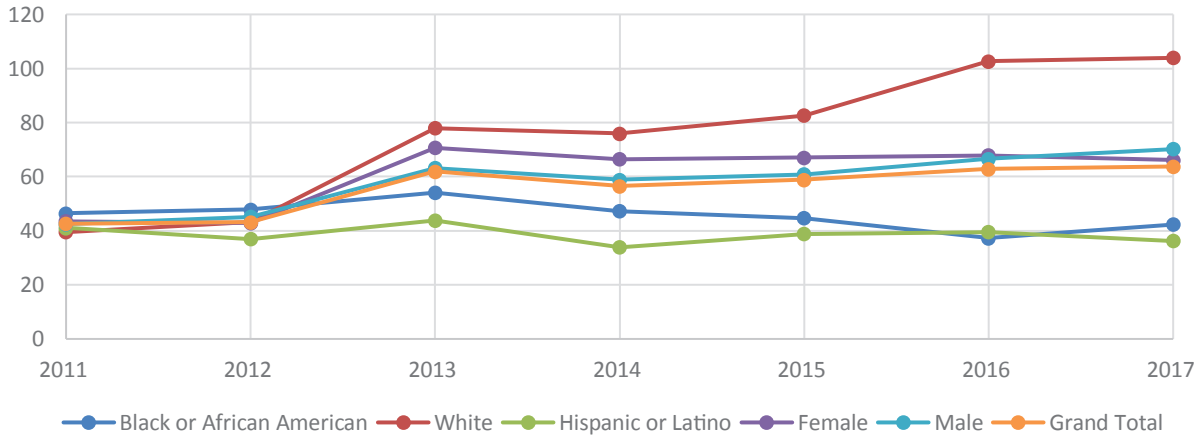

Figure 9. Average annual total absentee hours, RTS frontline employees by demographic characteristics, 2011–2017.

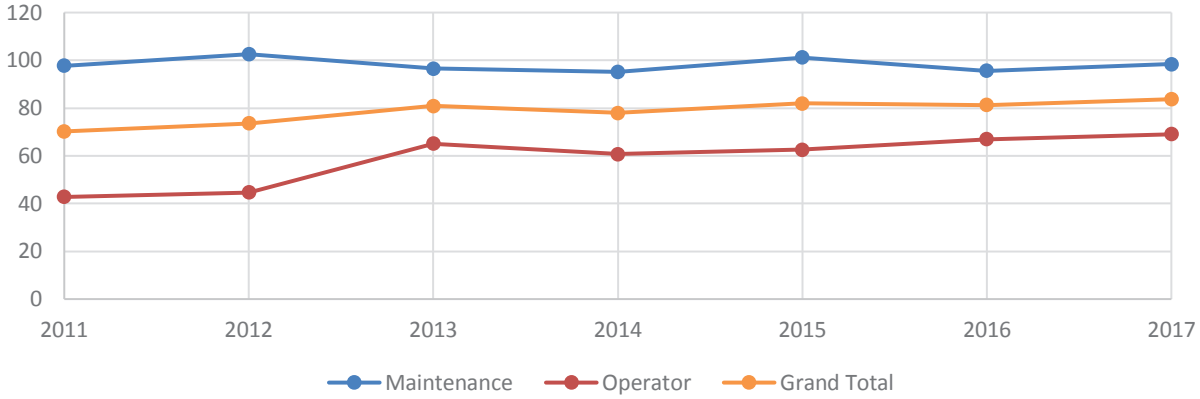

Figure 10. Average annual total absentee hours, RTS frontline employees by job classification, 2011–2017.

Figure 11 presents the average annual total of absentee hours for RTS frontline employees for 2011–2017. On average during this 7-year period, onsite employees used fewer sick days then did offsite employees.

6.3.12 Workers' Compensation

Whereas Figures 9, 10, and 11 show trends related to absenteeism, Table 36 uses data provided by RTS to illustrate trends related to workers' compensation over the same period (2011–2017), although data for 2013 and 2014 were not available. Table 36 presents workers' compensation indemnity claims for the period and the average cost per unique claim.

Table 37 includes the estimated number of days of workers' compensation paid for all claims and the average number of days per claim. The claim percentage rate in 2011 (before program implementation) was 8%, and the percentage rate also was 8% in 2016–2017, well into the program. The percentage rose to 11% in 2012 but was reduced to 5% in 2015 (the next available year). The linear downward trend may indicate some effect due to the wellness programs, particularly if other (undocumented) factors were working at the same time to increase the percentage. It was not possible to statistically test these possibilities.

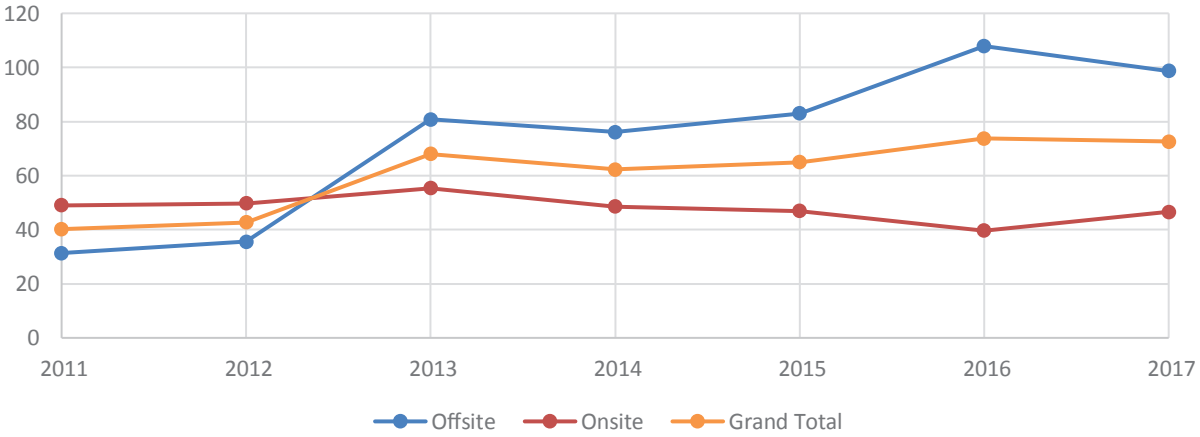

Figure 11. Average annual total absentee hours, RTS frontline employees by work location (onsite/offsite), 2011–2017.

Table 36. Workers' compensation indemnity claims at RTS, 2011–2017.

Year	Sum of Claims	Unique Claims	Average Cost per Claim
2011	$77,532	36	$2,154
2012	$225,487	47	$4,798
2013	Unavailable	Unavailable	Unavailable
2014	Unavailable	Unavailable	Unavailable
2015	$116,875	29	$4,030
2016	$512,173	46	$11,134
2017	$638,591	50	$12,772

Total workers' compensation days were calculated based on the 2017 average wage for 731 RTS operators and maintenance workers of $24.32 and the workers' compensation payment of 66.67% of that wage to fully disabled workers in the state of New York.

6.3.13 Results

Several variations of the linear regression were performed, the results of which are presented in Appendix A. The project team varied the dependent variable (e.g., sick day, total leave days), changed the mix of the independent variables, and tried several interaction terms of program participation (e.g., *onsite* as interacted with various demographic variables). In no case was the coefficient on the effect of program participation statistically significantly different from zero. Similarly, in no case did participation have a statistically significant effect on health, measured as the change in days absent. Appendix C discusses potential reasons for the lack of significance for the participation variables and Table C-3 presents representative regression results of the variations run, accompanied by analysis.

6.4 TARC

This case study was developed with the input of the president of ATU Local 1447 and the benefits manager at TARC.

6.4.1 Background

TARC provides public transportation to greater Louisville, Kentucky, and the surrounding counties of Clark and Floyd in Indiana. The agency was founded in 1971 after legislation allowed the use of local funding from city and county governments to operate mass-transit systems (TARC n.d.).

Table 37. Workers' compensation indemnity claims and calculated absentee days at RTS, 2011–2017.

Year	Unique Claims	Frontline Workers	Percentage With Claims	Total Indemnity Claims	Total Workers' Compensation Days	Average Days per Claim
2011	36	447	8%	$77,532	604	16.8
2012	47	447	11%	$225,487	1756	37.4
2013	N/A	468	N/A	N/A	N/A	N/A
2014	N/A	531	N/A	N/A	N/A	N/A
2015	29	549	5%	$116,875	910	31.4
2016	46	582	8%	$512,173	3,988	86.7
2017	50	592	8%	$638,591	4,972	99.5

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6.4.2 Program Startup and Development

The employee wellness program began in 2015 with the goal of changing workplace culture as prompted by an observed need for smoking cessation programs. The agency was further motivated to start a program that would reduce health insurance claims, which were relatively high. In 2015, TARC began offering smoking cessation classes, bringing together a motivated group of individuals that evolved into a more organized health and wellness committee.

6.4.3 Work Organization/Work Environment

Many operators at the agency work split shifts, which can take up a majority of the employee's time, although breaks can be scheduled that allow for meals or time at the gym. Operators feel that they have time for little else besides resting for the next day. Operators can request specific shifts at three points during the year, when shifts are scheduled. Eligible operators also have the option of working four 10-hour runs and taking weekends off plus one additional day off during the week. Parameters for split runs are governed by the bargaining agreement with the union, and during the period examined by the project team TARC was well under the threshold designated for split runs. From the perspective of the union president, the agency has prioritized restroom access for operators; this issue has improved over time. According to management, the agency has worked to establish ample restroom stops on every route.

6.4.4 Health, Wellness, and Safety Concerns

According to the prevalence rates reported by TARC's health insurance company, the five most prevalent health concerns by number of members (employees and family members) for 2015–2018 were hypertension, hyperlipidemia, back pain, osteoarthritis, and diabetes. In interviews with TARC management, obesity-related diseases were a common concern. TARC reported approximately 15–20 short-term medical disqualifications per year. The disqualifications increased over the period examined, mostly due to non-compliance with sleep apnea requirements.

According to the union president, the top health and safety concerns are passenger assaults on operators, operator injury resulting from equipment in the bus or accidents involving the bus, and breathing in harmful fumes. According to the union president, these health concerns are not addressed in the wellness program because they are categorized primarily as "safety" concerns and are dealt with separately under the joint safety committee. (Hamilton, personal communication, 2019).

6.4.5 Program Activities/Elements

Highest-scoring items from employee interview survey:

- Walking to increase physical activity,
- Having healthy snacks available for purchase at work,
- Increasing my physical activity level,
- Participating in "tasting" events, and
- Learning about healthier food choices and portions to help manage my weight.

TARC's wellness program activities have been based on survey responses from employees indicating the activities they would be interested in. Though the initial program was developed around smoking cessation, this is no longer a primary focus of the program, and was not an item that received interest in the most recent employee survey. Currently, the program consists of events and programs organized around a theme of interest, an annual corporate games weekend, and a boot camp program. Tracking data on participation has been an area of difficulty for the agency, but TARC has seen some success in encouraging participation by offering incentives and prizes to participants. According to the agency, these items are low cost ways to promote participation and camaraderie. TARC has also invested in creating onsite fitness centers at each of the agency's main facilities, which the agency's health insurance company has rewarded by issuing a premium refund to the agency and employees.

Specific program activities include weekly yoga classes, 5K runs and participant preparation assistance, periodic weight loss/weight maintenance challenges, walking events, and bioscreenings. A point system for participation allows employees to earn small prizes, such as exercise accessories, gear, or gift cards.

6.4.6 Organization

The employee wellness program is led by a six-person health and wellness committee made up of representatives from TARC's Human Resources Department and members of ATU Local 1447, including its president, an operator, and a mechanic. The committee meets every other month to determine upcoming program elements and themes.

According to the union president, the relationship between labor and management regarding the program is cooperative. The union encourages participation in wellness program events and activities.

6.4.7 Resources

The employee wellness program is funded through TARC's Human Resources Department. In fiscal year 2018, $10,000 was budgeted for the agency's fitness centers and wellness program. The wellness program also has relied on the portion of the health insurance premium refund retained by the agency after premium refunds were distributed to the participating employees.

6.4.8 Qualitative Program Benefits

The union president said that the program has been effective in promoting physical activity, although it is not clear whether the employees who have participated are those who would already be active independent of the program. Events are primarily attended by the same group of people, and the program has not broadly affected the employee population. Management at TARC noted that the activities promote team building and encourage a more cooperative work environment. Aside from health outcomes, the program sends a message to the employees that health and wellness are priorities for the agency.

6.4.9 Participation Metrics

Participation in several of the activities increased from 2017, the program's first year, to 2018. For example, participants in the corporate games event rose from 25 in 2017 to 43 in 2018, a significant increase.

Data from TARC's health insurance provider also showed a growing level of involvement since the beginning of the transit agency's wellness program. Participants are given points for reaching certain levels under the "Humana Go" program (blue, bronze, silver, gold, and platinum). Total participation increased from 84% of all health insurance subscribers (not including dependents and spouses) in 2016 to 94% in 2018.

6.4.10 Workforce Characteristics

A total of 338 frontline operators and maintenance workers were employed in 2015 (at the time the program was introduced). Following the program's rollout in 2016, of these 338 workers 13 employees had attended boot camps, 49 employees had a "high" Humana Go level (i.e., bronze, silver, gold, or platinum level), and 54 employees had attended a bioscreening.

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Table 38. Demographics of TARC frontline population, 2015.

Demographic Characteristic	Operator			Maintenance			All Employees		
	Count	Percent	Age*	Count	Percent	Age*	Count	Percent	Age*
African American	228	80.6%	51.2	2	3.6%	44.0	230	68.0%	51.1
White	55	19.4%	55.6	53	96.4%	52.6	108	32.0%	54.1
Female	135	47.7%	49.8	1	1.8%	54.0	136	40.2%	49.8
Male	148	52.3%	54.1	54	98.2%	52.2	202	59.8%	53.7
Total	283	100.0%	56.8	55	100.0%	55.6	338	100.0%	56.5

*All ages are averages.

The project team selected these participation variables for analysis because they had the highest participation numbers of the numerous activities included in TARC's health program.

Table 38 presents demographic characteristics for both the total population of TARC's frontline employees and for the agency's operators and maintenance employees in 2015.

As seen in Table 38, the White population was slightly older than the African-American population. The average age for the 108 White workers was 54.1 years, compared with 51.1 years for the 230 African-American workers. Men were slightly older than women, with an average age of 53.7 years for men compared with 49.8 years for women. The table replicates the pattern observed at IndyGo and RTS, where the majority of the maintenance workers were male.

The project team used the data from TARC to further examine how outcomes related to absenteeism were related to participation in the program. To be counted, the workforce under observation in the two analyses performed had to have been employed with TARC since 2015, and their employment had to include at least 1 full calendar year during the period 2016–2017.

In this case, multiple measures of participation (key independent variables) were used, and analysis was conducted to see if each one individually was associated with a change in absenteeism. Each category of participation was represented by groups with characteristics, as displayed in Table 39.

As shown in Table 39, 13 employees participated in boot camps; these participants had a younger average age (45.3 years) compared to the non-participants (52.3 years). Forty-six employees had an elevated (silver-level or gold-level) Humana Go participation status, and

Table 39. Program participation and age of TARC frontline population, 2016–2017.

Program Participation	Operator			Maintenance			All		
	Count	Percent	Age*	Count	Percent	Age*	Count	Percent	Age*
Key independent variable: participation in boot camps									
Participated in boot camps	4	1.4%	45.3	9	16.4%	52.4	13	3.8%	50.2
Key independent variable: elevated (gold, silver, or platinum) Humana Go status									
Base Humana Go status	245	86.6%	52.8	47	85.5%	52.8	292	86.4%	52.8
Elevated Humana Go status	38	13.4%	48.4	8	14.5%	51.8	46	13.6%	48.4
Key independent variable: attended bioscreen									
Did not attend bioscreen	241	85.2%	52.4	45	81.8%	52.7	286	84.6%	52.5
Attended bioscreen	42	14.8%	50.9	10	18.2%	52.3	52	15.4%	50.9
Total	**283**	**100.00%**	**52.2**	**55**	**100.00%**	**52.6**	**338**	**100.00%**	**52.5**

*All ages are averages.

these participants were younger on average (48.4 years) compared to employees who had a base (blue) level of participation (52.8 years). Fifty-two employees participated in bioscreens, and again had a younger average age (50.9 years) than employees who did not participate (52.5 years). In general, the employees who participated in the wellness program activities tended to be younger than those who did not participate.

The Humana Go program was sponsored by the insurer. Employees received points for their participation in wellness program activities, including bioscreens. The points were added up to reach defined levels under the Humana Go program, progressing from blue (the base level) through bronze, silver, and gold, to platinum (the highest level). As an incentive to participation, employees also could earn prizes based on the points they accumulated (participation level).

6.4.11 The Program Over Time

Figure 12 presents the average annual number of absentee hours for frontline employees over the 4 years from 2015 through 2018. This analysis used 2015 as the baseline year because the comprehensive wellness program began in 2016. Only one pre-program data point was available, so the data shown in Figure 12 should be interpreted cautiously. Absenteeism days were defined as total hours of sick leave, personal leave, and unpaid leave. As the figure shows, the total average annual absentee hours increased from about 45 hours in 2015 to about 60 hours in 2018. It further shows that women had higher rates of absenteeism, which also was seen in other case studies.

Figure 13 presents the average number of annual absentee hours for TARC operators and maintenance workers over the same period, compared to the averages for all frontline employees (Grand Total). As seen in Figure 13, operators consistently had a higher average of total annual absentee hours than did maintenance workers. Again, for all frontline workers, the average annual total absentee hours ranged from about 45 hours in 2015 to about 60 hours in 2018.

6.4.12 Workers' Compensation

Table 40 shows the number of indemnity claims by year from 2015–2017, with partial-year information from 2018 (the 4 years provided by the agency). It was not possible to associate claims with the individual/participant in the health claims, so a regression analysis examining the relationship between changes in claims and participation was not conducted.

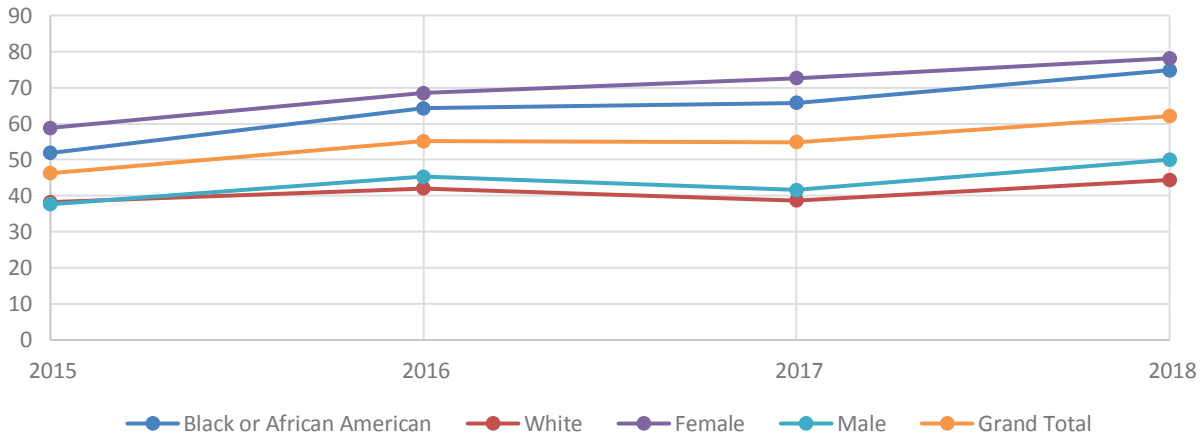

Figure 12. Average annual total absentee hours, TARC frontline employees, 2015–2018.

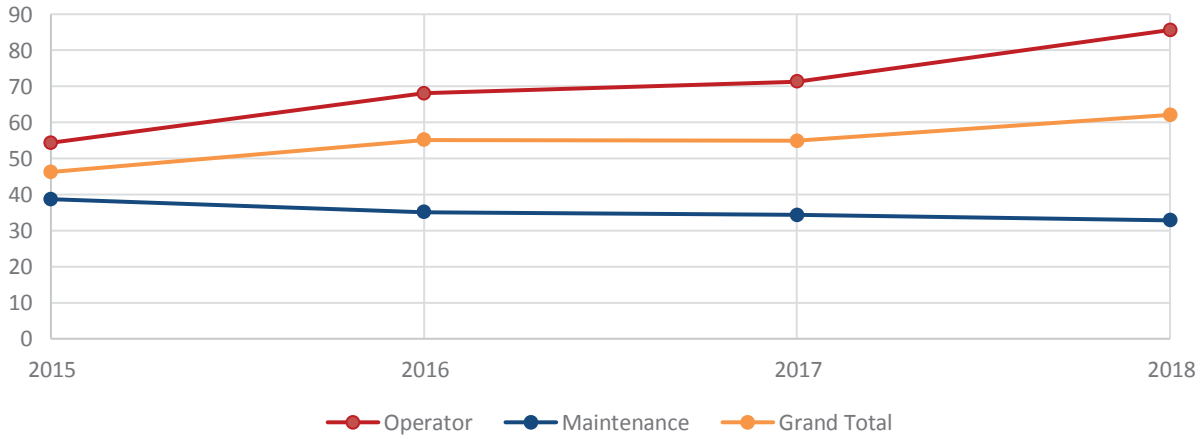

Figure 13. Comparing average annual total absentee hours for TARC operators, maintenance workers, and all TARC frontline workers, 2015–2018.

Table 40 demonstrates a trend commonly seen across the case studies, which was that indemnity claims were variable and subject to fluctuation due to factors such as a few high claims. In the case of TARC indemnity claims, the table also shows that the number of unique claims is not much higher than the number of employees with claims, indicating that the instance of repeat claimants was not large.

6.4.13 Results

Many variations of the linear regression were performed. The project team varied the dependent variable, changed the mix of the independent variables, and tried several interaction terms of program participation (e.g., boot camp participation or Humana Go level interacted with various demographic variables). In no case was the coefficient on the effect of program participation significantly different from zero, and in no case did participation have a statistically significant effect on health (here measured as the change in days absent). Appendix C presents the results of the linear regression analysis, and within the appendix Tables C-4 (Humana Go), C-5 (boot camp), and C-6 (bioscreens) present representative regression results of the various models.

6.5 DART

This case study was developed with the input of the human resources manager and chief human resources officer for DART, and the president and business agent of ATU Local 441.

Table 40. Workers' compensation indemnity claims by year, TARC, 2015–2017 and part of 2018.

Year	Sum of Claims	Unique Claims	Average Cost per Claim	Employees With Claims
2015	$498,767	63	$7,917	58
2016	$458,357	63	$7,276	60
2017	$1,033,219	76	$13,595	69
2018, January–May	$260,673	36	$7,241	35
Total	**$2,251,016**	**238**	**$9,458**	**222**

6.5.1 Background

DART is the first regional transit authority in Iowa created under state legislation and was approved in 2005. The agency operates the largest transit system in Iowa, providing more than 15,000 trips per day with a fleet of approximately 145 buses. DART is expanding throughout its service area, introducing more express, shuttle, and weekend service hours. DART also has one of the largest vanpool programs in the Midwest, with more than 100 vans (Iowa DOT n.d.). More than 280 individuals are employed at DART, including its fixed-route and paratransit operators, maintenance and facilities staff, and administration (DART n.d.-b).

Taking advantage of a change in leadership within both the labor union and the transit agency management, DART has worked to encourage employees to enroll in the existing health savings account plan and make lifestyle changes. In 2017, DART implemented a comprehensive wellness program for all employees.

DART Program Elements

- Monthly topics incorporated into the wellness program: back care, cold/flu prevention, diabetes, financial wellness, healthy cooking/eating, heart health, physical activity, sleep management, stress management, and weight management;
- All topics chosen based on survey responses indicating employee interests;
- Two to three workshops per month (at DART);
- One to three wellness challenges per month that focus on making lifestyle changes (outside of DART);
- UnityPoint available at main campus or Central Station location once per month for coaching in operator lounge; and
- Gifts/prizes based on participation.

6.5.2 Program Startup and Development

DART's annual wellness program began in October 2017. Before developing this program, the agency's only targeted wellness-related activities were biometric screenings and health risk assessments (HRAs) (McMahon, personal communication, 2018). These programs started 2 years before the current wellness program. DART has promoted a rigorous safety program since 2007 and was recognized by APTA in 2011 for its achievements in building a strong safety culture (DART 2011). The development of the wellness program indicates a shift toward a more holistic approach to the health and safety of its employees. The wellness program was begun for several reasons, including a high number of workers' compensation claims, low morale, and low employee engagement, and to boost awareness of and participation in the existing wellness screening program and HRAs (McMahon, personal communication, 2018).

To structure the program to best suit the needs of the employees, a wellness interest survey was given to employees before the program inception. Ninety percent of employees participated in the survey; the program was designed and budgeted based on their responses (McMahon, personal communication). A total of 201 survey responses (182 complete, 19 partial) were received in which employees identified desired topics, the length of activities, and most convenient times of the day for activities to take place (McMahon, personal communication).

DART Survey Response: How Long Should Wellness Activities Last?

Most employees believe activities should last between 30–60 minutes, depending on the activity. Averaged across all activities, 41.1% of respondents indicated that activities should last 30 minutes; 20.0% of respondents indicated they should last 45 minutes, and 22.9% of respondents indicated they should last 60 minutes.

6.5.3 Work Organization/Work Environment

The union has worked with management to improve shifts for operators and therefore reduce the impacts of difficult working hours. The majority (53%) of operators work split shifts, arriving at 5:00 a.m. and working until 8:00 a.m. or 9:00 a.m., after which they break until 2:00, then work again until 6:00 p.m. Efforts have been made to reduce the length of the break between shifts. The union has been bargaining for better scheduling and has worked with management on this issue because it helps with worker retention. Maintenance workers have more standard shifts, working 8-hour or 10-hour shifts with a break scheduled midway during the shift.

Restroom access for operators has been a longstanding issue. Management adjusted operator routes due to complaints of urinary tract infections caused by not being able to use the restroom when needed. Recovery time is now spent at the station, so operators have access to the restroom there.

Another issue for operators is proper positioning and type of seat. In 2016, DART bought new seats for their buses and allowed operators to choose the model. The agency also redesigned

DART Survey Response: Topics of Interest

- Back care,
- Cold/flu prevention,
- Diabetes,
- Financial wellness,
- Healthy cooking/eating,
- Heart health,
- Physical activity,
- Sleep management,
- Stress management,
- Weight management,
- Men's and women's health, and
- Understanding medical insurance and other benefits offered at DART.

the wheelchair securement stations so that they require less bending and stooping and allow more room to maneuver (reducing lower back pain). When operators have specific complaints about the seat, they are addressed. Often this is done by readjusting the seat or teaching the operator how to do so. The agency also implemented job offer testing to make sure that operators are physically able to do all functional aspects of the position. Approximately 65%–70% of all frontline employees participate in the agency's health insurance plan. DART requires an annual bioscreening for every employee enrolled in the health insurance plan.

6.5.4 Health, Wellness, and Safety Concerns

The union stated that the most prevalent health concerns among its members were chronic pain from the demands of the job (e.g., back pain, injuries resulting from repetitive motion); high blood pressure; and metabolic disease (e.g., diabetes). The agency had a slightly different perception of the top health and safety issues, stating that the top three were weight management, cardiovascular health, and effects of the job (e.g., ergonomics/fatigue/stress management). The agency stated that their rates of medical disqualification among operators were low, but among those that had been disqualified, the primary reasons were diabetes and soft-tissue injuries, usually occurring in the shoulder due to repetitive movement.

6.5.5 Program Activities/Elements

According to DART, the program does not focus on any one aspect of health and wellness but rather on caring for the whole person. To that end, the program is multifaceted, incorporating many different topics and methods of approach. DART has engaged insurance providers, financial planners, and registered nurses to deliver workshops and provide coaching and advice to participants (McMahon, personal communication, 2018). A monthly theme is chosen that corresponds with the interests recorded by employees in the initial survey. To complement the theme, two to three monthly workshops are given at DART, as well as one to three wellness challenges that encourage participants to make lifestyle changes. Participation is incentivized with gifts and prizes ranging from sports equipment to gift certificates. Rewards are given for attending workshops and completing the monthly wellness challenges. Participants receive a reward based on the tier they have reached at the end of the program: Tier 1 is reached by attending three workshops and completing three challenges; Tier 2 is reached by attending six workshops and completing six challenges; and Tier 3 is reached by those who attend all workshops and complete all challenges (McMahon, personal communication, 2018).

Outside of the events organized as part of the program, the agency has implemented several policies to improve the work environment. DART has created a new vending program so that fruit, vegetables, eggs, and protein bars are available instead of the more common snacks found in vending machines. The agency also hired specialists to analyze the buses and create cards illustrating the stretches appropriate for operators and their environment.

Frontline employees are not paid for the time they spend at wellness events. This has caused some reluctance among operators and maintainers to attend events. Administrative employees attend the events during their workday, and are therefore being paid for their time.

DART Wellness Committee

- Seven members,
- Committee members from all departments, and
- Monthly meeting to prepare for next month and make changes/ adjustments.

6.5.6 Organization

The wellness program relies on the planning and support of a seven-member wellness committee. Positions are open to all departments within DART. The committee meets every month to prepare for the following month and make changes and adjustments to the program as needed. Currently, the committee is staffed by the human resources manager, an operations

instructor, two fixed-route operators, a maintenance employee, an operations supervisor, and a transit planner (McMahon, personal communication, 2018). The wellness committee and the program have the support and participation of the local union thanks in part to the membership of its president, a fixed-route operator, on the wellness committee (McMahon, personal communication, 2018).

6.5.7 Resources

DART's wellness program has a relatively low budget (approximately $5,000 annually) and has relied on existing staff to manage the program rather than hiring dedicated staff. For 2017, approximately half of the budget was used for workshops and the other half for the purchasing of incentives. No additional major capital expenditures have been made. Instead, DART has used existing resources to provide programming. Several workshops have been provided at no cost to DART through leveraging connections with wellness organizations and professionals.

6.5.8 Qualitative Program Benefits

Behavioral and cultural shifts have occurred both within the management of DART and within the employee community. A new leadership approach, brought about by a transition in management positions, has been instrumental in changing the environment and focus of the agency. DART appointed a new chief operating officer in October 2015 and a new chief human resources officer in December 2016 (DART n.d.-a).

Within the employee community, the inclusion of influential individuals on the wellness committee has been an important component to foster a sense of ownership of the program. There is a focus on the personal participation and commitment to life changes of the committee members. The administration has taken the feedback received at the monthly wellness committee meetings and used it to structure the program and increased the budget for next year of the program based on the input of the wellness committee (McMahon, personal communication, 2018).

Participation in the HRA was approximately 20% before the start of the wellness program because of workforce resistance to the biometrics screening, which was a requirement for being enrolled in the agency health insurance plan. Following the start of the program in October 2017, 100% of the agency's employees participated in the subsequent HRA, which occurred the next month. DART recognized that a lack of clarity about whether the HRA was a required part of the bioscreening contributed to the initially low participation rate. Among the employees, some fear also had existed about what the results of the HRA would be used for. The start of the wellness program prompted more discussion with union leadership and with the employees in general, which led to a shift in perception and an increase in engagement, which was the most important and effective change (McMahon, personal communication, 2018).

Despite these successes, management acknowledges that other elements of the wellness program have not reached all employees. Although events were held at different times of day and days of the week in an attempt to boost participation, scheduling remained an issue. The employees who did attend came to many of the events. The small percentage of employees who were very active in the program got the most benefit.

From the perspective of the union, the program was beneficial in raising awareness of health issues and there was a general sentiment that it was a good idea. Most employees lacked a willingness to participate long-term in the program, however. Frontline employees were asked to attend program events in their free time while administrative employees were often on the clock during events; this created some resentment among frontline employees and exacerbated

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problems of participation. Participation increased when incentives were offered, but the effect of the incentives dwindled over time.

Issues related to participation were difficult to address given the varying shifts of frontline workers, particularly operators. The types of shifts that employees worked had an impact on how they engaged with the wellness program. Operators were more likely to participate in the scheduled events (presumably because these events fit into their breaks between shifts), whereas maintainers/mechanics used the onsite gym at a higher rate.

After running for 9 months, the wellness program discontinued. Due to several agency staff members leaving who had been instrumental in the vision for the program, the committee was dissolved and no more regular events were scheduled.

6.5.9 Reported Metrics

Participation data were collected and recorded for each event (McMahon, personal communication, 2018). The goal for participation in the first year of the wellness program was 30% of employees. Actual participation, measured as having attended at least one activity/workshop, was around 42% of employees. Participation in the HRA and biometrics screenings increased from 20% before the start of the program to 100% in the month following the start of the program (McMahon, personal communication, 2018).

Although the program was too brief to be able to measure changes in other metrics, such as workers' compensation claims and absenteeism, program staff has continued to collect data to help assess the effectiveness of the program.

6.5.10 Workforce Characteristics

A total of 245 frontline workers (operators and maintenance) were employed with DART at the beginning of 2016, a year before the program started in 2017. Table 41 presents demographic information for the total population of frontline employees and separate breakdowns for the operators and maintenance employees. Unlike the other case studies, information on age at the individual level was not provided by DART.

Compared to some populations in the other case studies, a larger share of this workforce (84.9%) was male. As in the other agencies, the majority of maintenance workers were male.

The analysis method was to examine if and how outcomes related to absenteeism were related to participation in the program. Thus, the analysis divided the population of frontline employees into two groups: those who were recorded as having participated in at least one activity

Table 41. Demographics of DART frontline population, 2016.

Demographic Characteristic*	Operator		Maintenance		All	
	Count	Percent	Count	Percent	Count	Percent
Asian	9	4.4%	3	7.1%	12	4.9%
African American	64	31.5%	13	31.0%	77	31.4%
Hispanic or Latino	14	6.9%	8	19.1%	22	9.0%
Two or more races	1	0.5%	1	2.4%	2	0.8%
White	115	56.7%	17	40.5%	132	53.9%
Female	36	17.7%	1	2.4%	37	15.1%
Male	167	82.3%	41	97.6%	208	84.9%
All	203	100.0%	42	100.0%	245	100.0%

* Age-related information at the individual level was unavailable for this case study.

Table 42. Program participation of DART frontline population, 2016.

Program Participation	Operator		Maintenance		All	
	Count	Percent	Count	Percent	Count	Percent
Did not participate	191	94.1%	38	90.5%	229	93.5%
Participated in at least one activity	12	5.9%	4	9.5%	16	6.5%
All	**203**	**100.0%**	**42**	**100.0%**	**245**	**100.0%**

and those who were recorded as having participated in no activities. The characteristics of these two groups are displayed in Table 42.

The activities included a series of workshops and wellness challenges. As Table 42 demonstrates, 16 employees (out of a total of 245) were recorded by human resources as having participated in at least one activity.

Many of the individuals who participated in at least one activity participated in multiple activities. This analysis did not account for marginal gains associated with participation in multiple activities.

6.5.11 The Program Over Time

Figure 14 presents the average number of annual absentee hours for DART frontline employees for a 3-year period (2016–2018). Absenteeism hours were defined based on total hours of sick leave, personal leave, and unpaid leave. Figures 14, 15, 16, and 17 show absentee days over time by demographic characteristics and by job classification. A full year of information was not available for 2018, so for 2018 the full year was estimated by comparing the available months with the previous year and assuming that the difference in hours remained the same between the first and last six months of 2017 and 2018.

Figure 15 presents the median annual absentee hours for race and sex.

Figure 16 presents the average annual absentee hours for DART frontline employees divided by job type over the same 3-year period (2016–2018).

Figure 17 presents the absentee hours over time for all employees and those that participated or did not participate in any activities. On average, employees who participated in any activities

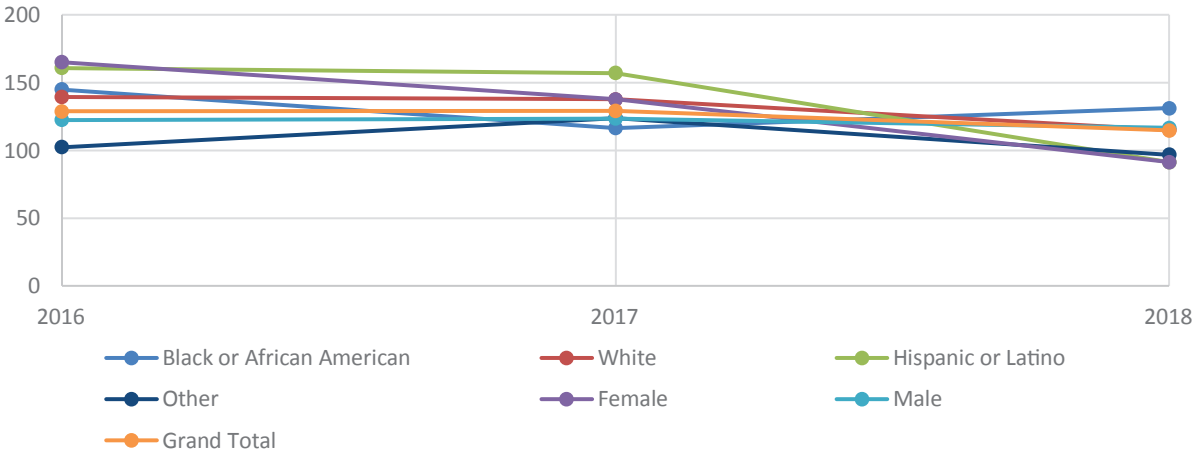

Figure 14. Average annual total absentee hours of DART frontline employees by demographic characteristics, 2016–2018.

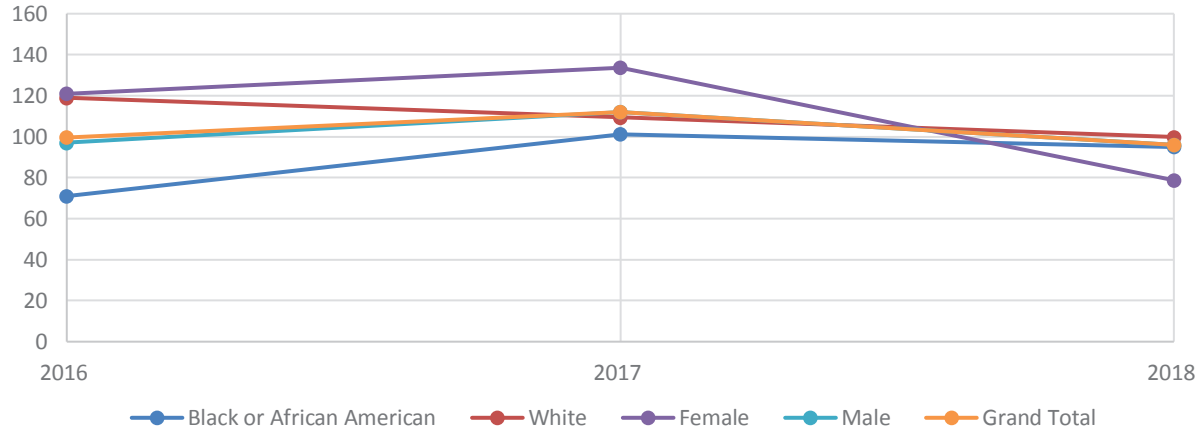

Figure 15. Median annual total absentee hours of DART frontline employees by race and sex, 2016–2018.

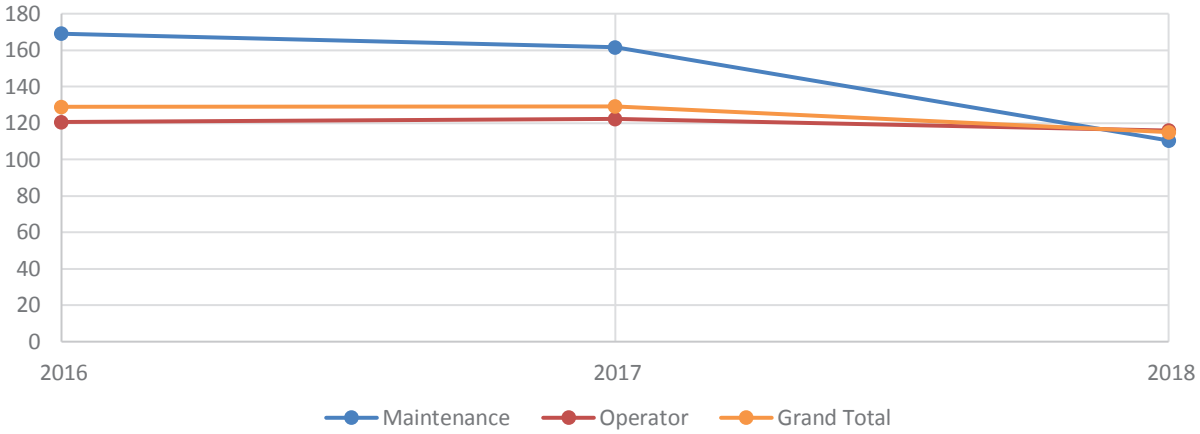

Figure 16. Average annual total absentee hours of DART frontline employees by job classification, 2016–2018.

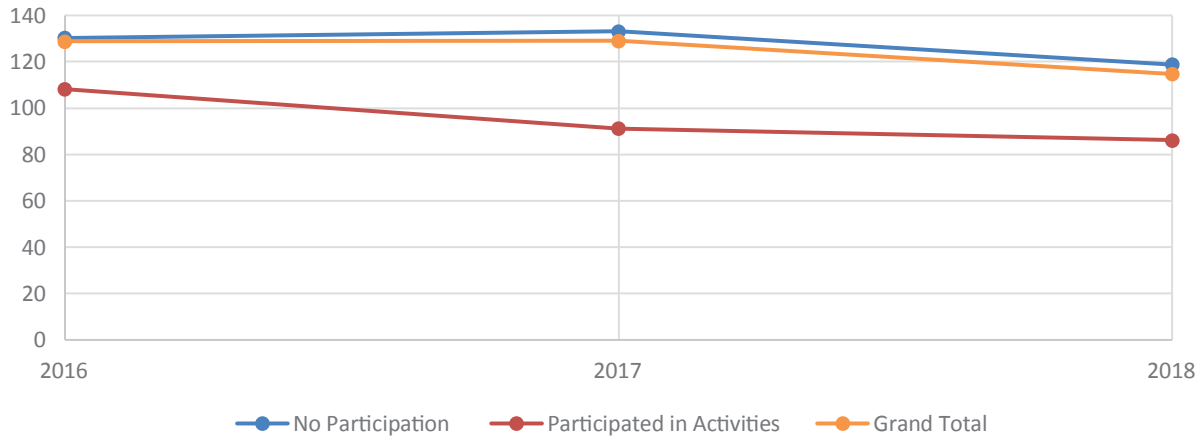

Figure 17. Total absentee hours, DART frontline employees, 2016–2018.

Table 43. Effect of program participation on absentee hours, DART frontline employees, 2016–2017.

Ordinary Least Squares: Change in Hours	Estimate	t-Stat
Intercept	38.0	3.60
Participation	**-3.9**	**-2.13**
Male	-5.9	-0.55
White	-16.2	**-2.32**
Mechanic	-3.5	-0.40
Observations	115.0	--
R^2	0.078	--
Adjusted R^2	0.046	--

used fewer sick days than did non-participating employees; however, because only 16 employees are recorded as participating in any activities, this is probably a case of self-selection bias.

6.5.12 Results

A set of 115 observations were available to test for whether program participation had an effect on health. The principal regression model was used to examine the relationship between program participation and absentee hours (see Table 43). The model included controls for race, gender, and type of employee (mechanic or operator). The coefficient estimate of –3.9 was statistically significant at the 95% confidence level. Thus, the project team estimated participation in the program resulted in a 4-hour decrease in absentee hours. Further, race was found to be statistically significant at the 95% confidence level. Specifically, if an employee was White, then absentee hours decreased by 16 hours. No other variable was statistically significant. Because the sample of workers was small—only 12 operators and 4 mechanics participated in at least one activity—the results may be meaningful, but should be interpreted with caution.

The results from this model demonstrate that it is possible to find an impact of a wellness program on one of the measures (absentee hours) that often is available at transit agencies. Other agencies may be able to use this approach to evaluate the effectiveness of their wellness programs.

6.6 LA Metro

This case study was developed through emails and discussions with the International Union of Sheet, Metal, Air, Rail and Transportation Workers (SMART)–Metropolitan Transportation Authority (MTA) wellness manager and the vice-general chairman of SMART Local 1565.

6.6.1 Background

LA Metro serves the 9.6 million residents of Los Angeles County, California, with 165 bus routes and a fleet of 2,308 buses alongside four light rail and two subway lines. Bus and rail operators at LA Metro totaled 4,397 employees in 2018. These occupations were represented by the United Transportation Union (UTU) until 2008, when the UTU merged with SMART. LA Metro also employs 2,370 mechanics, who are represented by the ATU. There are 9,817 total full-time employees at LA Metro. Together, SMART and the MTA manage a trust fund that administers benefits for bus and light rail operators.

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6.6.2 Program Startup and Development

In 2006, LA Metro piloted a health and wellness pilot program at two locations. The agency started the pilot to produce positive effects on absenteeism and workers' compensation claims. At the end of the pilot program in 2009, LA Metro determined that it did not have the resources to continue to fund the program long-term; however, the value of the program had been recognized and the SMART-MTA trust fund stepped in to manage a permanent program. The program was expanded to 24 locations, including all of the main facilities.

6.6.3 Work Organization/Work Environment

Currently, almost 50% of operators work split shifts, with the remainder split evenly between operators who work three shifts and those who work more traditional hours. Because of the demands of their schedules, fatigue can be an issue preventing operators from attending wellness program events. This type of schedule also can be seen as a benefit, however, because operators can use their breaks between shifts as an opportunity to rest, exercise, and/or participate in wellness activities.

Since 2017, SMART has worked with the University of California, Irvine, to assess the workplace and job tasks that positively and negatively impact employees' health and behaviors. The health program plans to use the findings from the university assessment to create programming to improve the overall health of employees and their families. The close attention to employees has helped uncover issues that can be resolved by influencing positive changes in corporate culture, policies, and procedures at LA Metro (e.g., schedule changes).

6.6.4 Health, Wellness, and Safety Concerns

According to the SMART-MTA Wellness Program Strategic Plan 2018–2020, diabetes, hypertension, and cancer are targeted for disease management programs. The vice-general chairman at SMART cited diabetes, high blood pressure/hypertension, and stress as the top three health and safety issues with which the union and its members are most concerned. He shared that stress contributes to many of the health issues that operators suffer from, such as heart conditions and sleep apnea, which are causes for medical disqualification of operators, though the instances are low (Wormley, personal communication, 2019).

6.6.5 Program Activities/Elements

The primary focus of the health and wellness program is to assist operators, but all employees, regardless of union affiliation, can participate. One program feature cited by the agency and union as leading to its success is the use of ambassadors. Ambassadors are selected from among the frontline workers to promote the wellness program. Each location has an ambassador, and large locations may have multiple ambassadors. Most locations have two wellness ambassadors from SMART (usually a main and an alternate). On specified days (called *Wellness Wednesdays*), the wellness ambassadors are given 8 hours of release time to engage employees in program activities. Ambassadors also are given hours of release time for offsite events, which are primarily weekend events. Compensation for ambassadors' time spent on wellness program duties is covered by the MTA.

LA Metro's wellness program runs year-round and features disease management and education, seminars and table topics, fitness challenges, health fairs and screenings, free family sporting events, and a monthly wellness newsletter. Each year, eight health fairs are held at different facilities on a rotating schedule with the result that over 3 years, all locations hold a

health fair. Wellness activities occur mainly on Wednesdays and are scheduled to coincide with operator breaks between split shifts.

The wellness program also has an incentivized weight loss program, called the Metrofit Club. The program is optional and requires a commitment of 10–12 weeks. Participants weigh in every other week with their wellness ambassador and receive assistance in their efforts through education on calculating caloric intake, recipe preparation, and basic nutrition. The program is incentivized with monetary rewards of up to $100 for losing a certain percentage of body weight.

A concerted effort has been made to promote LA Metro's wellness program. This has been done in several ways, including the presence of wellness ambassadors; union, employer, and health plan communication channels; incentives, rewards, kickoff events, challenges, and contests; a consistent theme and key messages; and mail, posters, email, newsletters, and social media marketing and testimonials.

Program Promotion

- Wellness ambassadors;
- Use of all communication channels (union, employer, and health plan);
- Incentives, rewards, kick-off events, challenges, and contests;
- Consistent theme, key messages; and
- Mail, posters, email, newsletters, social media, and testimonials.

6.6.6 Program Organization

The health and wellness program is managed by a full-time coordinator. A health and wellness committee also provides input on programming and goals. The committee meets quarterly, is chaired by the wellness coordinator, and is represented equally by staff and labor members, though two unions working with LA Metro are not represented on the committee (the ATU and the Teamsters Union, which represents security guards). SMART is working toward a goal of including the Teamsters Union and the ATU on the committee, representing mechanics.

Ambassadors are chosen jointly by union leadership and management. Every January, the ambassador roles and responsibilities are reviewed, and ambassadors are asked if they want to renew their contract. Training for new ambassadors occurs every quarter.

6.6.7 Program Resources

Program costs, not including ambassador pay and the salary of the wellness program manager, amount to approximately $55,000 annually. Health insurance providers contribute to the budget as part of the services offered to employees in exchange for premiums; however, the insurance provider does not control the program fund itself. A union trust fund covers the ambassador pay (about $275,000 annually) and also covers the salary of the wellness program manager.

6.6.8 Qualitative Program Benefits

The project team's analysis indicated that the pilot program produced benefits. Injury-related claims decreased at some locations, and employees reported better sleep, weight loss, and reduced stress. Participation was tracked by employee badge number and showed that 382 employees participated in some element of the program during the pilot. Since 2009, the expanded program has seen increased levels of participation.

Between 2009 and 2012, long-term goals of the program were to reach 10% participation and limit health insurance premium rate increases to no more than 5%. Increased participation in the expanded program meant that more employees accessed services covered by the health insurance provider, which led to higher premium rates. Although the increased participation was a positive step, it negatively impacted the premium; for this reason, the wellness committee changed the goal respecting premiums to maintaining a cost "less than the Southern California healthcare trends."

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SMART uses program data from its health insurance provider to tailor the program and counter cost trends. For example, high numbers of emergency room (ER) visits led to program education on how to avoid using the ER by scheduling appointments and going first to primary care. Results from biometrics screenings performed at the health fairs and data from LA Metro on employee metrics also are used to inform programmatic elements. Results are communicated in a newsletter for members with highlights of the changes in different measures.

The program has resulted in policy changes that signify management and union willingness to work together toward the health of employees and ensure that the program receives the proper support and attention. When the program first started and the concept of wellness ambassadors was introduced, management at LA Metro agreed to provide time off for the ambassadors' participation in Wellness Wednesday activities. As the program progressed, wellness ambassadors were given paid time for Wellness Wednesdays, and eventually were given paid time off for events outside of work hours, including weekend events. This shift has raised the status of wellness ambassadors and the program generally.

According to the program coordinator, the employees' attitudes toward the program have changed from indifference to more overtly positive sentiments. Employees actively seek out elements of the program and are more willing to provide their success stories, which are published in the wellness newsletter. Union leadership expressed the view that members are genuinely excited about the program and appreciate the involvement of the union and management because it shows that both the union and management have taken a concern in the operators' health.

6.6.9 Reported Metrics

For this analysis, participation was defined as a person attending at least one event within a year. From 2012 through 2017, participation data from LA Metro showed generally positive trends, rising to 38% by 2014 and remaining close to that percentage in later years (Figure 18).

Through the Metrofit Club, SMART has tracked the weight loss of participating employees. Figure 19 shows a peak in pounds lost in 2014, after which the amount of weight lost declined in 2015 and 2016. The drop-off may not be a negative trend, however, as the amount of weight lost in 2014 might mean that many participants had already reached or were approaching a healthy weight.

Figure 20 shows the number of health club participants per year. The peak was in 2014 at 584 participants. There was a drop-off in 2016, but a slight increase in 2017 brought the number

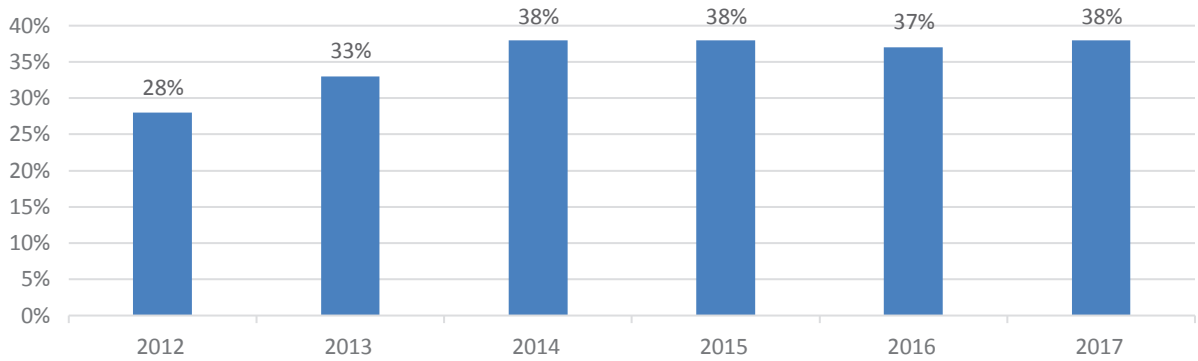

Figure 18. Participation in health program as a percentage of total LA Metro employee population, 2012–2017.

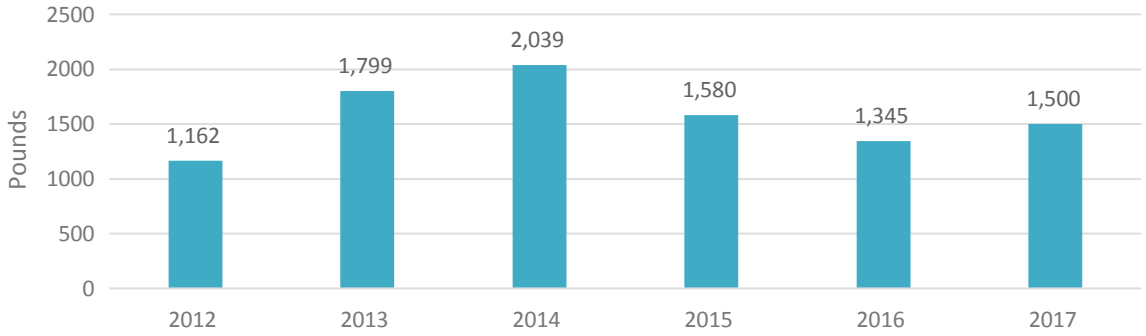

Figure 19. Weight lost per year (in pounds), Metrofit Club participants, 2012–2017.

of participants back up to 446. The pattern seems to be fairly stable and all other years were higher than the initial year of 2012.

Data from LA Metro was only provided in the aggregate, so the project team was unable to conduct regression modeling as was done with the other case studies. The information learned from this case study was based on LA Metro's reports of employee participation in the activities and the overall weight lost by employees, but could not be correlated with outcomes such as absenteeism or controlled for race, gender, or type of position.

6.7 Summary of Case Studies

The work organization and environment at each case study location was unique, and each agency faced different health, wellness, and safety challenges. Many commonalities were found across the locations, however: For example, at all five locations, the majority of bus operators worked split shifts, and some operators worked irregular schedules. The varied scheduling patterns impacted operators' access to healthy food and their sleep patterns, and limited their ability to participate in certain health and wellness program activities.

6.7.1 Program Development and Work Environment

The health and wellness programs examined were developed for various reasons and to meet various needs. For example, IndyGo added an onsite clinic as a way to avoid steep insurance premium increases. RTS began with a focus on physical fitness, but added more goals after several years, eventually hiring a full-time health and wellness coordinator. TARC's

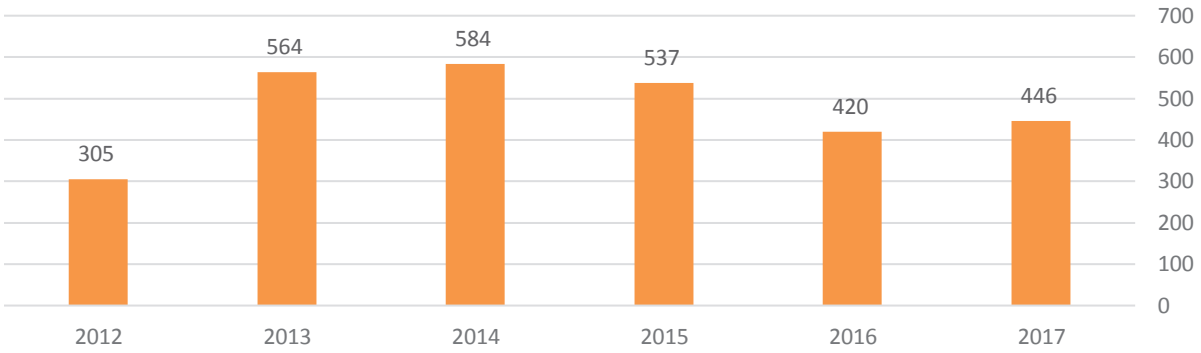

Figure 20. Number of Metrofit Club participants per year, 2012–2017.

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initial focus was on smoking cessation, but the program was expanded to include more general wellness goals. DART encouraged employees to take advantage of all existing employee benefit programs, including a health savings account, and implemented a comprehensive wellness program for all employees. LA Metro's program began as a pilot in two locations and expanded to 24 locations.

At all the sites, at least half of the operators worked split shifts. This presented some challenges for staff, including accessing healthy food choices and finding time for regular exercise. Irregular shifts also contributed to sleep deprivation. An issue emphasized at most sites by staff and union representatives was restroom access.

6.7.2 Health, Wellness, and Safety Concerns

Comparing the top three health, wellness, and safety concerns expressed by management and labor representatives and examining insurance claims data, the project team found hypertension, musculoskeletal injuries (back and neck pain), and diabetes to be the most commonly found concerns for frontline transit workers across the locations (Table 44). Other areas of concern included sleep apnea, cardiovascular diseases (heart conditions), injuries from bus accidents, obesity, stress/fatigue, and cholesterol disorders (hyperlipidemia). Table 44 lists the top three health issues for each of the health and wellness programs discussed in the case studies and breaks down each issue by three sources: management, labor, and claims data. Not all locations provided data from all three sources. In several cases, management used analysis from insurance claims data to respond to the question about their top health, wellness, and safety concerns.

At all five case study locations, labor listed diabetes as a major concern—indeed, in two of the five locations, it was the top concern. Hypertension also was named by labor in four of the five agency locations. Claims data added obesity (including hyperlipidemia) and back pain to the list of top health issues. Management, on the other hand, was more concerned with musculoskeletal injuries, weight management/cardiovascular health, and vehicular accidents.

Figure 21 graphs the information presented in Table 44. Again, the most commonly mentioned issue was hypertension, followed by diabetes and musculoskeletal injuries. Areas with only one mention were included in the "Other" category. The distribution of concerns in Figure 21

Table 44. Comparison of top three health, wellness, and safety concerns at five case study locations.

Program	Constituent	Priority of Health/Safety Concern		
		Primary	Secondary	Tertiary
IndyGo	Management	Musculoskeletal injuries	Slips, trips, and falls	Vehicle accidents
	Labor	Diabetes	Sleep apnea	Hypertension
	Claims data	Obesity	Hypertension	Diabetes
RTS	Labor	Sleep apnea	Diabetes	Hypertension
	Claims data	Hypertension	Cholesterol disorders	Back and neck problems
TARC	Labor	Operator assault	Operator injury from accidents	Breathing in harmful fumes
	Claims data	Hypertension	Hyperlipidemia	Back pain
DART	Management	Weight management	Cardiovascular health	Ergonomics/fatigue/stress management
	Labor	Chronic pain from the job	Hypertension	Metabolic disease (e.g., diabetes)
LA Metro	Joint trust fund	Diabetes	Hypertension	Cancer
	Labor	Diabetes	Hypertension	Stress

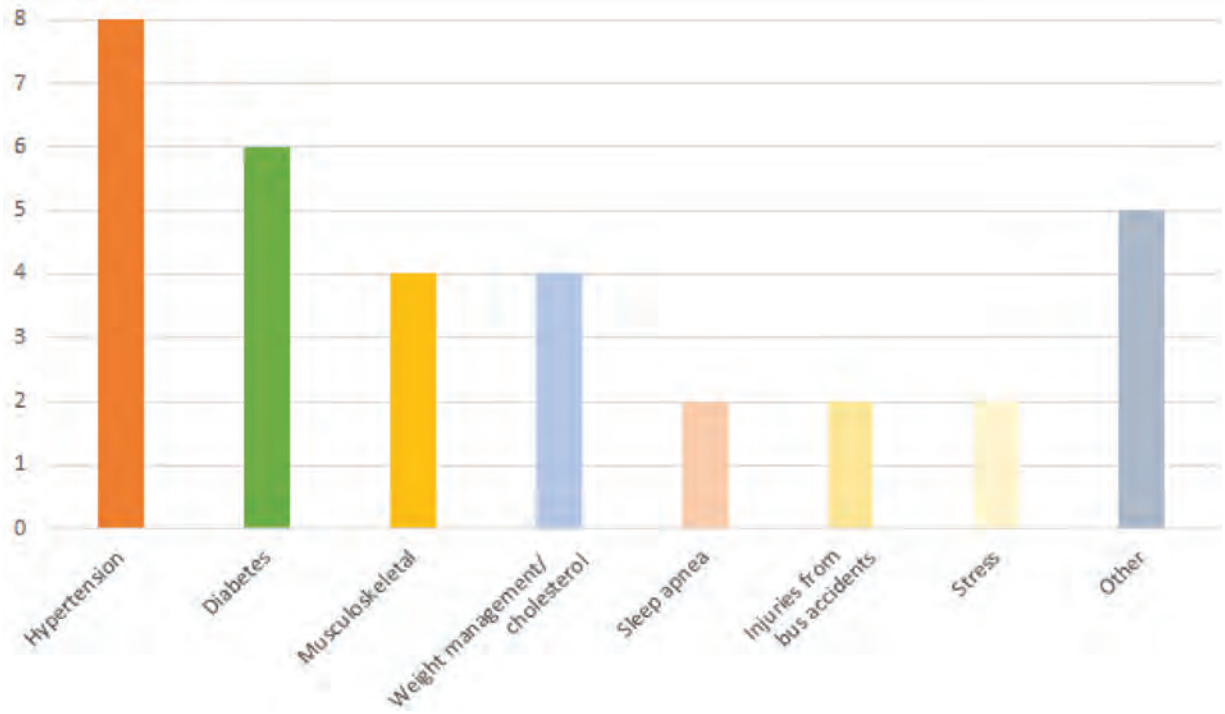

Figure 21. Most common health, wellness, and safety concerns at five case study locations.

broadly follows the data presented in Chapter 4 regarding the most prevalent health and safety issues for transit workers, with other key conditions also represented.

Given the variations in data-supported or perceived health and wellness concerns, program design elements such as activities offered, facility needs, incentives for participation, staffing, organization of committees, and selection of champions were distinct from location to location. Chapter 7 presents process-driven strategies based on these case studies that transit systems can use to maximize program effectiveness.

6.7.3 Program Activities and Elements

The programs offered various voluntary activities to employees, though it was common to provide incentives for participation. At IndyGo, participants were required to undergo a physical, health assessment, biometric screening, a minimum of four coaching sessions, and participate in a health activity to qualify for an insurance discount. Health activities might include gardening, Weight Watchers, exercise classes, walk–run groups, 5Ks, basketball tournaments, and/or financial or nutrition classes.

RTS offered short workshops onsite, fresh fruit, team activities, different choices in their vending machines, blood pressure kiosks, health screenings, and a wellness center that includes a gym.

TARC's program began with a focus on smoking cessation but later expanded to provide events and programs organized around themes of interest, an annual corporate games weekend, and a fitness-oriented boot camp. The agency has offered some incentives and prizes to participants, but nothing systematic. TARC has provided its employees access to two onsite fitness centers, where they can participate in weekly yoga classes, 5K runs and participant preparation assistance, periodic weight loss/weight maintenance challenges, walking events, and bioscreens.

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DART's program did not focus on any one aspect of health and wellness but had a different theme each month that corresponds with the interests recorded by employees in the initial survey. DART has offered two to three workshops and one to three wellness challenges every month. Rewards were given for attending workshops.

LA Metro has used wellness ambassadors and provided incentives, rewards, kickoff events, challenges, and contests. The wellness program featured disease management and education, seminars and table topics, fitness challenges, health fairs and screenings, free family sporting events, and a monthly wellness newsletter. Following a rotating schedule, eight annual fairs were held at different facilities so that, over 3 years, all locations had held a health fair. Wellness activities were scheduled to coincide with operator breaks between split shifts. The wellness program also had an incentivized weight loss program.

6.7.4 Organization

Most programs were overseen by human resources departments and used third-party vendors to provide services. Several programs had full-time coordinators and volunteers (or paid employees) who served as wellness "coordinators" or "ambassadors." The funding came from a mix of operating budgets, and agencies were able to detail staff who were already employed with the agency to serve the programs. All the sites examined had a wellness committee that was staffed with a mix of management, union representatives, and frontline staff. Committees met regularly and helped determine the activities and goals of the programs. These programs worked best when there was a cooperative relationship between management and the union.

The programs demonstrated a wide range of budgets and operating processes. The best-funded of the case studies was IndyGo, which staffed a clinic with two nurse practitioners, a part-time doctor, and medical assistants. During the assessed period, IndyGo operated with a budget of $500,000 per year. RTS employed one full-time wellness coordinator and funded the program through the agency's operating budget, using third-party vendors, spending approximately $41,000 per year. TARC's program was funded by the agency's human resources office with a budget of approximately $10,000 per year, though the program received additional funds via a premium refund from their health insurance carrier. DART had a relatively low budget of approximately $5,000 annually. Dart relied on existing staff members to manage the program rather than hiring dedicated personnel. Finally, LA Metro spent approximately $55,000 annually, not including the salary for the program coordinator. The health insurance provider contributed to the program budget through a negotiated premium arrangement, though the fund itself was not controlled by the health insurance provider. A union trust fund covered the ambassadors' pay and the salary of the wellness program manager.

6.7.5 Workforce Characteristics

Overall, a racial and gender divide was evident based on job roles. The majority of operators were male, but some gender diversity could be found, with one site having a male population of "only" 52.3% (see Table 45). Maintenance workers were overwhelmingly male, with no site lower than 93%. At all sites, at least three-quarters of maintenance employees were White.

The demographics of the populations that are eligible or participate in the wellness programs can help agencies decide on how to focus their activities and how to market them effectively.

Figure 22 shows the annual total average absentee hours for each of the case study sites. A great deal of variability can be seen across the agencies, which leads to the conclusion that each must be considered in a local context. Absenteeism seems to be a much greater issue in

Table 45. Summary of wellness program participant characteristics.

Agency	Operator			Maintenance		
	Black	Male	Age [a]	Black	Male	Age [a]
IndyGo	85.7%	60.9%	54.7	24.1%	93.1%	58.5
RTS	39.3%	74.9%	56.8	33.3%	98.1%	55.6
TARC	80.6%	52.3%	56.8	3.6%	98.2%	55.6
DART	31.5%	82.3%	Unavailable	31.0%	97.6%	Unavailable
LA Metro [b]	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable	Unavailable

[a] All ages are averages.
[b] LA Metro did not share individual-level data.

some places than others: DART, in particular, experienced such high rates that it is possible to suspect some data discrepancy may explain it, though our discussions with the agency did not suggest this. IndyGo experienced a fairly steady rise in absenteeism beginning in 2014, which might be attributable to a structural change. RTS and TARC have more level numbers, but also seem to have experienced slight rises in absentee hours. This issue is one that agencies will want to continue to monitor. Although absenteeism seems like a good outcome variable for evaluation, it is open to many potential causes that a wellness program will not be able to address.

6.7.6 Conclusions

The newly available primary source employee data from this study has provided informative descriptive statistics and statistical results. Details have been included about how programs were developed, the organizing process, and the services and activities offered by each site. Where possible, the project team gathered individual-level data on workforce characteristics, participation rates, and program metrics. The metrics gathered included claims data, data on specific disorders, prescription claims, absentee hours, and workers' compensation claims. These data have provided a big picture understanding of workforce patterns—and how variable they are.

The data examined in this chapter adds to findings from the literature review on the effectiveness of health promotion programs. Although these studies may not have produced measurable

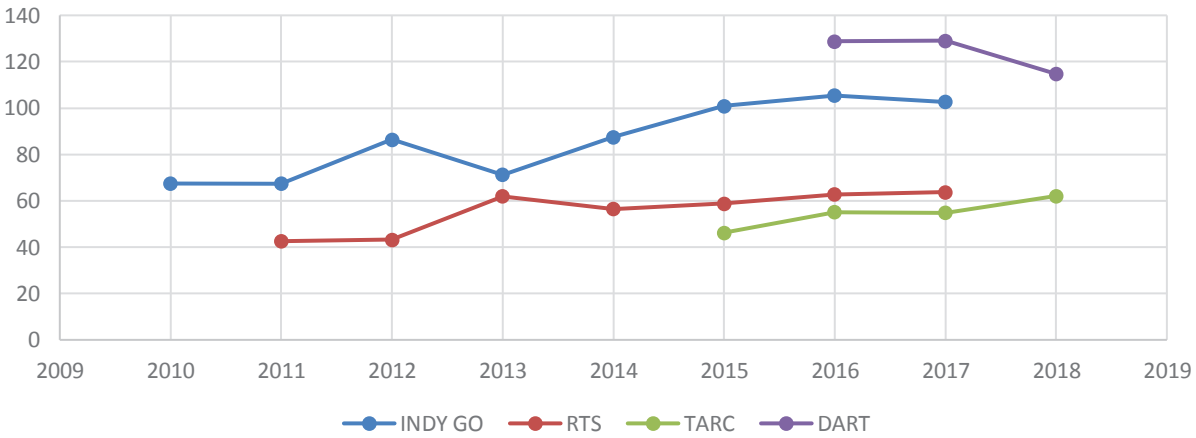

Figure 22. Comparison of average annual absentee hours across sites.

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effects that translate to quantifiable cost savings for agencies, the absence of concrete statistical evidence does not mean the cases lack substantial value. The data that was collected and analyzed adds a host of new information on employee patterns of absence/sick leave and how it relates to participation in health and wellness programs among different segments of the employee population.

The project team could not identify a direct relationship between the programs offered and the outcomes examined, but the process followed offers a good way to understand how agencies may undertake such evaluations regarding their own programs. Having clear data available on participants, what programs they have participated in, and for how long, could make future research easier to undertake and interpret.

CHAPTER 7

Implementation Strategies

Using the roadmap from *TCRP Report 169* as a guide, this chapter identifies elements from the case studies that demonstrate qualities of scalable and sustainable strategies. It discusses the best practices deployed by these wellness programs and provides examples from the case studies to showcase how each strategy has been applied in a transit agency environment. The chapter then identifies and evaluates potential measures and methods for benefit-cost and cost-effectiveness analysis of these programs as learned from the case study evaluations of this project. Finally, the chapter presents an implementation plan that suggests next steps for industry dissemination and application of the research results to transit agencies.

7.1 Scalable and Sustainable Strategies of Transit Wellness Programs

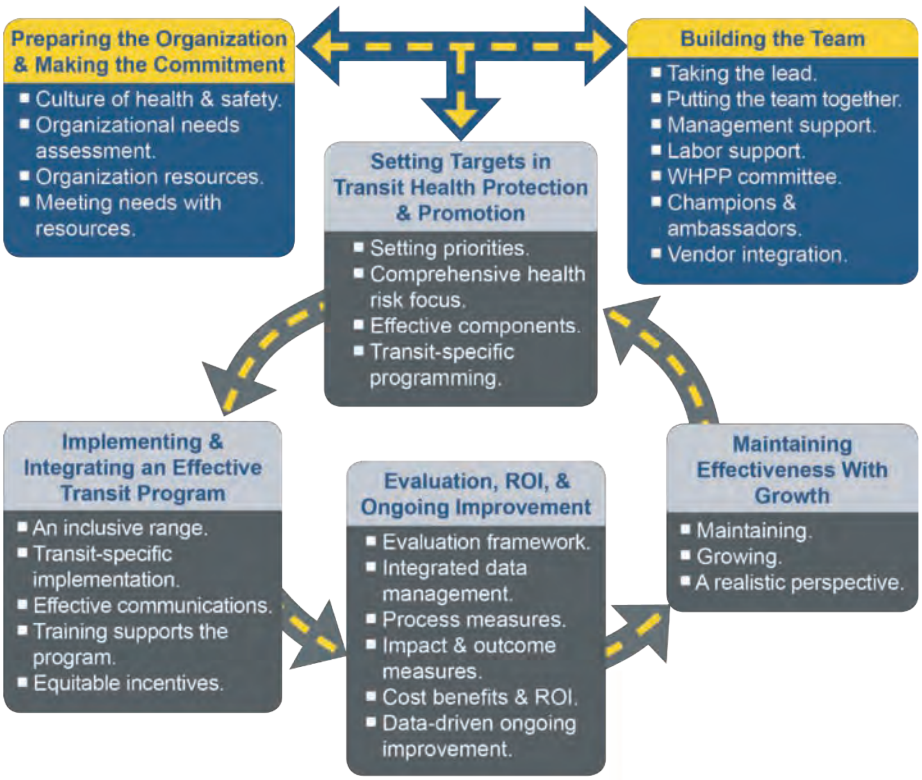
TCRP Report 169 (Gillespie, Wang, and Brown 2014) described a research-based framework of six action areas for transit workplace health protection and promotion (WHPP). Reproducing a figure from that report, Figure 23 presents a transit workplace WHPP roadmap depicting the best-practice elements that make up each action area. The roadmap illustrates a model for best practices that has been developed to apply the current art and science of worksite health to the particular demands of work in the transit environment.

The framework and best practices shown in Figure 23 were derived from the NIOSH Total Worker Health® approach and theory-based practice models, such as the SafeWell Integrated Management System for Worker Health and the World Health Organization Healthy Workplace Framework and Model. These frameworks and best practices were further based on information collected from stakeholders, including U.S. and Canadian transit agency staff, union leaders, and bus operators, and analysis by the authors and contributors to *TCRP Report 169.*

The framework emphasizes the integration of health and safety in a holistic approach to addressing health issues, taking work organization, work environment, and organizational policies into consideration. In the remaining sections of this chapter, tables rate the five case studies examined for this project in relation to the best-practice elements of the WHPP framework. This examination provides insight into the strengths and weaknesses of the selection of programs currently implemented at the participating transit agencies and advises on the broader implementation of effective program elements at other agencies.

7.1.1 Preparation and Commitment

In the areas of program preparation and organizational commitment, the five case locations selected for analysis are known in the industry for maintaining a healthy and safe culture. They



Source: Reproduced from Gillespie, Wang, and Brown (2014), Figure 8

Figure 23. Roadmap for transit health and safety.

not only provide excellent workplace health and wellness programs but, working with their local unions, these sites have instituted related policies addressing work organization, work environment, and safety issues, such as bus route scheduling, restroom access, bus design and ergonomics, and operator assaults. They excel in conducting organizational needs analysis before program initiation, understanding the nature and health risks of frontline transit occupations, the demographics and prevalence rates of health conditions of their employees in comparison to the general and local populations, health and workers' compensation claims data, and premium trends. Several of the sites also gauged employee attitude, needs, and concerns through opinion surveys, and these programs have continued to conduct surveys through the years to adjust program design. Two programs had stable funding sources, using agency operating budget, insurance premium refunds, and/or labor management joint trust funds. For these two programs, program provisions were negotiated between management and labor and institutionalized in the collective bargaining agreements. These programs tended to be larger in scale and could afford to offer a variety of activities, especially ones that focused particularly on frontline needs. The other three programs had smaller budgets and offer more limited program activities. Regardless of their scale, all five programs demonstrated many of the traits of effective programs.

7.1.2 Team Building

All five case studies exhibited exemplary practices in the areas of team building for health promotion programs, as summarized in Tables 46–51. Several programs were equipped with a full-time wellness manager or coordinator, which demonstrated the organizational commitment and investment into the health and wellness of employees. Wellness committees, consisting

Table 46. Rating of case studies for WHPP best-practice elements: preparation and commitment.

Best-Practice Elements	Description	IndyGo	RTS	TARC	DART	LA Metro
Culture of health and safety	The organization maintains a healthy and safe culture based on leadership and organizational commitment.	✓✓✓	✓✓	✓✓	✓✓✓	✓✓✓
Organizational needs assessment	The organization identifies workforce health status and needs and understands the sources of health problems.	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Organizational resources	Program planners identify resources including staffing, finances, programs, structures, and internal and external partners.	✓✓✓	✓✓	✓✓	✓	✓✓✓
Meeting needs with resources	The organization develops a plan to provide effective health assessments, a healthy and safe environment, and targeted and population-based intervention programs for all employees.	✓✓✓	✓✓	✓✓	✓	✓✓✓

Blank = Not observed; ✓ = Present; ✓✓ = Strong; ✓✓✓ = Exemplary

of members from all divisions and ranks of the organization, were assembled at the onset of the programs. Often the union president was personally involved in the committee activities, along with other frontline employees. This made it more likely that the needs and concerns of the workers who the program was to serve would be heard and built into the program design and ongoing adjustments. In nearly all cases, the union leadership supported the health promotion initiatives, actively participated, and promoted the program to represented employees. Some programs also used ambassadors and champions effectively to spread knowledge, encourage participation, and collect feedback.

Table 47. Rating of case studies for WHPP best-practice elements: building the team.

Best-Practice Elements	Description	IndyGo	RTS	TARC	DART	LA Metro
Taking the lead	The organization designates dedicated staff to coordinate and implement the WHPP program.	✓✓✓	✓✓✓	✓✓	✓	✓✓✓
Putting the team together	Input is gathered from across the organization.	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Management support	Senior and midlevel management support WHPP initiatives as evidenced by documented communications, infrastructural initiatives, and health-focused policies.	✓✓✓	✓✓✓	✓✓	✓✓	✓✓✓
Labor support	Union leadership and other representatives support and influence the WHPP goals and content.	✓✓✓	✓✓	✓✓	✓✓	✓✓✓
WHPP committee	The organization sets up and supports a group to take action on WHPP.	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Champions and ambassadors	Employee skills support and contribute to planning and implementation.	✓✓	✓✓✓	✓✓	✓✓	✓✓✓
Vendor integration	The organization enlists insurance providers, healthcare providers, and other vendors to be partners in and contributors to the WHPP program assessment, planning, and implementation. *	✓✓✓	✓✓	✓✓	✓	✓✓✓

✓ = Present; ✓✓ = Strong; ✓✓✓ = Exemplary

* Depending on the program, vendors might include financial services/retirement planning providers or area businesses like fitness centers, grocery stores, convenience stores, or farmers' markets willing to provide discounts, services, or vouchers in support of the program.

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Table 48. Rating of case studies for WHPP best-practice elements: setting targets.

Best-Practice Elements	Description	IndyGo	RTS	TARC	DART	LA Metro
Setting priorities	The organization establishes what matters and what can be done with available resources.	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Comprehensive health risk focus	The organization identifies and targets multiple contributing factors to operator health problems and conditions.	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓
Effective components	WHPP program activities are based on feasible and effective practices that address the identified program targets.	✓✓✓	✓✓	✓✓	✓✓	✓✓✓
Transit-specific implementation	Program planning and content address transit-specific risks, exposures, and conditions.	✓✓✓	✓✓	✓✓	✓✓✓	✓✓✓

✓ = Present; ✓✓ = Strong; ✓✓✓ = Exemplary

7.1.3 Setting Targets

With the targets and priorities set through comprehensive organizational needs analysis, these programs focused not only on addressing the identified health problems and conditions, but also on the contributing factors. The programs emphasized prevention as much as treatment, with HRAs and bioscreenings included as key components of almost all programs. The programs were designed to address transit- and occupation-specific risks, exposures, and conditions.

7.1.4 Implementation and Integration

Vendor integration was a strong component in several programs. Health insurance providers provided periodic reports on claims and prevalence rates. These programs also built excellent relationships with third-party vendors that staffed onsite clinics, fitness centers, health fairs, and education sessions. Strong vendor integration was observed at two locations in particular, where the health insurance providers were actively engaged in program design, provided detailed data analysis, and instituted strong incentives for employees to participate.

In general, training was used to raise awareness and deliver program information. Few of the agencies had begun building the health and wellness program components into the training and apprenticeship programs for new-hire operators and mechanics.

The two large programs built strong incentives into the employee contribution of health insurance premiums, which led to wider participation and a more meaningful program impact. Other programs offered smaller incentives, such as gift cards and coupons, to employees who participated in various events. All programs rewarded positive steps rather than punishing employees' current health status.

7.1.5 Evaluation

Like the cases that were examined in *TCRP Report 169*, the cases examined for the current research were rated weakest in establishing a comprehensive evaluation framework, using integrated data management, tracking progress, impact and outcome measures, and ROI calculations. Most of the case locations tracked some, but not all, participation data. The most commonly tracked impact and outcome measures were employee attitude, morale, and behavioral changes; health status (e.g., weight loss); health premiums; health claims; and workers' compensation claims. Absenteeism was tracked, but this measure was rarely linked

Table 49. Rating of case studies for WHPP best-practice elements: implementing and integration.

Best-Practice Elements	Description	IndyGo	RTS	TARC	DART	LA Metro
Inclusive range	The WHPP program offers varied activities and resources.	✓✓✓	✓✓	✓✓	✓✓	✓✓✓
Transit-specific implementation	The implementation structure is adapted to suit the mobile workforce, multiple base locations, and varied schedules including evening, night, early morning, and split shifts.	✓✓✓	✓✓	✓✓	✓✓✓	✓✓✓
Effective communications	The organization sets up a strategic, comprehensive, integrated communications plan with multiple communications pieces and delivery channels that are tailored to the transit population.	✓✓✓	✓✓✓	✓✓	✓✓	✓✓✓
Training supports the program	Training is designed to promote the program goals, not just deliver information, and is integrated into other agency training.	✓✓✓	✓✓	✓✓	✓✓✓	✓✓✓
Equitable incentives	The organization uses equitable, nondiscriminatory incentives that encourage active involvement and a healthy workplace culture.	✓✓✓	✓	✓✓	✓✓	✓✓✓

✓ = Present; ✓✓ = Strong; ✓✓✓ = Exemplary

to participation in the health or wellness program or analyzed as a potential program outcome. None of the locations engaged in a comprehensive benefit-cost analysis on their own, but most were willing to provide the researchers with raw data for the analysis and showed strong interest in learning the results.

7.1.6 Growth

Among the cases examined for this research, the two long-established, stable programs (LA Metro and IndyGo) have maintained their momentum through new and innovative program offerings, ongoing communication of program benefits with leadership and workers, and getting

Table 50. Rating of case studies for WHPP best-practice elements: evaluating ROI and ongoing improvement.

Best-Practice Elements	Description	IndyGo	RTS	TARC	DART	LA Metro
Evaluation framework	The organization establishes a comprehensive WHPP program evaluation plan.	✓	✓	✓	✓	✓✓
Integrated data management	Data collection, management, and analysis are coordinated throughout the organization.	✓	✓	✓	✓	✓✓
Process measures	The organization tracks data on costs, participation, goals met, and barriers, and then uses the data to improve the program.	✓	✓	✓	✓	✓✓✓
Impact and outcome measures	The program documents change in impact measures and outcome measures.	✓✓	✓	✓	✓	✓✓
Cost-benefit and ROI	Quantify cost savings when the program affects absenteeism, productivity (presenteeism), healthcare utilization, and other costs, and document other benefits.	✓	--	--	--	✓
Data-driven ongoing improvement	The organization communicates the impact of the program.	✓	✓	✓	--	✓✓

✓ = Present; ✓✓ = Strong; ✓✓✓ = Exemplary; -- = Not Observed

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Table 51. Rating of case studies for WHPP best-practice elements: carrying on (growth).

Best-Practice Elements	Description	IndyGo	RTS	TARC	DART	LA Metro
Maintaining	WHPP is essential to the organization, not an extra	✓✓✓	✓✓	✓✓	--	✓✓✓
Growing	The WHPP program adapts	✓✓	✓✓✓	✓✓✓	--	✓✓✓

✓ = Present; ✓✓ = Strong; ✓✓✓ = Exemplary; -- = Not Observed

additional employees involved in the wellness committee and as ambassadors. The smaller programs also have continued to adapt based on changing employee needs and evaluation of earlier program activities, but it was observed that the overall direction of these programs can be vastly different. One program clearly was growing, as seen in the dramatic increase in the allocated budget after initial positive results, whereas another program was going into hiatus without a clear timeline for restarting, due to a key champion leaving their post. Numerous factors can affect the stability or growth of an agency's program, and an analysis of why different programs took different directions was beyond the scope of this research project.

7.1.7 Summary

As shown in these five case studies, when faced with the crisis of skyrocketing health premium costs, some transit organizations chose to involve stakeholders from all levels of the organization and partners from outside to collectively tackle the critical issue. Rather than focusing on cutting benefits and reducing services, they paid attention to the underlying causes of the health premium increases: health conditions and health risks, and the environmental factors that contribute to them. Programs that have strong management and union support, provide strong incentives for employee participation, and receive the most funding support had the longest standing and demonstrated the most positive outcomes.

The data analysis for this research did not demonstrate strong statistical findings on the benefit-cost of transit workplace health promotion programs. Despite this lack of conclusive findings, the organizations and employees recognized the tangible and intangible benefits of these programs. More systematic program evaluation, encompassing more systematic processes, outcome measures, and internal benefit-cost and ROI analyses using the measures laid out in the next section could enable these programs to continuously improve and communicate their value to leadership and participants.

7.2 Measures and Methods for Benefit-Cost and Cost-Effectiveness Analysis

Transit agencies and unions can use several measures to track how successfully wellness programs reduce costs. Any gains from the implementation of a wellness program may require a long lead time (years) before its beneficial effects begin to affect measurable indicators like absentee hours. Except for cases when the negative health aspects of a particular behavior are so extreme and widespread that an immediate change brought about by a new program would promptly reduce absentee hours, workers' compensation, or healthcare spending, it is expected that benefits will only begin to be detected after a substantial lead time. For this reason, the process of tracking the success of the wellness programs at reducing costs should ideally be initiated before the program is implemented. If prior tracking is not possible, tracking should begin no later than as soon as the program is implemented. The

challenge is setting up the systems to successfully and accurately document the full extent of what actually transpires.

Before programs are initiated, it is useful to consider additional metrics the transit agency can record that would detect positive changes earlier than waiting for decreased absentee hours to manifest. Detecting improvements by periodically checking blood pressure and heart rate measurements, or by recording fitness performance, may impose only a minor inconvenience to employees in terms of time or privacy, but can provide early indications as to whether the program is showing positive results. The agency also should be committed to establishing a process to record program participation that allows for valid statistical significance testing. Regularly recording program participation and the extent of that participation is crucial to eventual success at measuring the effectiveness of these wellness programs.

An attempt should further be made to quantify any changes in activity that occur outside of the wellness programs, whether those changes are good or bad. As a positive example, an employee may institute a personal program to add or improve his or her diet or exercise and fitness levels. As a negative example, a worker may experience new or changing stresses related to the medical problems of family members (e.g., a spouse, parents, or children). These complexities pose challenges in determining a method for measuring the impact of services, particularly when using a pre- and post-analysis model. It is nearly impossible to control for the additional programs or services that individuals participate in separate from the program being evaluated. If at all possible, however, this information should be obtained so that it can be incorporated into the subsequent statistical analysis.

Ideally, the system the agency organizes to collect information that can be used for statistical comparisons will not be overly time-consuming and will ensure the privacy of the employees. Agencies could work with evaluation experts (possibly from a local college or university) to develop plans to regularly record program participation/extent, and health measures, including a well-designed short intake survey for which the answers will make subsequent statistical analysis more effective. Annual or quarterly surveys of employees could be useful in understanding their participation, nonparticipation, and outside influences. If any kind of survey is attempted, it must be clear that the data will be kept confidential, that the data will not have any impact on an employee's performance reviews, and that the data is vital to the agency's efforts to provide a better quality of life for its employees.

Having established a comprehensive set of data that will be collected and recorded at regular intervals, the analyses conducted to estimate improvements and cost reductions will be statistically valid and the success of the wellness programs can be systematically assessed. Any number of rigorous statistical estimation techniques and testing procedures can be used to extract and analyze information from the collected data. Benefit-cost and cost-effectiveness analyses are straightforward, productive exercises when suitable data are available.

Figure 24 diagrams cost areas for employers and workers. Agencies can use these areas as targets when they design and modify wellness programs that have the reduction of bottom-line costs as one of their goals.

7.2.1 Employers

7.2.1.1 Absenteeism Measures

The unit of analysis used for absenteeism is important for this measure, as is the method of analysis. Ideally, multiple categories of absenteeism should be classified in payroll so that the most detailed form of analysis can be conducted. For example, personal and sick days should be counted, as should be unpaid sick and personal leave, which may be a measure of extended

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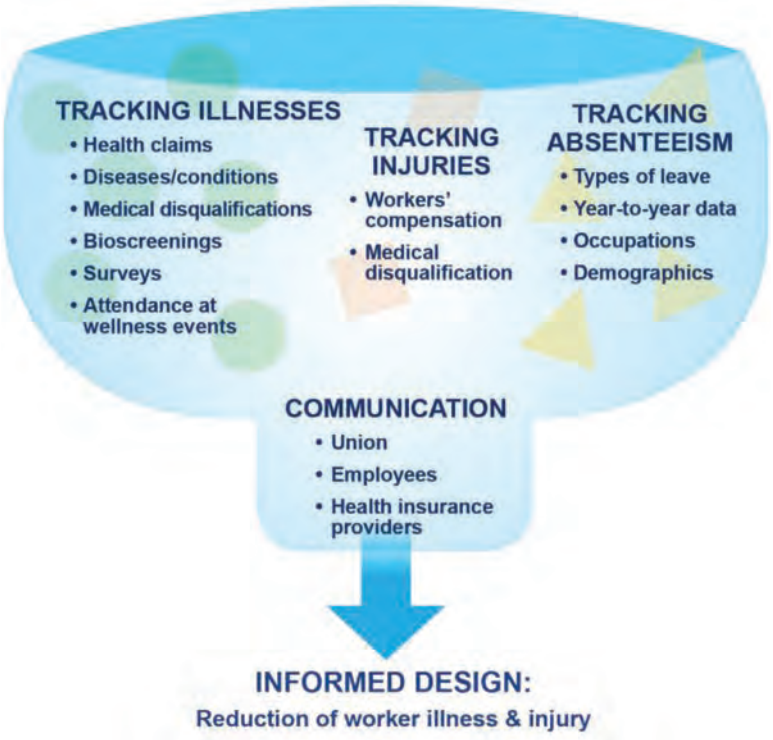

Figure 24. Measures and methods for cost-benefit analysis of wellness programs.

injury or illness and not workers maxing out on the sick day allocation. For this analysis, the project team used the total of sick, personal, unpaid sick, and unpaid personal (or the maximum subset of those categories available).

To track trends in the number of sick days taken over time, the median or the average total days can be measured for different years. Different measures are likely to yield different results. For example, the average sick days will likely be higher than the median sick days for the population of workers or any subpopulation. Any given period could include cases of workers who have taken extended unpaid leave (e.g., more than 200 hours per year) due to a serious injury. Because the mean, or average, is sensitive to large numbers, it will appear somewhat inflated by the cases for which large numbers of sick days were taken. By contrast, the median is the number in the middle of the sample population—the point at which an equal number of employees fall above and below it. The median is less sensitive to distortion from a few large numbers, so the median may more accurately reflect the typical number of hours of sick leave taken.

Another way of handling instances of unnaturally high numbers of sick hours is to remove the cases with uncharacteristically high numbers from the database, labeling them as outliers. In these cases, the project team chose to take into account the effect of these numbers on the database, both because it was hard to determine a cutoff for outliers and because the presence of such cases was relevant to our analysis.

Subpopulations can be tracked for absenteeism by job type (maintenance/operator) or demographic (racial group, gender, age). Analysis at this level may be of interest if injuries and illnesses are correlated with features of the job or with risk factors for particular groups; the findings can be used to help design wellness programs that target interventions needed to improve the health of those groups. If an analysis is done, it is important to note that for

findings related to a subpopulation to be of significance, the subpopulation should have a sufficiently high number of members. For example, this research project did not make analytical conclusions about groups with 30 or fewer employees.

7.2.1.2 Turnover/Employee Exit

Turnover is defined as the percentage of employees who leave in a calendar year divided by the total population of workers for that year. It can be calculated as long as the agency keeps track of the final day of employment. When this statistic is not available, it can be imputed from the last paycheck for that employee, though sometimes the timing of the paycheck varies with respect to the last day of work. Low turnover can be a sign of a healthy population. Health issues—whether mental, physical, or both—make up one factor that causes employees to exit a job.

A more direct measure of employee exits related to health is the number of medical disqualifications of employees. Documenting the reasons for medical disqualifications could be important in understanding what health problems are so severe that they prevent transit workers from remaining employed so that agencies can design wellness programs to target these problems. Obtaining data about employee medical disqualifications was difficult, however, due to confidentiality concerns. Because the case numbers are low in most sites, it would be relatively easy to identify individuals.

7.2.1.3 Health Insurance Costs and Claims

The costs of insurance claims can be used to measure the effectiveness of health programs. It also is possible to consider the total numbers of general health insurance and prescription claims, especially if cost data are not available. Ideally, to reveal possible impacts, baseline data from before the initiation of any health or safety initiative are compared to data tracked over time from the beginning of the program. Examination of insurance claims might also reveal the prevalence rates of common chronic conditions for the agency's employees. As laid out in this report, transit workers are more likely to experience several chronic conditions—but rather than assume that the employees of any given agency have the same prevalence rates, an analysis of the types of claims could help provide a focus for program elements offered by the agency and what to measure going forward. This analysis can provide a benchmark for internal analysis and a way to compare incidence rates with the general population or subpopulation of transit workers nationally, or with other members of the same insurance plan. These data should be collected over time as well.

7.2.1.4 Workers' Compensation: Shared Cost With Society

Several measures of workers' compensation can be examined, such as the number of indemnity claims and the total cost of claims. When considering either of these measures, the types of claims can be examined by type of injury, cause of injury, or by worker characteristics (e.g., age, race, sex/gender). By examining the number of claims and the costs of claims before and after a program is implemented the agency can assess whether there are program impacts.

7.2.2 Workers

Various measures should be considered to understand the direct impacts of health and wellness programs on workers. The main areas identified for this research were lost wages, out-of-pocket medical expenses, and diminished quality of life.

7.2.2.1 Lost Wages

To measure lost wages, leave without pay should be considered. If a worker is not covered by workers' compensation, actual wages for that time can be calculated. Attempts should be

made to distinguish leave for health reasons from leave for personal use (e.g., vacation). Leave without pay also may be used to care for a loved one. If worker pay is replaced by workers' compensation, the difference between regular pay and the amount received through workers' compensation should be calculated. The amount of time at the reduced wage is used as a factor to calculate the lost wages.

7.2.2.2 Out-of-Pocket Medical Expenses

Out-of-pocket expenses typically are tracked by the health insurance provider. This is an effective measure of the health expenditures for workers in a particular agency, but the amount spent will vary based on the type of insurance plan. Thus, this measure may not be useful for comparisons to other agencies. Within an agency, conducting a pre- and post-comparison of expenditures before and periodically after implementing a health and wellness program would be a useful measure of program effectiveness.

7.2.2.3 Quality of Life

The Quality of Life Scale developed by Burckhardt and Anderson (2003) can be part of a regular survey effort to measure the impacts of a health and wellness program over time. This scale has been extensively tested and validated, though other measures can be considered. Improvements in health could conceivably impact the measures used in the Quality of Life Scale, an important dimension to consider.

7.3 Implementation Plan and Next Steps

To promote wider industry adoption of the best practices at transit agencies, the information and cases presented in this report could be used to create a series of promotional materials. One- to two-page pamphlets could be developed highlighting the key characteristics of each site's implementation model. Impacts on health, safety, and the bottom line could be featured. Fact sheets also could be created based on the case studies in this report. The fact sheets would describe the measures and methods used to track program outputs and outcomes, and would provide useful examples for other agencies regarding how to evaluate their own programs.

Given the variations of agency programs, goals, and data reporting constraints, not all agency-created pamphlets would be uniform. Nonetheless, the creation of such pamphlets would create a broader universe of case studies and best-practice examples that could be compared and examined by agency peers.

The project team suggests a two-step process for using this report to design wellness programs that benefit the health of transit workers:

1. Review the background research on the types of health issues workers are most likely to experience and the programs that are most effective in addressing them. The programs studied in this project may have been beneficial even though the analysis could not detect statistically significant effects.
2. Determine the key issues facing employees, the types of programs they would use, and a means of evaluating impacts before initiation are the critical steps to program implementation and evaluation. Over time, agencies can assess the programs' ROI and make adjustments as needed. Prior TCRP publications include resources to help design and track programs. In particular, the spreadsheet-based tool titled "Transit Operator Workplace Health Protection and Promotion Planning, Evaluation, and ROI Template" may be helpful. Based on the research in this report, using the "Outcome" tab could be a good starting place to track the key measures the programs are meant to impact. The tabs for "Financial Benefits,"

"Cost," and "ROI" provide a way to track results. The Excel-based document containing the template is available for download at no charge from the *TCRP Report 169* webpage at www.trb.org.

Presentations and discussions at industry conferences and webinars are key methods for dissemination of this report and its findings. Relevant industry events include the following:

- APTA annual meetings,
- The APTA Mobility Conference,
- APTA Workforce Development Committee webinars,
- Transportation Research Board annual meetings, and
- Transportation Research Board/TCRP Webinars.

The Transportation Learning Center's Coach Operator Apprenticeship Committee and Bus Maintenance Apprenticeship Committee meetings can also be a platform for industry-wide dissemination. These two committees consist of management and labor representatives from over two dozen transit properties and focus on developing and expanding local registered apprenticeship programs for bus operators and maintainers. A critical component of these apprenticeships is education related to the health and safety of the frontline workers. Committee members can gain knowledge and awareness of the health risks and safety hazards associated with working as an operator or mechanic and strategies to mitigate the negative effect of these risks and hazards through a health promotion and protection program instituted by the agency and/or local union.

CHAPTER 8

Conclusions

8.1 Overview

The objective of this study was to identify ways to improve employee health and safety outcomes resulting from work conditions and broader health promotion practices and the corresponding impacts on the bottom line. The project team's research focused on the prevalence of conditions, costs associated with conditions, and statistical analysis of data on participation in and results of health and wellness promotion programs. This report adds another layer of research to past studies that have explored health and safety outcomes for transit workers and health promotion programs. This report quantifies the costs of widespread and consistently poor health and safety outcomes and the cost savings, if any, of health promotion programs. Dangerous and strenuous work environments exact a toll on workers that affects their employers and society. A better understanding of that toll, its costs, and the potential means of mitigating it are an important research pursuit.

The research for this project began with an in-depth review of the literature to better understand the position of transit workers in relation to health and safety programs, the general effectiveness of such programs, and the specific health and safety issues that are most prevalent and costly among transit workers. The research approach was designed to respond to specific questions, and the substantive work used extant data to explore in-depth the issues of the prevalence and costs of health conditions, as detailed in Chapter 4 of this report. Chapter 5 covers an extension of that work, presenting estimates of the costs to employers, society, and individual transit workers. In both analyses, transit workers' costs were compared to those of the general worker population to get a sense of the "excess" health and safety costs associated with transit work. In general, most condition prevalence rates and costs were found to be higher for transit workers (without holding other factors constant, such as age, sex, or race).

In the literature review, the project team explored issues linked to health and safety outcomes and costs as they relate to workforce conditions, as well as programs used to mitigate negative health and safety outcomes. Where possible, evidence of the cost-effectiveness of such programs was reviewed, and the project team found that several factors faced by transit workers affect the health and safety of operators. These factors include, but are not limited to, the following:

1. Urinary tract problems that arise as a result of limited access to restrooms,
2. Musculoskeletal injuries resulting from prolonged sitting and repetitive motion,
3. Safety factors linked to actions by other drivers and unruly passengers, and
4. Access to food alternatives and fitness centers due to long, irregular, and split shifts.

For non-operators, exposure to exhaust fumes and other automotive chemicals are also risk factors for poor health. The literature also has documented worker stress and fatigue as health and safety issues. Recognizing that transit workers experience these factors disproportionately helps us understand the differential costs that affect this population. The literature provides evidence of the direct costs of chronic health conditions, including absenteeism and turnover, and how wellness intervention programs function to mitigate these costs. Relatively few studies measure the indirect costs of occupational health injuries for transit workers, however, and limited data are available that provide evidence for the effectiveness of wellness intervention programs for the transit worker population. The literature is largely inconclusive on the effectiveness of wellness programs to reduce costs in general and specifically for transit agencies. Most programs are not well supported, funded, or targeted to the unique challenges transit workers face.

The project team also assessed the prevalence rates for the most common health conditions for transit workers, the costs associated with those conditions, and additional medical expenditures. Most transit workers (72%) are involved in vehicle operations. Of these workers, just over 50% are bus operators. Most transit workers are male (63%), over 45 years of age (66%), and White (63%). Although the majority of workers in the transit industry are White, the percentage of Black workers is higher in the transit industry (29%) than in the general workforce (12%). Women, however, are underrepresented in the transit industry, making up 37% of transit workers but 47% of the overall workforce.

The most common health conditions associated with transit workers are cardiovascular disease, hypertension, diabetes, musculoskeletal disorders, mental health, and respiratory conditions (e.g., COPD, asthma). Further, it was found that rates of smoking and obesity were higher in the transit worker population than in the general population. The costs of each of these conditions were estimated by drawing on available information from journal articles and other sources. After establishing prevalence rates and the associated costs for the most common health conditions, the costs and rates of those conditions for transit workers were compared with those of the general population. The costs for transit workers were found to be consistently higher than those for the general worker population, reaching as high as millions of dollars, though it is important to note that the costs associated with treating each condition are not necessarily additive because of comorbidities. The findings suggest that available resources might be most effective if allocated toward the prevention of these conditions. The result would likely be a lessening of programmatic costs of responding to transit worker health problems.

Average annual expenditures and prevalence rates were used to estimate per-condition costs. Costs of average annual costs to workers from injury and death were estimated, as were the costs to employers and society in the categories of injury, death, absenteeism, workers' compensation, disability (SSDI), disability (SSI), and Medicare. The method used for this research compared the costs for individuals in the transit sector with the costs for the general worker population and calculated the "excess" costs associated with transit work. In all cases, the project team found that the transportation/transit sector saw higher costs to workers, employers, and society in each cost category as related to the general worker population. Monetized estimates of the costs linked to health risks and conditions faced by transit workers were presented, and elevated costs for transit workers and agencies were highlighted. The elevated costs point to areas where health and wellness programs may improve the health conditions of workers, thus reducing costs across multiple categories.

Further improvements in on-the-job safety may decrease disability and injury costs. The costs estimated for this study were not an exhaustive list of employer and societal costs; many additional costs could not be itemized, such as quality of service. It is important to note that the cost categories overlap and are not additive.

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The project team also conducted five in-depth case studies on health and wellness programs provided by transit agencies. The case studies provided the project team an opportunity to:

- Learn about the types of programs provided to transit workers;
- Examine the potential impacts of existing programs;
- Identify what health and safety issues were addressed in each program; and
- Examine how those issues aligned with the issues that had been uncovered in the literature review and analysis of secondary data.

In most cases, the programs addressed several of the key issues faced by transit workers, including cardiovascular health, fitness (exercise), access to healthy food, diabetes, stress, and smoking. For the five cases examined, the details of program startup, organization, activities, resources, and participation were documented over time.

In four of the case studies, individual-level data were available that enabled the project team to develop descriptive statistics and perform econometric regression modeling. Most of the programs had a weak relationship or no demonstrable relationship with the outcomes of interest (absenteeism and workers' compensation claims). Nevertheless, these data provided a host of new information about participation in wellness programs and their potential for developing strategies to improve the health of transit workers. The project team's analysis found no statistically significant associations with the programs and the outcome measures except for the DART wellness program, for which the project team found participation in the program had decreased the total number of absent hours. This result was based on a small sample, however, and should be interpreted with caution.

8.2 Key Findings

The project team found that the most prevalent chronic conditions in the transit worker population are cardiovascular disease, hypertension, diabetes, musculoskeletal disorders, mental health, and respiratory illnesses. These six chronic conditions are the ones of greatest concern, however, and are found at much higher prevalence rates for transit workers than for the general worker population. Transit workers also suffer from other health conditions that may be related to their work, including hearing loss, bladder conditions, and cancer. Smoking and obesity also disproportionately affect transit workers.

The case studies showed that programs often focus on obesity, offering increased and more diverse food choices and exercise programs. The programs examined also offer check-ins with nurses and health screenings, which could potentially identify diabetes and other potential health issues earlier. Only one program was found in which the relationship between participation and lower absentee hours resulted in statistical significance, though the sample size was small and the project team hesitated to draw conclusions based on a single finding.

The literature review suggests that the health and wellness programs that transit agencies design should focus on problems caused by limited bathroom access, split shifts, and sustained sitting, rather than on exercise and weight loss, which are more typical. Changes that could improve safety include providing enhanced rest opportunities before and after shifts. Some of the agencies studied provided healthy snacks, which could benefit operators who may have difficulty accessing healthy foods before and after their shifts. Working to create more comfortable seating for operators would also be helpful, though it would take a large investment of resources over a sustained period.

The most common problem, cited by agencies and labor and further underscored by claims data, is hypertension. Following hypertension, diabetes, musculoskeletal disorders, and weight

management were identified as the next most common problems. Some programs had elements that addressed these issues, such as health assessments, exercise programs, and nutrition classes. Unfortunately, it was not possible to measure changes in health outcomes based on program elements directly, although the project team did try to relate the program activities to outcomes that were part of an agency's "bottom line." The lack of data measuring the objectives of the programs is an area that could be improved by linking individual participation in programs to outcomes based on the participants' health records or self-reports. These types of evaluations would have to control for confounding factors, such as age. It was difficult to identify a direct impact of health and wellness programs on measurable outcomes such as absenteeism or annual number of medical claims.

None of the analyses of individual-level data from the case studies had strong results. A significant result was found at one case study site, but given the small sample in that case, the project team cautions against making generalizations based on it. Despite the lack of statistically significant results, most of the health and wellness programs were well designed and well implemented. Transit agencies can use the programs examined and the other information in this report to help them design wellness programs that can benefit the health of transit workers. The programs provide models and the research on prevalence and costs can suggest where to focus efforts, but consideration should also be given to the specific needs of the workers at any given agency. The project team recommends reviewing the background research on the types of health issues workers are most likely to experience and the programs that are most effective in addressing them. Surveying workers, as was done by several of the agencies studied, is a good way to gauge what kinds of programs will attract worker participation.

As noted in Chapter 7, prior TCRP publications include resources to further help design and track programs. The spreadsheet-based tool, "Transit Operator Workplace Health Protection and Promotion Planning, Evaluation, and ROI Template," could be helpful. The spreadsheet is available for download at no charge from the *TCRP Report 169* webpage on www.trb.org. Based on the research conducted for this report, the project team suggests using the "Outcome" tab in the spreadsheet as a good starting place for tracking the key measures the programs are meant to impact. The tabs for "Financial Benefits," "Cost," and "ROI" provide a way to track results. Using these resources can put agencies on a path to creating programs that benefit workers and will also have a positive impact on the bottom line.

8.3 Study Limitations

The research in this report has been subject to several limitations. First, additional cost categories exist that could not be itemized, including quality of service. This limitation primarily resulted from a lack of available data. Moreover, the cost categories can overlap and are not additive as a function of comorbidities. The research approach for this study used cross-sectional data where necessary because it was the only data readily available for a sufficient number of transit workers to answer the fundamental research questions; however, the project team recognizes that cross-sectional data can distort the results.

Second, it was not possible to "follow" a transit worker whose career was shortened as a result of job-related injuries or health issues. Similarly, data were not available that would allow the project team to track whether transit workers have shorter lives or more health problems after retirement or leaving transit work for other reasons. It was not possible to account for former transit workers who added to the prevalence rates in the general population. Similarly, the study could not include controls for differences in gender and age in the data analysis on condition costs and prevalence, as this level of detail was beyond the scope of the research. Exploring differential response patterns affected by gender and age would be

worth examining, recognizing that transit workers are disproportionately older and male in comparison to the general population.

Last, this study could not account for differences in local regulations. The number and diversity of local agencies is considerable. Examining how local regulations might affect outcomes could be another fruitful area for future research. The conclusions of the research recognize and have accommodated these limitations and reflect a careful implementation and consideration of the level of detail represented in the original research work plan.

8.4 Areas for Further Research

Additional study could be conducted in other cost categories, though some of these categories may be harder to quantify, including costs to workers in the form of job satisfaction and morale, costs to family in terms of stress and injury, and costs to unions in terms of turnover and management. It would be useful to gather more information on intermediary outcomes related to health, such as changes in hypertension, reductions in type 2 diabetes, and reductions in stress levels. Understanding how programs impact intermediary health impacts and then testing their effects on bottom-line measures such as absenteeism or claims costs would be a fruitful approach to future research. Understanding if wellness programs result in a positive ROI also could help agencies, unions, and workers decide if they are the best use of discretionary funds. Learning more about the actual needs and conditions of workers might further help to better shape health and safety programs. Work that includes surveying transportation workers or conducting in-depth interviews with union leaders could inform the costs experienced in the transit work environment.

Work that looks to the future of transit workers and the impacts of higher rates of illness and injury (and the lost days that result) on the industry, as well as work surveying those who exit the industry for health-related reasons, could improve understanding of the effects that health and safety issues can have on the bottom line. Studies that examine these issues using a life-course perspective would be most valuable because they would allow observations of the full health trajectory of transit workers and how they are impacted after retirement or being forced to leave transit work due to injury or disability. Using cross-sectional data to answer these questions is challenging at best and can easily distort the results; however, finding good sources of longitudinal data for this industry will remain a challenge. Providing the context of broader regulatory and geographic frameworks for understanding the health outcomes for transit workers could add further value. A possible question to examine is, "Do state or local regulations have any impact on bottom-line health-related costs for transit workers?" Including regulatory information in either cross-sectional or longitudinal analyses would provide a helpful perspective on the issues.

This report will be valuable to research programs in different settings, including industry, labor, and academic venues. It provides a comprehensive summary of the literature and data on chronic conditions among transportation workers that can be used to determine the health and safety issues on which to focus research. An expansion of the data analysis on condition costs and prevalence that controls for differences in gender and age would be a valuable contribution, as would a better understanding of how transportation workers may have a shorter working life than those in other professions. This was something beyond the scope of the present research, but it is worth examining. For industry, a better understanding of the health issues faced by their workers means producing health and wellness programs that could target their issues more effectively—and measuring their efforts by tracking pre- and post-program outcomes.

It is important to understand that the literature shows that very few health and wellness programs have impacts, including the cases presented in this report. This suggests that (1) the measures are insufficient, (2) the pre- and post-observation periods are too short, and/or (3) the interventions are not well-designed. Setting up systems to capture data reliably is challenging and costly. More research on the most effective types of health interventions clearly is needed, both in general, and specifically for the transportation worker population.

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APPENDIX A

Case Study Identification

This section summarizes the research activities and results related to data collection for case study site identification as of September 30, 2018. The Econometrica team developed and distributed a survey to agencies and unions that had participated in a prior TCRP project, the results of which are published in *TCRP Report 169: Developing Best-Practice Guidelines for Improving Bus Operator Health and Retention* and to agencies that responded to a query on the American Public Transportation Association (APTA) Listserv. Agencies selected from both sources reported tracking metrics on costs and benefits of their wellness programs. The project team next applied selection criteria including willingness to participate, charted out respondents in terms of representation by size and geography, and made telephone calls to gain information about the programs and to verify whether the agencies would be willing to contribute data to participate in the benefit-cost analysis.

A.1 Case Study Identification: Local Health Promotion Programs That Measure Cost-Effectiveness

To address the research question about tools and techniques that can be used for measuring program costs, benefits, and effectiveness, the project team conducted a series of case studies that featured a benefit-cost analysis. The case studies detail the features of a series of health and safety promotion programs at several transit agencies. Desirable sites had either already conducted some form of a benefit-cost analysis or had sufficient data to allow the project team to conduct one. A narrative on the programs at each of the selected sites augmented the quantitative analysis.

The Econometrica team created a list of the agencies that had tracked metrics for programs or estimated a past or projected return on investment (ROI) based on information from a prior TCRP project. If an agency tracked a program or estimated the ROI, it was more likely to have data that allowed the team to measure program costs and benefits. This list served as the preliminary list of potential candidates for benefit-cost analysis case studies.

A second source of case studies was developed based on responses to a query sent by the project team to the APTA's Workforce Development Committee Listserv. The query asked for interest and responses to questions that allowed the project team to apply preliminary screening criteria. The query asked about transit agencies with health promotion programs that maintain performance metrics. The APTA Listserv recipients include more than 300 agency representatives (although multiple recipients may correspond to the same agency).

The agencies and unions identified through these two sources constituted a preliminary list from which the project team could select sites for case studies. Information in the preliminary list

included agency name, size, region, and type of service. The Econometrica team then submitted the preliminary list to two rounds of evaluation criteria.

A.2 Preliminary Screening

This section lists the program characteristics that were required to pass the preliminary screening for consideration as one of the benefit-cost analysis case studies. Much of the information needed for the preliminary screening was found by reviewing the information provided in *TCRP Report 169* and the email responses to the APTA query.

1. **Program is located in the United States.** As the data analysis was to be based on U.S. data, the list for potential case studies excluded Canada.
2. **Program targeted the frontline worker population, at a minimum.** Additionally, it was possible to isolate the frontline workers from other participants.
3. **Agency/union had at least 20 participants in its program.** This criterion provided for a benefit-cost analysis with sufficient inferential power.
4. **Program used one of the following metrics to measure cost-effectiveness: absenteeism, sick days, turnover, worker disability, workers' compensation, smoking cessation, weight/Body Mass Index (BMI) reduction.**
5. **Willingness to participate.** Agencies were encouraged to participate through potential gain from the results of the study: These agencies had already undertaken some benefit-cost analysis, and by participating in this research project, they would benefit from a more detailed analysis of their program.

Potential case studies that met the criteria of this initial screening were subjected to a secondary screening that focused on data availability.

A.3 Secondary Screening

With input from the project panel, the Econometrica team developed a list of questions for secondary screening based on data availability. Each agency that passed the preliminary screening was asked questions to determine the availability of data in the following categories:

1. Occupational categories of targeted employees;
2. Program type (comprehensive health promotion, smoking cessation, weight management, nutrition, cardiovascular disease prevention, ergonomics, etc.);
3. Specific program activities;
4. Number of participants in the program;
5. Length of the program;
6. Existing program benefit-cost analysis (conducted by program staff or external researchers);
7. Program costs (administrative costs, opportunity costs of workers' time, incentive payments);
8. Program benefits (healthcare claims costs, workers' compensation claims cost, time lost/absenteeism, disability, productivity, turnover, etc.); and
9. Program impact on other operational areas (scheduling, hiring, safety, training, work assignment/work accommodation, procurement, etc.).

Preliminary case study identification and data collection occurred during the secondary screening. Candidate agencies whose programs passed the second screening then received follow-up communications from the project team to collect additional data for the narrative and benefit-cost analysis.

Next, the selected case studies were analyzed for representation among categories of interest. The goal was at least five case studies representing a diversity of program types, regions, and size and type of agency. The case studies would include benefit-cost analysis if data on program participation and absenteeism and/or workers' compensation were available for individual transit workers. Five case studies were examined, of which four provided individual-level data that could be used for statistical modeling.

A.4 Case Study Narratives

The project team compiled a narrative for each site selected as a case study. The narrative described the general landscape of the agency and the types of workforce health and safety programs available to transit workers. The narratives were based on information gained from communications with each agency, including a phone interview and program literature from the agency's website or other materials provided by the agency. Developing the narratives allowed the project team to explore some of the outcomes of health conditions that have costs that are difficult to measure directly. Because such costs are difficult to quantify, they could not be used as dependent variables in the benefit-cost modeling; however, they added to the discussion in the literature review. The analysis of the various site characteristics and methods used to measure performance, strengths, and weaknesses is provided in the body of this report.

A.5 Case Study Benefit-Cost Analysis

The goal of the benefit-cost analysis was to produce estimates of the impact of programs administered by transit agencies on transit worker health and overall safety. The first step of the analysis was to identify those factors that may affect transit worker health or safety. Based on the literature review and the process discussed above, the project team identified variables and used as many variables as were available at each site. In general, demographic (age, race, and gender) and occupational (operator, maintenance) variables were included.

The models produced estimates of the effects of specific programs on health or safety (insofar as it was possible to capture these data). The models could isolate the potential effects of both a program and a specific demographic characteristic. For example, a program might be effective at decreasing some adverse health issues for persons under age 50, but not for older persons. The analysis was designed to identify those distinctions.

The analysis was constructed as a series of regressions that were run for each year (annually) and in aggregate (for all years pooled together). A single observation was created from data at the worker level and included demographic, economic, geographic, program, and health variables. The models were designed to evaluate changes in health over time, then ascribe the changes to either demographic or structural changes; thus, a hypothetical regression analysis controlling for race, gender, income, and rural location might estimate that 20 hours spent on a specific program decreases sick days by 6%. The models also allowed for sensitivity analysis of changes in population components or estimated effects—that is, the estimated effects could be varied over a range to determine if small variations had an outsized influence on the results.

Measures of program outcomes were typically the dependent variables (e.g., sick days, disability, wages lost), whereas the demographic and occupational variables were the independent variables. This structure helped control for the effects of the program-related independent variables in the model. Health claims costs or health costs were not used as a dependent variable because, for various reasons, it is difficult to isolate and compare health-related costs. Employers may not have access to all sources of employee health-related payments (e.g., Medicaid, Medicare, employee out-of-pocket payments) to generate accurate health costs for use in analyses. Furthermore, definitions of inputs and outputs vary, which means the costs as collected and reported by different sources may be difficult to compare.

Table A-1 shows a list of potential dependent variables.

Table A-1. Potential dependent variables.

Dependent Variables	Value
Absent Days	Count
Sick Days	Count
Disability Days	Count
Workers' Compensation Indemnity Payments	Dollars

Table A-2 shows a list of potential independent variables.

Table A-2. Potential independent variables.

Independent Variables	Value
Duration of Length Participant Spent in Program	Hours
Type of Program	= 1 if general = 2 if smoking = 3 if weight
Occupational Category	= 1 if operator = 2 if maintenance = 3 if other
Years in Occupation	Count
Age	Years
Race	= 1 if Black = 2 if White = 3 if Asian
Gender	= 1 if female
Program Participant	= 1 if participant
Participation × Age	Interaction term

To produce empirical estimates that provided evidence on the impact of health programs administered by transit agencies and their effect on transit worker health and overall safety of transit agencies, the project team used a series of regressions. For count or ratio variables, ordinary least squares (OLS) models were run. The dependent variables depended on what was available for each agency (e.g., data on absent days, lost wages, number of sick days and workers' compensation payments.) The following equation provides an example of the analysis:

$$Y\ or\ p = \beta_0 + \beta_1 programparticipation + \beta_2 race + \beta_3 female + \beta_4 age + \beta_5 occupation + \varepsilon$$

The results allowed for an analysis of the characteristics of programs that produced measures of cost savings or net positive benefits that could be quantified, isolated, and potentially applied successfully in other situations. Although past studies have included profiles of successful strategies to promote the health and safety of public transit workers, there have been limited examples of strategies that provided net benefits (benefits minus costs) through empirical testing, such as the testing performed through the benefit-cost analysis in this research.

A.6 Screening Survey Design and Distribution

The Econometrica team used two sources to generate a list of agencies and programs for case studies. First, the team examined agency and union survey responses in *TCRP Report 169* to identify agencies that, at the time of the study, reported having tracked metrics for programs or estimated past or projected ROIs. The rationale behind this criterion was that if an agency had tracked a program or ROI, it would be more likely to have the data that would allow the team to measure program costs and benefits. Data from the agency and union survey responses were extracted and filtered to identify locations and contacts that met the project team's preliminary criteria. Based on this initial analysis, 16 programs reported by agencies fit the criteria. Additional candidate agencies were identified from a query to the APTA Listserv, which also had to meet the preliminary screening criteria.

The project team then drafted and edited initial (opening) emails to be sent to the selected candidate agencies. Tailored emails were sent to candidate agencies identified from *TCRP Report 169* and a more generic email was sent to candidate agencies identified from responses to the APTA Listserv query. Both groups received the same set of survey questions, which were entered into SurveyGizmo (an online survey engine) and provided by a link in the emails. The estimated time to respond to the questions in the survey/screening tool was about 5 minutes.

Many follow-up emails were sent to the 16 agencies from the prior TCRP project, either to the initial agency or union contact or to other contacts within these agencies who could encourage a response. Five union respondents indicated one or more perceived improvements in metrics. In most cases, however, the local unions did not have access to the type of detailed data required by this study, except for a joint trust fund program. Based on these union leads, the research team reached out to contacts in senior management, joint trust fund administrators, and wellness specialists at these locations to obtain the necessary screening data.

Simultaneously, the team requested that APTA send out an email to the Workforce Development Committee Listserv. A week later, APTA sent a reminder email to the Listserv.

A.7 Survey Responses

After deleting the "ghost responses," for which no agency name was provided and only one or two questions were answered, the team determined that a total of 29 responses were received. Nine responses were considered partial responses—the respondent filled out the agency name and answered the question "Does your agency have a workplace health protection and promotion [WHPP] program or carry out related activities that target frontline operations and/or maintenance employees?" These responses did not contain enough information to determine the availability of

A-6 Improving the Health and Safety of Transit Workers with Corresponding Impacts on the Bottom Line

data and the agency's willingness to participate. They did not provide a detailed program description, even though some did indicate the existence of a program.

Twenty-one respondents completed the majority of the questions in the survey, and of those, 17 indicated that they had active programs. Three respondents indicated that they did not wish to participate in the study, leaving 14 good leads for potential sites for the next step. Of these, 4 respondents tracked only program outputs (participation rate) and non-quantitative outcomes such as employee feedback or behavioral changes. These agencies would not be strong candidates for the full benefit-cost analysis, but they were still pursued if they had some raw data that could be analyzed.

Ten sites fully satisfied the initial screening criteria set out by the team (based in the United States, targeting frontline employees, with at least 20 participants, tracked program metrics, and willingness to participate). Three of the sites had calculated the ROI for their worksite health promotion programs. To ensure an adequate number of final case studies, the team decided to pursue all 14 "good" leads to discuss case study engagement.

Given the design of the screening survey and the wording of the emails, respondents were highly likely to self-select based on the existence of their programs and metrics they tracked. The survey was not intended to provide a scan of the industry practices, but rather to identify enough locations for the case studies. Therefore, the number of responses generated was considered adequate.

A.8 Site Selection Matrix

The 14 potential sites in Table A-3 were analyzed for representation among categories of interest including agency size, types of services provided (i.e., bus, heavy rail, and light rail), union representation, and region.

A.8.1 Agency Size

No official categorization of public transportation agencies by size is available from APTA or other sources, such as the FTA's National Transit Database; however, many agencies are ranked by annual unlinked passenger trips (ridership). For the initial analysis, the research team defined the following agency size categories based on unlinked passenger trips in 2015:

- Large: 100 million passenger trips or more,
- Medium: 15–100 million passenger trips, or
- Small: Less than 10 million passenger trips.

Based on this categorization, the 14 potential sites included four large, four medium, and six small agencies.

A.8.2 Service Modes

The potential sites provided a variety of transit modes, from fixed-route buses and trolleybuses to various rail services to demand-response service and vanpools.

A.8.3 Union Representation

Two of the potential sites were non-union. Because the majority of the frontline workers in public transportation are organized, this distribution indicates a good representation of the industry.

A.8.4 Regions

The proposal indicated the following six regions: Northeast, Southeast, Southwest, Pacific, Northwest, and Midwest. As an official map with these divisions was unavailable, the team decided to use the map from the U.S. Census with four divisions: West, Midwest, Northeast, and South.

Table A-3. Potential sites for case studies (ranked by ridership).

Agency Name	Approx. Number of Participants	2015 Agency Ridership (Thousands)	Agency Category	Bus	Heavy Rail	Light Rail	Commuter Rail	Hybrid Rail	Streetcar	Trolleybus	Bus Rapid Transit	Commuter Bus	Demand-Response	Vanpool	Union	Geographic Area–Census
Los Angeles County Metropolitan Transportation Authority (LACMTA)	4,000	457,356	Large	✓	✓	✓					✓			✓	Y	West
Southeastern Pennsylvania Transportation Authority (SEPTA)	2,000	344,297	Large	✓	✓		✓		✓	✓			✓		Y	Northeast
King County Transit	5,000	126,268	Large	✓					✓	✓			✓	✓	Y	West
Denver Regional Transportation District	1,000	102,250	Large	✓		✓							✓		Y	West
Metro Transit (Metropolitan Council)	2,100	85,832	Medium	✓		✓	✓								Y	Midwest
Utah Transit Authority (UTA)	738	46,722	Medium	✓		✓	✓					✓	✓	✓	Y	West
Capital Metro	800	34,700	Medium	✓			✓	✓					✓	✓	Y	South
Regional Transit Service	650	17,292	Medium	✓									✓		Y	Northeast
Transit Authority of River City	100	14,684	Small	✓									✓		Y	South
OmniTrans	100	14,391	Small	✓									✓		N	West
Champaign–Urbana Mass Transit District	100	13,536	Small	✓									✓		N	Midwest
Indianapolis Public Transportation Corporation, Inc.	500	9,952	Small	✓									✓		Y	Midwest
Intercity Transit	100	5,135	Small	✓			✓						✓	✓	Y	West
Des Moines Area Regional Transit Agency	85	4,795	Small	✓									✓	✓	Y	Midwest

APPENDIX B

Case Study and Benefit-Cost Data Collection

There are two parts to each case study: the narrative, with background about the program, and the benefit-cost analysis. The research team compiled short narratives for each case, describing the types of workforce health and safety programs available to transit workers and the general landscape of the agency. If sufficient data were available, a full benefit-cost case study was conducted. The Econometrica team met the goal of producing at least five full case studies from the 14 identified sites, a goal that was dependent on the cooperation and availability of data from the sites.

B.1 Case Profile/Narrative

For each potential case study location, the research team reached out to the screening survey respondent to schedule an initiation call introducing key team members and roles; explaining the background, scope, and timeframe of the study; collecting narrative information for the case profile; and probing the availability of benefit-cost data. Follow-up interviews were conducted with other key informants from the agency or local union. Information collected included:

1. Program goals (targeted health and safety problems);
2. Targeted worker populations;
3. Program funding;
4. Length of the program;
5. Program type (comprehensive health promotion, smoking cessation, weight management, nutrition, cardiovascular disease prevention, ergonomics, etc.);
6. Specific program activities;
7. Qualitative program benefits (e.g., employee feedback, behavioral changes);
8. Program impact on other operational areas (scheduling, hiring, safety, training, work assignment/work accommodation, procurement, etc.);
9. Existing program benefit-cost analysis (conducted by program staff or external researchers);
10. Participation rates by mode and occupational categories;
11. Program costs (administrative costs, opportunity costs of workers' time/average wages, incentive payments); and
12. Identification of any quantitative program benefits and availability of data such as:
    a. Absenteeism/time lost,
    b. Workers' compensation claims cost,
    c. Disability rates,
    d. Turnover,
    e. Injuries,

f. Health status changes (e.g., BMI, smoking rates, etc.), and
g. Healthcare claims costs.

This round of information collection also served as the secondary screening to finalize case selections. The final case study locations were determined by the agency's cooperation in furnishing the data listed in items 10, 11, and 12. Several locations indicated that they either did not track participation data or would not be able to provide access to individual-level data.

B.2 Benefit-Cost Data Collection

Depending on findings from the secondary screening call, the research team sent customized lists of data requests to agencies that had promised to share data. Individual-level benefit-cost data collected including the following:

1. Excel files (or tab-delimited files) with downloads of the number of personal days and number of sick days with employee names or employee ID numbers, gender, date of birth, occupational code, and date of hire and departure (if applicable) for 2011 through 2018 (or whatever historical years the organization has) for all employees;
2. Excel files (or tab-delimited files) with downloads of workers' compensation payments for 2011–2018 with employee names or employee ID numbers for all employees;
3. Excel files (or tab-delimited files) with race with employee names or employee ID numbers for all employees;
4. Employee feedback survey results;
5. Data/reports on healthcare claims from 2011 (starting the year before the wellness efforts began and--if unavailable for 2011--as early as the data were available) through 2018;
6. An analysis of healthcare claims based on prevalence and cost; and
7. The claims data that come in August following nutrition efforts of the last year.

All agencies were asked to respond to items 1–3, and requests for additional data (items 4–7) were based on the data the agency said it had available. Four agencies provided more than 75% of the data for items 1–3. One agency provided data for all seven items.

The project team asked for and received health condition prevalence data from one agency, and asked for and received data on types of injuries from workers' compensation data from another agency. Chapter 4 of this report details some of the findings on prevalence rates that agencies requested and/or had available from their insurers.

The following agencies provided both narrative information and individual-level data that appeared sufficiently comprehensive for a benefit-cost analysis:

- Regional Transit Service (RTS), Rochester, New York;
- Transit Authority of River City (TARC), Louisville, Kentucky;
- Indianapolis Public Transportation Corporation, Inc. (IndyGo), Indianapolis, Indiana; and
- Des Moines Area Regional Transit Agency (DART), Des Moines, Iowa.

The LA Metro did not provide individual-level data, so regression modeling was not possible for this location. A fifth case study was conducted based on aggregate data obtained from Los Angeles County Metropolitan Transportation Authority (LACMTA). The results of the case study analysis are included in the main report; however, because the data available from California differed in format from the data provided by the other four agencies, a case study narrative was not developed for inclusion in this appendix or Appendix C.

Data use agreements were signed with all five agencies, setting forth guidelines for the secure management and protection of individual-level data in accordance with Federal Information Security Management Act (FISMA) requirements and allowing the Econometrica team to possess the received data until the end of its contract with the National Academy of Sciences, at which time Econometrica would provide the agency with a certification of destruction of the data. In the fourth case, data were provided using employee IDs, so all individual-level data remained anonymous.

APPENDIX C

Regression Models for Indianapolis, Indiana; Rochester, New York; and Louisville, Kentucky

C.1 Limitations of Regression Analysis

The results of the Indianapolis Public Transportation Corporation (IndyGo), Rochester Regional Transit Service (RTS), and Transit Authority of River City (TARC) health promotion program evaluations, combined with employee data, could not substantiate any statistically significant improvements on the health outcomes for participants in health promotion programs as compared with non-participants when it comes to data-driven benefits, measured in this study as changes in absenteeism, workers' compensation, and turnover. The results of the Des Moines Area Regional Transit Authority (DART) health promotion program did show a statistically significant effect associating participation in the program with reduced absenteeism.

The majority of studies have not shown that wellness programs affect the bottom line, as measured by absenteeism and other metrics. A study conducted by the National Bureau of Economic Research of 4,800 university employees showed statistically insignificant differences between those who participated in an incentivized wellness program and those who did not, as measured by sick days and healthcare spending (Jones, Molitor, and Reif 2019). Other studies have also found behavioral changes among participants in healthcare (e.g., rate of hospitalization) but no reduction in overall costs to the employer (Gowrisankaran, et al. 2013). Other analyses reviewing ROIs have found mixed results among health promotion programs (Baxter, Sanderson, Blizzard, and Palmer et al. 2014).

The lack of statistical significance may be due to several factors. First, variables measuring individual health improvements may not be appropriate to obtain a representative measure of program impacts. Tracking sick days is an obvious potential metric, but it may be that all workers take their allotted sick time, regardless of their health. Assuming employees use all of their days, the metric would then measure the number of sick days an employee was granted rather than reflect an employee's actual health—or the number of days an employee was sick. Possible improvements to this metric involving the addition of paid personal and/or unpaid days to sick days do not necessarily contribute toward a reliable measure. Employees should have every incentive to take any kind of paid leave (e.g., personal leave in addition to sick leave), and unpaid leave could be the result of a one-off period used for a family emergency not related to the employee's personal health.

Workers' compensation could be another promising potential metric, but it has done a poor job for many reasons, including the fact that only a small percentage of the population receives it (5%–8% annually, from IndyGo data). The infrequency of use of workers' compensation can

create fluctuations from year to year in the aggregate compensation, particularly if the population is not large enough to smooth this sum out; were there a downward trend in compensation over time, infrequency coupled with a small population would create high variability from year to year and the downward trend might not be detected.

It is possible that an agency's wellness program may have been substantially beneficial, but in addition to the benefits not being picked up by the metrics, the effects of the program may have been diffused. For example, the benefits may include improvements in sleep, lower levels of pain when walking or conducting other activities, less fatigue during the day, and more overall energy—that is, benefits that are spread out to different areas but do not register enough in any one metric to be detected by observable variables. Also, the program may not have been in place for a long enough time to pick up these diffuse effects.

The programs in these case studies were not designed to measure changes in the risk factors of smoking and weight loss, which exact a toll on healthcare costs. Currently, these are intermediate variables that may be measured in outcome variables from annual health insurance claim statements (e.g., those related to respiratory illness or cardiovascular illness).

The benefit of an agency program may be an infrequent event with a large payoff. For example, if a blood pressure screening prevents a potential death, then even one prevention every 20 years would be extremely valuable; however, such an event may not happen during the observed period (in the case of the 5–6 years of the IndyGo and RTS programs). Thus, the duration of the study period was inadequate to capture all the benefits that might accrue to the program.

A program may have been substantially positive, but taken individually, the measurable effects may not have been strong enough to show a significant result, even using ideal health promotion metrics (if they were available). In other words, the participants may have become healthier, but the improvements may not have manifested in ways measured (or easily measurable) by the program. The program may have had positive spillover effects outside the workplace—for example, by improving the quality of leisure time—or it may have contributed to better health habits of family members. This might explain self-reported results, such as surveys of employers and employees that report positive outcomes from the wellness programs when the data-driven metrics do not reflect this.

Self-selection into a program also may affect the estimated effects. Statisticians are always on the lookout for potential self-selection issues. The hope is that unhealthy workers would select into a program at a higher rate than healthier workers, meaning that the program would get more positive results for a given expense of resources than would otherwise be expected if participants were randomly chosen to participate. The healthier workers might feel healthy enough to forego any health promotion program; therefore, participants would have large gains on a per employee basis. Instead, it seems that the reverse might happen: Employees who are already healthier may have taken advantage of the program, whereas less-healthy employees failed to participate or may even have resisted participating. The reasons for employee participation or non-participation in voluntary programs are variable, and a detailed analysis of those motivations was not within the scope of this research project. This will be a continuing research question to explore in future case studies where participation in the health promotion programs is voluntary.

There are self-selection issues specific to the populations at the different agencies. For IndyGo, an employee receives access to the health promotion program if he or she opts in for insurance. Those employees who do not opt in for insurance do not receive access to the program and act as the control group. As Bushnell notes, those who obtain insurance through their spouse may work for employers offering less generous health benefits and may have different working conditions and health characteristics than those who have spouses with more generous plans (Bushnell, Li, and Landen 2011). Therefore, it is not necessarily the case that those employees who could best take advantage of the programs are the ones who actually do so. If opting for insurance is not correlated with initiative, drive, and enthusiasm—which it likely is not—then the IndyGo non-participants are closer to a classic control group. The analysis would pick up the pure effect of the program. This is good for gauging the effect of the program compared with programs in other localities, but it does not necessarily indicate that the employees who are most likely to benefit from the program participate in it. Any estimated effects are less likely to be detected as statistically significant.

For the RTS groups examined, the participants were the onsite employees who had access to the programs and the gym at the headquarters location, whereas the control group was made up of offsite employees, based on the assumption that they had less access to those options at headquarters. However, offsite employees may have higher rates of utilization of health and wellness activities than was assumed. The higher the offsite groups' utilization, the less likely it is that the true effects of the health promotion programs can be isolated, measured, and deemed a statistically significant improvement.

For TARC and DART, participation in the wellness program appeared to be correlated with enthusiasm for the program's activities, which could mean that the employees who benefited from the program were not the ones who would have received the greatest marginal gain from participation. In other words, self-selected participants were likely more fit to begin with. Such self-selection can be interpreted as a contributing factor for participants in workshops like those at DART or in more rigorous activities at TARC, like boot camps.

An analysis by RAND found some meaningful improvements in exercise frequency, smoking, weight loss, and cholesterol control; however, the analyses could not "account for unobservable differences between participants and non-participants such as differential motivation to change behavior," however (Mattke et al. 2013). Thus, the factor of self-selection could play a role in a result indicating that program participants were more likely to improve their health if these participants were the ones that were more motivated to change behavior.

Even if a factor of self-selection is related to participation in programs, the gains in outcomes that the programs achieve are material only for those participants. These gains may not, therefore, be associated with the targeted populations most in need of marginal gains (i.e., the population with the most at-risk factors or prevalence of conditions).

C.2 Regression Modeling

Linear regression models designed to test whether a factor changes an outcome—here, whether wellness programs improve health—follow a similar construction. That construction was applied to four of the five metropolitan transit agencies analyzed in this study. The aggregated data from California was examined using a different approach, so it is not addressed in this appendix.

Three key features of the analysis were:

1. The observations that make up the data were at the employee level. That is, each "observation" represented an employee of the transit agency, regardless of whether that employee did or did not participate in a wellness program.
2. Following standard practice, the dependent variable was a measure of the health differences before and after the program was initiated (again, regardless of whether the employee did or did not participate in any of the programs).
3. The key independent variable in the model indicated if (and/or the extent to which) the employee participated in the available program(s). If that variable was statistically significantly different from zero, then that was an indication that the wellness programs benefited employee health.

Factors that are not included will be unobserved by the regression model, which can distort results. Therefore, a carefully designed model includes (that is, controls for) as many factors as possible. In the case of this project, the regression model included as many demographic, geographic, and economic factors as feasible so that effects on health that were due to these factors were not incorrectly credited (for good or bad) to whether or not the employee participated in the wellness program.

For example, if younger employees are more likely to participate in a wellness program and young peoples' outcomes also remain stable for approximately 10 years, then if age is not controlled for (i.e., if age is not included as a variable in the regression), the program will appear less effective than if there had been a more representative mix of people by age. In this research, if a wellness program's effects were expected to differ by age, then an interaction term of the indicator variable times age was added to the model as an independent variable to account for that effect.

The all-new primary source data collected on employee wellness program participation, health conditions, and demographic characteristics were relatively similar across the four major metropolitan transit agencies examined. Information was available on sick days (and other absentee days) and on workers' compensation, which allowed the project team to construct a dependent variable for changes in health before and after the programs were initiated. Information on the employees who did and did not participate in the programs also was collected for use in constructing the key independent variable on program participation. Information collected on age, gender, and race of each employee served as controls—independent variables that allowed the true program effect on health to be isolated.

C.3 Indianapolis (IndyGo)

The model controlled for demographic factors that affect health to isolate the effect due to the wellness program. The model also employed a dependent variable that measured a potential health improvement due to the wellness program—the change in absent hours before and after the initiation of the program.

Many potential independent variables were considered for inclusion in the regressions presented, as were interactions with the key independent variable measuring program participation. After considering various possible linear regression equations, two representative equations were selected to control for (1) age and gender and (2) age, gender, and race. (The second equation

included an additional variable to capture effects of race.) Table C-1 presents the results of the two regressions.

Table C-1. Effect of health promotion program on absent hours, IndyGo.

Ordinary Least Squares (OLS): Change in Hours	Estimate	t-Stat	Estimate	t-Stat
Intercept	–40.6	–0.59	–44	–0.64
Ever in Program	40.5	1.77	37.9	1.65
Age	0.6	0.53	0.9	0.76
Female	15.1	0.64	7.2	0.29
White			–35	–1.21
Observations	252		252	
R^2	0.013		0.027	
Adjusted R^2	0.002		0.016	
F-Statistic	1.131		2.445	

In both equations, the dependent variable was the change in absent hours from 2011 (the year before the program was instituted) to the most recent full year that the worker was employed (through 2017). The key independent variable in the equation was whether the employee was ever in the program. The interaction terms were designed to detect effects due to the program, controlling for age, gender, and (in the second regression presented) race.

In this model, the base consisted of workers of African-American descent (making up 77% of the population), and workers of Asian descent, Native American descent, or "two or more" races/ethnicities (1%). "White" was used as the 0–1 race variable. "Male" (65% of the population) was used as the base, and "Female" was used as the 0–1 gender variable. No variable in the model, including the intercept, was statistically significantly different from zero at the 10% level (t-stat for a one-sided 90% confidence level is 1.28). The key variable had t-stats of 1.77 and 1.65 (significant at even the one-sided 95% level), but they were the incorrect sign, indicating that participation in the program *increased* absentee hours. Even the F-Statistic, which measures the significance of the regression in its entirety (meaning that if even one of the dependent variables is significant, the regression will be significant) was insignificant (1.13).

One other variation on the above pair of regressions was presented. The two runs shown in Table C-2 have the same independent variables as those listed above, but the dependent variable is slightly altered. In Table C-1, the dependent variable was the change in absent days from 2010 to the most recent year. In Table C-2, it is the change from 2010 to 2013 (the first full year after the program was established). The rationale was to try and isolate the change that happened soon after establishment of the program but before all "unobservables" about an employee (the error term) became notably different from 2010. As many other unobserved factors may have come into play from 2011 to 2017, using absentee days from 5 years later introduced uncertainty into the estimate—meaning the estimate was much less likely to be statistically significant.

Table C-2. Effect of health promotion program on absent hours, 2010–2013.

OLS: Change in Hours	Estimate	t-Stat	Estimate	t-Stat
Intercept	38.2	0.59	35.2	0.55
Ever in Program	17.0	0.79	14.8	0.69
Age	0.7	0.68	0.9	0.88
Female	29.3	**1.33**	22.6	0.99
White			–29.7	–1.09
Observations	252		252	
R^2	0.009		0.014	
Adjusted R^2	–0.003		–0.002	
F-Statistic	0.771		0.878	

The results were not much different using this variation on the dependent variable. The key variable of whether the employee was in the program was still statistically insignificant from zero at the 10% level. Only "Female" was significant at the 10% level (the t-stat of 1.33 was greater than one-sided 90% confidence level cutoff of 1.28). This second set of regressions demonstrated the robustness of the result that none of the independent variables—in particular, the program-participation variables—were statistically significant.

C.4 Rochester (RTS)

The results from Rochester on the detection of a wellness program effect on health were similar to those for Indianapolis. The model controlled for demographic factors (age, gender, race) which affect health to isolate the effect due to the wellness program. The model employed a dependent variable that measured a potential health improvement due to the wellness program—the change in absent hours before and after the initiation of the program. Table C-3 presents the regression.

Table C-3. Effect of health promotion program on absent hours, RTS 2011–2017.

OLS: Change in Hours	Estimate	t-Stat
Intercept	28.2	3.63
Onsite	-2.0	–0.73
Age	-0.5	–4.04
Female	-2.8	–0.97
White	5.3	1.88
Observations	466	
R^2	0.036	
Adjusted R^2	-0.027	

The dependent variable was the change in absent hours from 2013 (the year before the program was instituted) to the most recent full year that the worker was employed (through 2017). The key independent variable in the model was whether the employee was onsite, because onsite employees had access to the programs and the gym at the headquarters.

This variable was designed to pick up any effect due to the program, controlling for age, gender, and race. African-American workers (61% of the population) were kept as the base, and "White" was used as the 0–1 race variable. "Male" (72% of the population) was used as the base, and "Female" was used as the 0–1 gender variable. The results showed that the coefficient for onsite was negative, indicating that onsite employees (in the model, the participants in the wellness program) were associated with 2.04 fewer hours of absentee leave than offsite employees. The t-

statistic for this coefficient was not significant at the 10% levels of significance, however, so the results were not substantiated.

None of the variables in the model were statistically significantly different from zero except for one—age—for which the estimated effect was in the wrong theorized direction. With a t-statistic of -4.04, the age variable was estimated such that an employee was associated with 0.52 fewer hours of sick leave in a year for each additional year of age.

In this analysis, the F-Statistic was insignificant (0.71). The F-Statistic measures the significance of the regression in its entirety—meaning that if even one of the independent variables is significant, the regression will be significant. The insignificance of any of the independent variables could have been for any combination of the reasons listed in this appendix, especially as the offsite employees may have had a higher rate of program/gym utilization than what was assumed (which is zero).

C.5 Louisville (TARC)

A wealth of descriptive statistics were culled from the primary source data on the wellness program participation, health, and demographics of TARC employees. Beginning with the health information collected, Figures C-1, C-2, and C-3 compare the differences in average annual absenteeism over time by participation (or not) for three wellness programs—boot camp, Humana Go level, and bioscreen attendance. All three graphs present the average annual absentee hours for frontline employees for the four years from 2015 to 2018.

Figure C-1 shows that frontline workers who participated in boot camp had a much lower average total number of hours of absenteeism than nonparticipants. Boot camp attendees averaged approximately 20 hours of annual sick leave, whereas workers who did not attend averaged three times that (60 hours). Only a small percentage of workers participated in the boot camp, however: the number of participants was 11 in 2015, and 12 in each year from 2016 through 2018, while the number of employees increased from 305 to 365 between 2016 and 2018. Consequently, participation was between 3% and 4% for each of the four years (2015, 2016, 2017, and 2018).

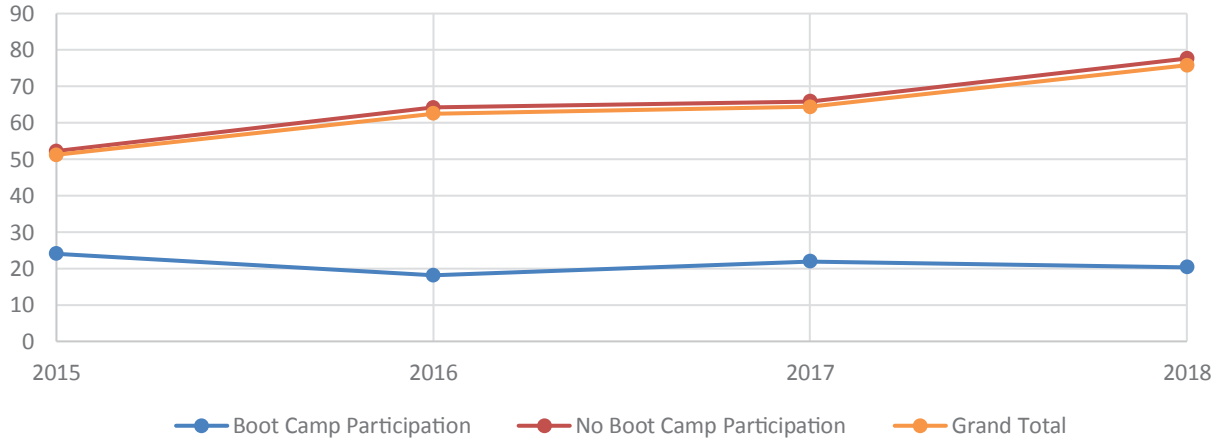


Figure C-1. Average annual total absentee hours, frontline employees' boot camp participation, Louisville, Kentucky, 2015–2018.

Figure C-2 compares average annual total absentee hours between frontline employees with a high Humana Go level (blue) and employees with a baseline Humana Go level (red). The graph shows little difference in the absentee levels between the two levels.

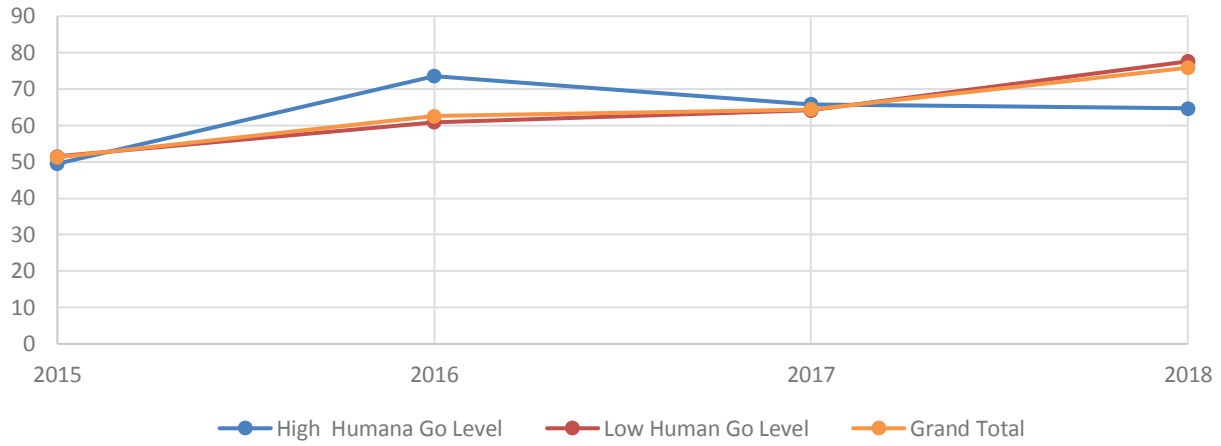


Figure C-2. Average annual total absentee hours, frontline employees' Humana Go level, Louisville, Kentucky, 2015–2018.

Figure C-3 compares the average annual total of absentee hours between frontline employees who attended a bioscreen (blue) and those who did not (red). This graph shows little difference between the two groups until 2018, when the average for those attending (60 hours) is 25% less than those who did not (80 hours).

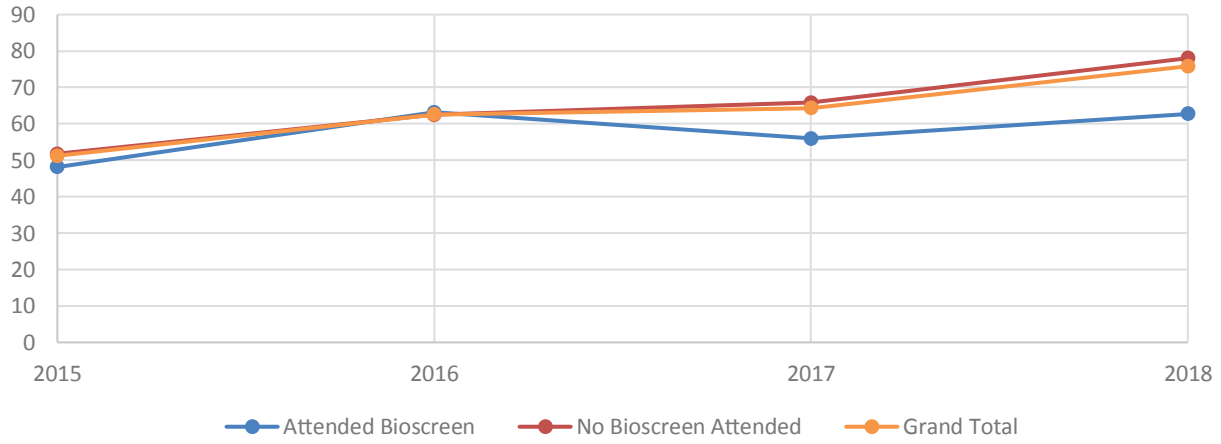


Figure C-3. Average annual total absentee hours, frontline employees' bioscreen attendance, Louisville, Kentucky, 2015–2018.

Three distinct multiple regression equations were developed, each with an independent variable to isolate the possible health effects of the different wellness programs: (1) Humana Go level, comparing frontline employees with the baseline (blue) status and higher level statuses (bronze and silver); (2) boot camp attendance, comparing frontline employees who attended at least one boot camp with those who attended none; and (3) bioscreen attendance, comparing frontline employees who went to at least one bioscreen and those who attended none. The models contained observations at the employee level, the change in the number of absentee hours from before to after program participation as the dependent variable, and controlled for age, gender, and race.

The health program was introduced in January 2016. To capture any lagged effects, three time periods were compared in creating the dependent variables for the Humana Go level and boot camp equations. They were (1) 2016–2015, to compare the year of program introduction to the baseline; (2) 2017–2016, to compare the year after the introduction to the year of introduction; and (3) 2017–2015, to compare the year after introduction to the baseline. For the bioscreens, time periods were pre- and post-2017 Quarter 2, because the first bioscreen was introduced at that time. Table C-4, Table C-5, and Table C-6 show the results of these runs. Any factors significantly different than zero at the one-sided 90% level of confidence (t-stats greater than 1.28) that are the correct theorized sign are denoted in bold.

Table C-4. Effect of Humana Go level on absent hours, TARC 2016–2015, 2017–2016, and 2017–2015, OLS.

Dependent: Change in Absent Hours	(1) 2017–2015		(2) 2016–2015		(2) 2017–2016	
	Estimate	t-Stat	Estimate	t-Stat	Estimate	t-Stat
Intercept	-38.5	-0.48	118.3	1.2	60.4	0.6
Humana Go Level	63.3	1.55	-51.7	-1	19.9	0.39
Age	2.4	**1.56**	-1.1	-0.59	1.3	0.68
Male	-46.6	**-1.51**	-44.1	-1.15	-74.7	**-1.96**
White	-42.5	**-1.33**	-1	-0.02	-41.2	-1.04
Observations	361		386		361	
R^2	0.026		0.008		0.021	
Adjusted R^2	0.015		-0.003		0.01	

Table C-5. Effect of boot camp participation on absent hours, TARC 2016–2015, 2017–2016, and 2017–2015, OLS.

Dependent: Change in Absent Hours	(1) 2017–2015		(2) 2016–2015		(2) 2017–2016	
	Estimate	t-Stat	Estimate	t-Stat	Estimate	t-Stat
Intercept	-7.7	-0.1	98.6	1.02	72.3	0.74
Boot Camp Participation	-47.2	-0.62	-2.5	-0.03	-43.8	-0.47
Age	2	1.3	-0.9	-0.46	1.1	0.59
Male	-48.6	**-1.57**	-42	-1.09	-74.6	**-1.96**
White	-37.6	-1.16	-2.2	-0.06	-38.1	-0.96
Observations	361		386		361	
R^2	0.021		0.005		0.021	
Adjusted R^2	0.01		-0.005		0.01	

Table C-6. Effect of bioscreens on absent hours, TARC 2016 Quarter 3–2018 Quarter 2.

Dependent: Change in Absent Hours	2018 Q2–2016 Q3	
	Estimate	t-Stat
Intercept	-174.2	**-3.02**
Bioscreens	-6.9	-0.23
Age	1	0.91
Male	35.6	1.47
White	41.9	1.73
Observations	565	
R^2	0.016	
Adjusted R^2	0.009	

Although some of the control variables in the equations presented are the correct sign and are statistically significant at the one-sided 10% level (1.28), none of the wellness participation variables are statistically significant.

APPENDIX D

Implementation Memo

D.1 Overview

TCRP Research Report 217 presents the results of TCRP Project F-26, "Improving the Health and Safety of Transit Workers with Corresponding Impacts on the Bottom Line." The report explores the types of health and safety issues that are most likely to impact transit workers, beginning with a review of the available literature (Gillespie, Wang, and Brown 2014). The research used several existing data sources to understand the prevalence of common conditions and their costs to society and carried out five in-depth case studies of transit agency health and wellness programs. Based on the work in the report, the project team can suggest possible approaches to implementing a health and safety program at a transit agency and how to assess impacts on the bottom line. An immediate conclusion was that even the most well-designed programs will take time to set up properly and will need a steady source of funding. Also critical to any successful program is a process of evaluation—evaluation of programs is essential to understanding their effectiveness and improving their ability to serve the needs of transit workers. Incorporating evaluation elements into the program design from the beginning will lead to the best results.

The literature review for this project explored issues linked to health and safety outcomes and costs as they relate to workforce conditions, as well as programs used to mitigate negative health and safety outcomes. The study reviewed, where possible, evidence of the cost-effectiveness of such programs and found that several factors faced by transit workers influence the health and safety of operators. These factors include, but are not limited to, the following:

1. Urinary tract problems that arise as a result of limited access to restrooms;
2. Musculoskeletal injuries resulting from prolonged sitting and repetitive motion;
3. Safety factors linked to actions by other drivers and unruly passengers; and
4. Access to food alternatives and fitness centers due to long, irregular, and split shifts.

For non-operators, exposure to exhaust fumes and other automotive chemicals are also risk factors for poor health. The literature review further helped to document worker stress and fatigue as probable health and safety issues. The literature provides evidence of the direct costs of chronic health conditions, including absenteeism and turnover, and how wellness intervention programs function to mitigate these costs. There are relatively few studies that measure the indirect costs of occupational health injuries for transit workers, however, and limited data that provide evidence for the effectiveness of wellness intervention programs for the transit worker population. The literature is largely inconclusive on the effectiveness of wellness programs to reduce costs in general and specifically for transit agencies. Most programs are not well supported, funded, or targeted to the unique challenges transit workers face.

D.2 Procedures

The first step in deciding to implement a health and safety program is to identify the key issues that might affect the local workforce and identify existing sources of data related to the health and safety profiles of local transit workers. Any recent surveys or health insurance (claims) data are a good place to start. If there is no previous survey, claims data generally provide the best information about health issues. Accident records would be a good place to begin assessing whether sleep deprivation impacts transit workers.

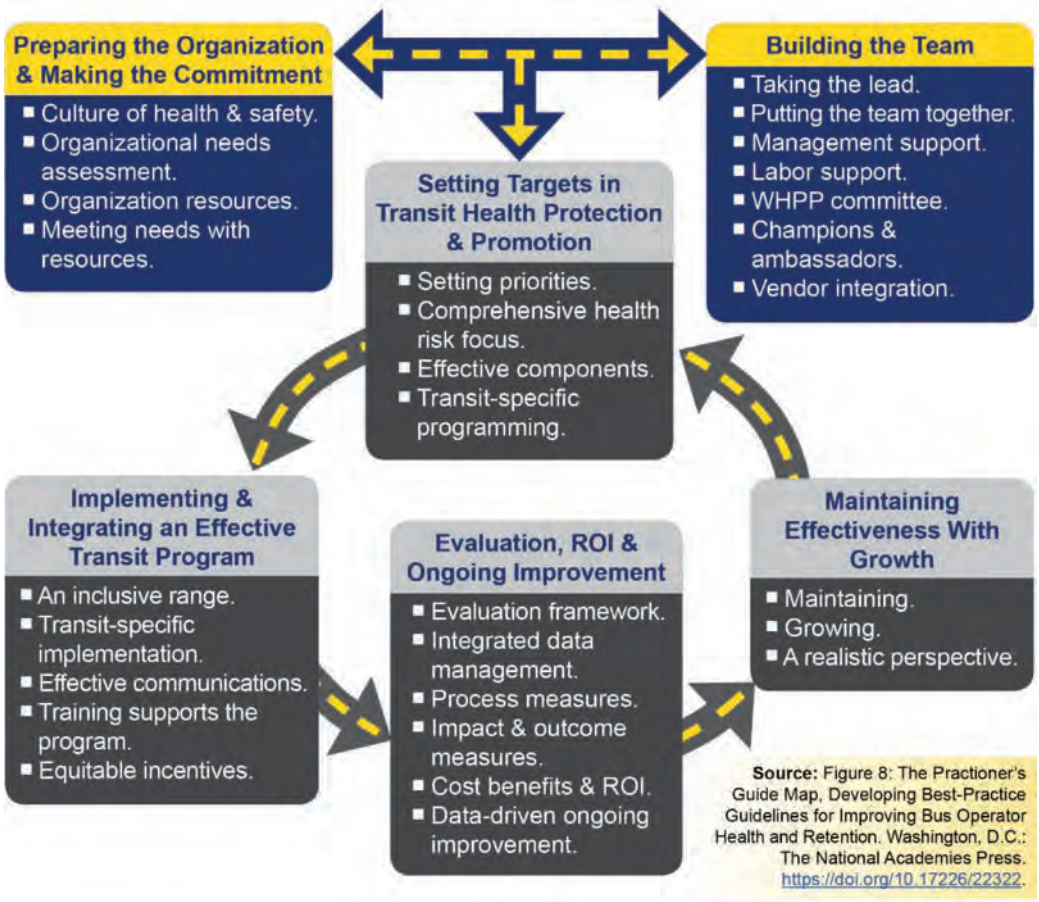
It is important to decide if the program will target only operators, or if maintenance staff will be included. Maintenance staff may face environmental issues (fumes, chemical exposures) but not the musculoskeletal and metabolic issues related to a sedentary job with limited access to restrooms, nutritious food, and irregular schedules.

Agencies may want to consider a preventive program that encourages a "safety culture." Agencies that focus on safety can get ahead of preventable accidents and other issues. This kind of program may be harder to implement because it will not show a large impact on the bottom line, but will rather be designed to prevent many problems, particularly maintenance and traffic accidents, from ever occurring.

As part of the design process, agencies will need to assemble and seek support from management and labor. All the agencies we studied had a wellness committee with representation from labor and management. A planning committee is essential to implementing a program with the greatest reach. The planning committee should review the data and decide on a focus for the program. The potential program options should be shared with staff before a final decision is made about the program components, as gaining support from the staff is critical to success. Publicizing the program, how it works, and how to participate is further critical to see program success.

D.3 Approaches and Policies

After deciding what kind of issues to address, the next step is to design the program. Following the roadmap (Figure D-1), the agency must set priorities and decide on program components. Addressing health and safety issues may be a challenge because they require different kinds of interventions. Some items may overlap, because improving access to healthy foods and providing more regular access to restrooms can improve operator health and may lead to safer operating conditions, if indirectly. Adjusting schedules to ensure operators are well-rested could be particularly challenging when it comes to also providing adequate service to customers.



Source: Gillespie, Wang, and Brown (2014)

Figure D-1. Roadmap for transit health and safety.

Each agency must decide on its policy priorities and design program interventions to achieve them. Focusing on one priority at a time will make it easier to focus on designing the appropriate interventions. Even if many programmatic elements are deployed, a clear goal will make it easier to evaluate the success of the program. The case study sites explored in the report provide many examples of health and wellness programs. Usually, these programs had an overarching goal of health improvements and offered various programmatic elements. Focusing on narrower goals might be a good idea: For example, if an agency identifies a high rate of type 2 diabetes, designing a program to specifically address this condition would make sense. If accident rates were rising at a particular agency, designing a program to improve safety operations would be important.

Overall, a clear statement of purpose, partnership between management and labor, and buy-in from the workers are the keys to program participation. A successful program will provide services and activities that appeal to workers that, if used, will help them meet the program goal.

D.4 Evaluation Measures

There are several measures that transit agencies and unions can use to track the success of wellness programs at reducing costs, but measuring gains from the implementation of a wellness program may require a long lead time. Impacts on absentee hours, workers' compensation, and reduced

healthcare spending will take a long time to appear because they can only be addressed indirectly, with the possible exception of cases where the negative health aspects of a particular behavior are so extreme and widespread that an immediate change brought about by a new program would be realized quickly. For this reason, the process of tracking the success of the wellness programs at reducing costs should be initiated as soon as the program is implemented.

As part of program participation, participants should be asked to allow the use of their de-identified data collected through other systems to evaluate the program. Simple surveys can be administered to all workers and program participants to fill in any gaps in system-level data. Pre- and post-participation surveys can be used to supplement the other data used in the evaluation. These surveys can gauge participant interest and provide qualitative data about the program.

The best evaluations are randomized controlled trials (RCT), which require a control group that would continue as usual, and a treatment group that would have the opportunity to participate in the program. RCTs are a technically complicated research approach and are unlikely to be practical for transit agencies to undertake. We also do not recommend RCTs for health and wellness programs due to the likelihood of confounding variables. It is very difficult to control for the possibility that people participate in similar programs outside of the workplace. The more practical approach to evaluation, and what we used in the report, is to compare data from before the start of the program to that taken after it has been implemented for some amount of time.

A well-designed "pre-post" evaluation would include several years of data before the program to develop a baseline that can be compared to the post-implementation measures. The goal is to compare data on the outcomes of interest before the initiation of the program and after the program has been operating for at least a year, but ideally 2–3 years. Having 2–3 years of data before the program is also ideal. Setting up systems that can collect and store individual-level data on the outcome of interest is a critical part of program implementation and will allow for robust evaluation. Setting up the systems successfully to accurately document the full extent of what actually transpires is challenging.

Setting up the evaluation must occur in conjunction with formulating the program. Program coordinators should work in partnership with the evaluator(s); otherwise, the evaluation may be perceived as an unnecessary burden. Prior Transit Cooperative Research Program publications include resources to help design and track programs, such as the spreadsheet tool titled "Transit Operator Workplace Health Protection and Promotion Planning, Evaluation, and Return on Investment (ROI) Template." (The spreadsheet file can be downloaded at no charge from the *TCRP Report 169* webpage at www.trb.org.) Based on the research in this report, using the "Outcome" tab would be a good starting place to track the key measures the programs are meant to impact. The tabs for "Financial Benefits," "Cost," and "ROI" provide a way to track results.

D.5 Summary

A successful implementation can be achieved by combining a clearly stated policy goal and an evaluation plan. Implementation has several stages, of which some may be undertaken simultaneously, including determining goals, getting feedback from workers, and constituting a committee with labor and management representation to help design and oversee the program. Similarly, an evaluation must be an integral part of the planning process. An evaluation plan will

help determine if the program has a positive ROI and if it needs modification. Agencies must make sure to plan the program carefully; buy-in from management, labor, and workers is essential to success. Agencies must clearly define the ultimate goal of the program and make sure to design something that could plausibly achieve that goal. If indirect outcomes are desired, a clear trajectory from the intermediate goal should be determined before program implementation. With these pieces in place, an agency can be confident about their approach to implementation.

Abbreviations and acronyms used without definitions in TRB publications:

A4A	Airlines for America
AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FAST	Fixing America's Surface Transportation Act (2015)
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
MAP-21	Moving Ahead for Progress in the 21st Century Act (2012)
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TDC	Transit Development Corporation
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S. DOT	United States Department of Transportation

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