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Prevention, Medical Management, and Adjudication of Workplace Injuries

A Thirty-Two Year Follow-up of an Integrated Workers' Compensation Program

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Objective: To describe the cost outcomes of an integrated workers' compensation program. **Methods:** We studied a population that increased from 20K to 59K, incurring 8807 lost-time claims between 1988 and 2020. **Results:** Lost-time claims decreased from 22.15 to 4.32 per 1000 employees (1988 to 2020), and total closed lost-time claim costs per \$100 payroll, decreased from \$0.62 to \$0.17 (1988 to 2017). The percent of claims resolved within 3 years of the accident increased from 10% to 89% (1988 to 2017). Adjusting for medical inflation and wage increases, total workers' compensation benefits paid per claim decreased \$124 per year, medical benefits decreased \$45 per year and indemnity benefits decreased \$79 per year. **Conclusion:** On both a population (per employee) and on a per claim basis, workers' compensation costs decreased substantially, which is attributable to improvements in accident prevention and decreases in claim duration.

Keywords: case management, occupational injuries, prevention, return-to-work, workers' compensation

Beginning with a publication in 1995 and in follow-up studies, we described a workers' compensation claims management processes initiated in 1991/1992, where safety professionals, adjusters, medical case managers, physicians, and occupational health nurse practitioners collaborated in an effort to prevent accidents and expeditiously assess, treat, and return individuals to productive work.¹⁻⁷ The studies involved cost and lost-time outcomes related to work-related injuries affecting healthcare workers and academicians employed by Johns Hopkins Health System and University. Our 2003 publication summarized the program's first 10 years of activity.⁶ At that point in the program's history, we observed the frequency of

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Clinical significance: Occupational safety and medical personnel need to engage early and often with injured workers, supervisors, and adjusters to better manage the medical care and return to work process with the aim of achieving superior disability and cost outcomes.

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Learning Objectives

- Describe the overall approach and key elements of the integrated workers' compensation program reported in the study.
- Summarize the 32-year follow-up data on workers' compensation claims and associated costs.
- Identify key contributors to the reported reductions in workers' compensation costs over time.

lost-time and medical-only injuries decreased by 73% and 61%, respectively. Total workers' compensation expenses (medical, indemnity, and administrative) decreased from \$0.81 per \$100 of payroll in 1992 to \$0.37 per \$100 of payroll in 2002. The study of this institution's workers' compensation program was performed in a state where employers pay the cost of medical care at a fee-schedule and most wage losses associated with an injury, and where claimants have free choice of medical provider at all times: a seemingly difficult environment to reduce and control workers' compensation costs.^{8,9}

The major programmatic innovations were introduced in 1991/1992. They involved: 1. prompt accident reporting, expedited medical assessment, and treatment at a worksite occupational health clinic; 2. safety investigation of all OSHA recordable accidents and plan of correction to address unsafe environments initiated within one business day post-accident; 3. injured worker advocacy regarding medical care delivery and expedited integration into the workplace post-injury; 4. specialty care provided by an expert panel of selected physicians skilled in the management of injuries funded under the workers' compensation system; 5. frequent patient follow-up by the worksite clinic's practitioners and specialty medical providers from time of injury through claim closure; 6. nurse case management services provided to all claimants requiring medical care by specialty physicians; 7. twice-a-month case management meetings involving all parties (safety professionals, medical providers, adjusters, etc.) to discuss and resolve medical treatment, claim adjudication, and workplace accommodation issues impeding claim resolution.

The mechanics of the system (claims management system software improvements, electronic medical record revisions, ergonomic assessment program improvements, etc.) were periodically refined over the subsequent 25 years to improve efficiency. These refinements were the subject of follow-up studies that focused on the outcomes and impact of some of program components (eg, ergonomic modifications, carpal tunnel management, etc.).^{2,4,7} Some new healthcare safety programs were initiated in the latter 1990s through early 2000s, notably safe lifting programs, needle-less intravenous systems, etc.

However, the medical management innovations initiated in 1991/1992 (described in-depth later) did not change appreciably in 28 years. The principal take-away from these early studies was that similar results could be achieved at large employers with occupational health facilities on premises, if the individuals involved in occupational health and safety and claims management adopted best practices and closely coordinated their activities to prevent

accidents, expedite medical care, and return injured workers back to work as soon as possible. Two subsequent publications indicated that elements of the Johns Hopkins Workers' Compensation program could be adapted and expanded to a statewide population to achieve an acceptable level of cost-reduction outcomes.^{10,11}

The purpose of this investigation is to extend the period of observation of the program at the Johns Hopkins Health System's and University's Maryland campuses to assess the durability of the program and identify the major component (accident prevention, post-injury medical, and claim management) most responsible for any continued cost changes. The authors of this study sought to answer the following questions: 1. Were medical and indemnity reductions observed early in the program maintained as the program matured? 2. If so, which major program component may have accounted for continued savings? 3. Was the reduction in the rate of accidents accepted as compensable under workers' compensation (medical-only and lost-time workers compensation claims), maintained? If so, this would suggest that early and subsequent safety related interventions continued to be major drivers of both medical and indemnity cost containment. 4. Did the annual average medical and indemnity cost per claim decrease? If this could be demonstrated, programs designed to improve the medical care of injured workers (immediate reporting and treatment, expert panel of specialty physician, twice-monthly medical planning meetings, nurse case management and patient advocacy, etc.) could account for some of the observed changes.

Description of the Johns Hopkins Workers' Compensation Program (JHWCP)

History and Population

The Johns Hopkins Workers' Compensation Program (JHWCP) was established in 1969. Initially, the JHWCP consisted of the Workers' Compensation Office (WCO) whose function is the administration of the self-insured, self-administered workers' compensation program for the Johns Hopkins Health System's and University's Maryland based entities and employees.⁶ The WCO services include the determination of work-relatedness, medical, and indemnity payments as well as adjudication and resolution of all claims. The WCO utilizes an external law firm to reserve its cases and represent Johns Hopkins at the Maryland Workers' Compensation Commission and the State's Appellate Courts. In September of 1991, the WCO was placed within the Health, Safety and Environment Department (HSE) of the Johns Hopkins Health System and University. This transfer integrated the claims payment and adjudication process performed by the WCO with the occupational health and safety functions of the Health System and University (Occupational Health Clinics, Occupational Injury Clinic, Joint Commission Environment of Care Compliance, Health and Safety, Bio-safety and Radiation Safety). With this transfer, all of the entities within Johns Hopkins Health System and University responsible for the prevention of workplace accidents, treatment, and workers' compensation claim adjudication reside in the same organization headed by the Executive Director of Health Safety and Environment who also serves as Chairman of the Joint Committee on Health Safety, and Environment. Consequently, the JHWCP includes the functions of the HSE related to the prevention, treatment, and management of workplace injuries, as well as the payment of all workers' compensation expenses.⁶

At the initiation of the study (1988) approximately 20K employees were covered by the JHWCP and at the study's end (2020), over 64K employees were covered. However, only the claims from the Johns Hopkins Health System and University entities (individual hospitals and schools) administered by the WCO/JHWCP from 1988 to 2020 were included (59K employees) in this study. This was done to focus on workers' compensation claim frequencies and costs of the same cohort of Johns Hopkins

Health System and University entities impacted by the 1991/1992 JHWCP changes and subsequent improvements.

Maryland Workers' Compensation System

As mentioned, Maryland is an "employee choice" state. All employees injured at work have the right to choose their medical provider and have their medical care paid for under the employer's workers' compensation plan with no deductibles or copayments.^{8,9} The statutes also mandate payments to the injured employee for lost wages (temporary total benefits) and permanent disability. The temporary total benefits are paid while the injured worker cannot perform the functions of his or her job or a modified duty assignment. This benefit continues until maximum medical improvement has been achieved. Permanent partial and total disability benefits are awarded for the permanent loss of function of a body part when maximum medical improvement has been achieved.⁹ Virtually all injured employees awarded indemnity benefits lose time from work (with the rare exception of an award for indemnity benefits related to disfigurement from lacerations).

Change in Approach to the Identification and Prevention of Injuries and the Treatment of Injured Workers

The integration of the WCO within HSE altered the claims management process. All stakeholders (eg, safety professionals, employees, supervisors, human resource professionals, medical and nursing professionals, adjusters, and attorneys) became active participants in the claims process. The program adopted a non-adversarial stance, encouraged early reporting, patient advocacy, facilitation of care, and preventative measures as primary strategies in managing claims. Occupational health clinic physicians and nurses were encouraged to recognize the psychological and emotional needs of injured workers. Claimants were continuously provided with information regarding the therapeutic process.⁶

Injury Reporting, Accident Investigation, and Medical Care for Work-Related Injuries

Prior to the integration of the WCO into HSE, injured workers received the initial care for their injuries at hospital emergency departments, urgent care centers, and personal physicians. After the integration, all employees with work-related conditions at the Johns Hopkins Health System and University are now directed by their supervisors to immediately report to occupational injury clinics located on the various campuses for an initial evaluation and treatment. The employees are instructed to bring an "Employee Report of Incident Form" to the clinic. This form describes the location, circumstances, and conditions surrounding the accident.⁶ The clinics transmit this form to the WCO electronically through the claims payment system. The WCO uses this information to make a compensability decision. After reporting the injury to an occupational injury/health clinic at Johns Hopkins, employees may continue their medical care with any licensed medical provider in the State of Maryland.

Subsequent to the injured worker being seen at an on-site clinic, safety officers are contacted by the clinics to investigate significant (OSHA recordable) accidents. In addition, safety professionals (eg, industrial hygienists, safety engineers, bio-safety officers, radiation safety physicists, etc.) are able to review all new claims and may choose to initiate investigations of accidents without a clinic request. The accident investigations are entered into the database in real-time, as they are performed. The WCO may also request that safety professionals investigate accidents of employees who did not complete an incident form or presented to a non-Hopkins occupational health clinic.⁶

The occupational health advanced practice providers (APPs), supervised by a medical director take a detailed history of the accident

and provide the necessary medical care for the vast majority of the medical-only workers' compensation cases. For more complicated medical-only injuries and lost-time workers compensation' injuries, APPs perform the initial assessment but refer patients to the medical director, network physician, or surgeon for assessment and treatment, if indicated. Seriously ill or injured employees bypassed the occupational health clinics and were seen in the closest emergency department to their place of injury but subsequent follow-up occurred in a Johns Hopkins occupational health clinic.

Specialty Physician Expert Panel

A small (6 to 8) panel of full-time and part-time tenured or adjunct Johns Hopkins University faculty physicians credentialed by the Johns Hopkins Hospital from the Departments of Medicine (Occupational Medicine), Orthopedics, Neurosurgery and Physical Medicine and Rehabilitation was established to deliver specialty care for patients funded under Johns Hopkins self-insured workers' compensation program. Injured workers chose to be cared for by these physicians or a specialty physician of their choice. If the injured worker chose to be seen by these panels of specialists, they are followed jointly by the APP and specialists until maximum medical improvement is achieved. Approximately, 72% of the lost-time injuries from 1994 to 2020 were managed by APPs, occupational health clinic medical director, and Johns Hopkins specialty network physicians. While injured workers may choose to receive part or all of their treatment by Johns Hopkins occupational injury clinic associated or non-Johns Hopkins associated medical providers, all JHWCP workers compensation claims, regardless of provider status, were included in this study.

In 1997, the Occupational Medicine Practice Guidelines published by the American College of Occupational Medicine were adopted to set the parameters of medical care rendered by the APPs in various occupational health/injury clinics within the Johns Hopkins Health System and University.¹²

Nurse Case Management

The JHWCP initially employed a part-time Nurse Case Management (NCM) but expanded to 1 full-time NCM in 1996, and was periodically supplemented by contract NCMs if necessitated by expanded workloads. The primary duty of the nurse case managers is to coordinate the medical care and return to work of injured workers referred to the specialty physicians participating in the workers' compensation physician panel. The secondary function of the position is to track the status of injured employees who receive care from non-Johns Hopkins specialty physicians. In these instances, the WCO notifies the NCM manager of employees who filed a claim and elect to receive their care from a non-Johns Hopkins specialty physician.

The NCMs review the files on all cases involving medical care outside the on-site occupational health clinics and coordinate referrals to the specialty physicians. The NCMs also set up independent medical evaluations if there is a question of causality or appropriateness of medical treatment. In addition, the NCMs authorize continuing treatment, as well as payment of temporary/total benefits based on findings and recommendations contained in independent medical evaluations. The NCMs are responsible for authorizing diagnostic testing, medical treatments, surgeries or procedures, and durable medical equipment. The NCM manager reviews all bills referred by adjusters if there are questions about the appropriateness of a procedure, physical therapy, or medications. Based on the NCM manager's review, the WCO decides whether it is appropriate to pay for an invoiced service. Authorization for care and review of invoices are limited to individuals treated by non-Johns Hopkins affiliated physicians. The NCMs accompany safety professionals on accident investigations to work environments where repetitive traumas and significant accidents have occurred.

Safety professionals' partner with the NCMs and supervisors in facilitating an employee's return to an accommodated duty assignment if they cannot perform their regular duty.^{3,6}

Claims Management System Software

Prior to 1991, the WCO claims payment system obtained only enough information to establish, pay, and adjudicate a workers' compensation claim. This information was entered into the claims management database by WCO personnel. The server and software were housed in the WCO but maintained by an outside contractor. Although this process was adequate to pay claims and fulfill the statutory requirements of the Maryland Workers' Compensation Commission, the system proved inadequate to input, maintain, and allow all participants to review information related to case management, disability management, or accident investigations.⁶ In 2002, a new software program was developed by Johns Hopkins that permitted input and review by all users, integrating all elements of the program into one database. Participants are restricted to viewing the portions of the system that relate to their discipline; medical information is viewed by physicians, clinic nurses, and nurse case managers; financial information is limited to WCO adjusters; safety professionals have access to causal disability and environmental data, but not financial or medical information. In 2012, this system was replaced by a commercial claims payment system incorporating the same workflows as the 2002 software.

Integration of Functions

The Johns Hopkins Workers' Compensation Program is highly integrated. The occupational medicine APPs provide the primary medical care and co-manage the medical care of claimants treated by Johns Hopkins panel of specialists. The NCM tracks the progress of patients seen by the specialty physicians in and out of the internal expert panel. Safety professionals assess work environments immediately post-accident establishing plans of correction to abate unsafe environmental conditions. Safety professionals, jointly with the NCMs, survey and correct ergonomic hazards in areas where repetitive traumas occur. AAPs and medical specialists can also request ergonomic assessments when there are concerns about possible work hazards and to help determine whether an incident is related to work site ergonomic factors. The result is a program that creates an integrated system that facilitates communication of "real-time" knowledge for all parties about the status of safety interventions to eliminate the environmental hazards identified at the time of the accident, the injured workers medical status and work restrictions, availability of accommodated work, and the adjudication process.

Facilitated Return to Work/Ergonomics Program

The process of returning an injured employee to their original assignment or modified duty was substantially modified in 1992 becoming a more coordinated effort. All parties, the injured employee, their supervisor, the safety team, and the NCM (representing the medical providers) each play a role in successful placements post-injury.²⁻⁴ The NCM provides input from health care providers on work restrictions, safety professionals assess workplace physical demands and with supervisors and injured workers, agree to a job assignment that satisfies each party's concerns. Alternative work assignments are developed that allow injured employees to perform work activities that meet their current capabilities. An alternative work activity is a modified version of the employee's original job, the same job with reduced hours, or a combination of tasks prescribed by the treating physician. Alternative work can be full- or part-time, but is time-limited. These assignments terminate with the worker's release to the original job duty. An important part of this process is the job analysis. This process begins with the safety/environmental health officer contacting the NCM for a job analysis meeting with the injured employee and the employee's supervisor. The safety professional

starts the meeting by describing that the purpose of the job analysis and role of each participant in the process: supervisor, provides information on the essential job elements; employee, provides information on how he or she performs the job; NCM, answers medical questions related to any restriction placed on the employee. If required, the safety officer quantifies physical stressors utilizing standard ergonomic assessment tools. After agreement has been reached on the necessary accommodations, a Return to Duty/Medical Restriction Form is signed by each participant. If accommodations cannot be made to suit the restrictions, the safety officer certifies this decision which is transmitted to the Workers' Compensation Claims Office to commence temporary/total benefits to the injured worker.

Medical Case Management Meetings (MCCM)

Twice monthly, the manager of the WCO, NCM manager, adjusters, occupational health medical director, and safety director (or representative) meet to discuss all open workers' compensation cases requiring on-going treatment or resolution at the Maryland Workers' Compensation Commission. The meeting is chaired by the NCM manager and cases are presented by the medical director of the occupational injury clinic. Each case is reviewed as to the appropriateness of medical care and status as related to claim resolution and settlement. Based on the discussions, treatment plans are revised and return to work efforts are coordinated between the NCM, physicians, APPs, and adjusters.

A quarterly report is prepared by the JHWCP, which evaluates trends in accident frequencies, medical and indemnity payments, case management activities, and accident investigations related to insured claims. These reports are presented to the MCCM to provide an objective assessment of the outcomes of the process and highlight areas where improvements may be made in facilitating better, more efficient treatment or expediting a safe return to work post-injury. The reports are also given to the Hospital and University leadership in order to provide trend analysis on number and types of work-related injuries, as well as cost analysis of these injuries.

Safety Enhancements

In addition to the existing once-yearly (university facilities) and twice-yearly (acute care hospital and laboratory facilities) inspections and corrections of safety hazards, two new preventive programs were initiated in 1992. The most widespread was the assessment and correction of hazards associated with OSHA recordable injuries reported through the workers' compensation claims management system. This innovation was the subject of an investigation and eventual publication of findings in 2003. The result of this effort was the reduction in the number of work-related musculoskeletal disorders and surgical procedures used to correct these conditions.^{1,3,6,7}

In a major effort to control bloodborne pathogen exposures, the Protective Devices Committee was established at the Johns Hopkins Hospital in 2000. Through the efforts of this committee and similar committees within the Johns Hopkins Health System, by 2004 the majority of unsafe needles and other "sharps" were replaced by safe-sharp devices. In 2007, a safe-patient lifting program that focused on teaching healthcare workers about proper lifting techniques was initiated at the Johns Hopkins Health System. The beginning of the same year (2007), the Safe-Patient Handling Committee was formed at the Johns Hopkins Hospital just prior to the December 2007 enactment of the Maryland safe-patient handling regulations.¹³ Subsequently (2008), the acute care hospitals of the Johns Hopkins Health System began the purchase and deployment of assisted lifting devices for use by front-line healthcare workers.

Data Collection and Analysis

The JHWCP's software system was used to obtain workers' compensation medical and indemnity benefit workers'

compensation claim data. All employees who sustained a work-related injury or illness between fiscal years 1988 and 2020 that resulted in a filed workers' compensation claim were included. This was done in order to limit the study to workers and workplaces where the 1991/1992 changes in safety and claims management practices were in effect throughout the study period. This study population represented 96% of the population at risk for the 32-year period.

Included for analysis was information regarding the frequency of medical-only and lost-time claims, injury date, indemnity expenses (temporary-total, temporary-partial, permanent-total, and permanent-partial), number of temporary/total days paid and date of claim closure (if closed). Excluded were allocated loss adjustment expense and other administrative costs including excess insurance costs. The number of employees and payroll data for each year were obtained from the Treasurer's Office of each of the participating Johns Hopkins entity.

Descriptive methods were used to examine the rate of injury per 1000 employees, by injury year and claim type (medical-only or lost-time claims). The major focus of the study was lost-time claims, which accounted for 95% of total workers' compensation cost. Percentage of lost-time claims closed within 3, 5, and 7 years post-injury were calculated by injury year to reflect the management achievement. The paid for medical, indemnity, and total cost per \$100 payroll were calculated with and without open claims included, respectively by injury year. An inflation adjusted average paid for medical, indemnity, and total cost in 2021 US dollar were presented for closed claims by injury year. All changing trends by injury year were simulated using logarithm or linear models.

Medical Care Consumer Price Index (CPI)¹⁴ and median weekly wages¹⁵ were used to adjust the medical payment and indemnity payment, respectively. As shown in Table 1, \$1.00 in payment in 1988 for medical care is equivalent to \$3.77 in 2021, while \$1.00 in the year 1988 for indemnity payment is equivalent to \$2.56 in 2021. It is important to point out that although the analysis is presented by injury year, the actual payments of a claim can last multiple years until it is closed. For this reason, the inflation adjustment was done in a time dependent manner for each year of the claim's duration. Assuming the total amount of payment is distributed evenly over the entire claim duration, the paid costs were adjusted by multiplying each payment year's inflation factor in the 2021-dollar equivalents of that year.

RESULTS

As seen in Table 2, between 1988 and 2020, there were 8807 lost-time claims (30.2%) and 20,369 medical-only (69.8%) workers' compensation claims recorded in the Johns Hopkins Workers' Compensation Claim Database. Almost 95% of the \$144.4M spent on the medical and indemnity benefits were allocated to the lost-time cases. The average cost of a closed lost-time case was \$15.5K and medical-only cases, \$0.38K. Table 3 presents yearly information on the number medical-only and lost-time claims, closure rates, medical, and indemnity payments as well as number of employees and payroll, which were used to calculate rates presented in the upcoming figures.

Figure 1 is a graphical representation of the number of claims per 1000 employees. Between 1988 and 2020, the lost-time claim rate decreased from 22.15 per 1000 employees to 4.32 per 1000 employees and medical-only claim rates decreased from 26.61 per 1000 employees to 4.78 per 1000 employees, both approximately 5-fold decreases. As seen in Figure 2, total benefits paid for lost-time claims per \$100 of payroll decreased from \$0.62 in 1988 to \$0.17 in 2017, a 3.6-fold decrease. Indemnity benefits paid for lost-time claims per \$100 of payroll decreased from \$0.42 in 1988 to \$0.11 in 2017, a 3.8-fold decrease (Fig. 2). Medical benefits paid for lost-time claims per \$100 of payroll decreased from \$0.17 in 1988 to

TABLE 1. Inflation for Medical and Indemnity Payment Adjustment

Injury Year	Medical Care CPI	2021-Dollar Equivalent for Medical Payment	Median Weekly Wage	2021-Dollar Equivalent for Indemnity Payment
1988	139	\$3.77	385	\$2.56
1989	149	\$3.50	399	\$2.47
1990	163	\$3.21	412	\$2.39
1991	177	\$2.95	426	\$2.31
1992	190	\$2.75	440	\$2.24
1993	201	\$2.59	459	\$2.14
1994	211	\$2.47	467	\$2.11
1995	220	\$2.37	479	\$2.05
1996	228	\$2.29	490	\$2.01
1997	235	\$2.23	503	\$1.96
1998	242	\$2.16	523	\$1.88
1999	251	\$2.08	549	\$1.79
2000	261	\$2.00	576	\$1.71
2001	273	\$1.91	596	\$1.65
2002	286	\$1.83	608	\$1.62
2003	297	\$1.76	620	\$1.59
2004	310	\$1.68	638	\$1.54
2005	323	\$1.61	651	\$1.51
2006	336	\$1.55	671	\$1.47
2007	351	\$1.49	695	\$1.42
2008	364	\$1.43	722	\$1.36
2009	376	\$1.39	739	\$1.33
2010	388	\$1.34	747	\$1.32
2011	400	\$1.30	756	\$1.30
2012	415	\$1.26	768	\$1.28
2013	425	\$1.23	776	\$1.27
2014	435	\$1.20	791	\$1.24
2015	447	\$1.17	809	\$1.22
2016	464	\$1.13	832	\$1.18
2017	475	\$1.10	860	\$1.14
2018	485	\$1.08	886	\$1.11
2019	498	\$1.05	917	\$1.07
2020	519	\$1.01	984	\$1.00

\$0.07 in 2017, a 2.4-fold decrease. Years 2017 to 2020 were omitted from the year-by-year comparisons because over 10% of the claims in these years were not fully developed (ie, closed).

Figure 3 presents the amount paid per \$100 of payroll for all (open plus closed) and closed lost-time claims by year of injury valued as of 12/31/20 excluding the most recent 3 years. This figure is included to indicate that the differences in payments by year for open and closed claims are very similar except for 1998, 2006, and 2013 when a few very serious accidents occurred that did not settle by the 12/31/20 valuation date.

Figure 4 indicates that the percentage of claims closed in 3, 5, and 7 years improved dramatically after implementation of the 1991/1992 changes in safety innovations and managing medical care and claim processes. The proportion of claims closed in 3 years of injury increased from 10.8% in 1988 to 89.0% in 2017, claims

closed within 5 years of injury increased from 32.0% in 1988 to 94.1% in 2015, and claims closed within 7 years of the date of injury increased from 70.0% in 1988 to 94.1% in 2013. Of these changes in 3, 5, and 7-year closure percentages were the almost 8-fold increase in claim closure. Adjusting for medical inflation (medical CPI) and wage increases over the study years, average total benefits paid decreased approximately \$124 per year, average medical benefits decreased approximately \$45 per year, and average indemnity benefits decreased approximately \$79 per year (Fig. 5).

DISCUSSION

Our study indicates that medical-only and lost-time workers' compensation claims rates decreased 5-fold over the 32-year study period. The decrease in rates translated into large decreases

TABLE 2. Cost of Medical-Only and Lost-Time Claims 1988–2020

Claim Type	Count of Claims	Count of Claims %	Average Indemnity Paid	Sum of Indemnity Paid	Average Medical Paid	Sum of Medical Paid	Average Total Paid	Sum of Total Paid	Sum of Total Paid %
Lost Time	8807	30.2%	\$8551	\$75,312,143	\$6279	\$55,298,365	\$15,518	\$136,664,676	94.6%
Medical Only	20,369	69.8%	\$0	\$0	\$381	\$7,758,102	\$382	\$7,778,604	5.4%
Total	29,176	100.0%	\$2581	\$75,312,143	\$2161	\$63,056,466	\$4951	\$144,443,280	100.0%

TABLE 3. General Lost-Time Claim Information by Injury Year

Injury Year	Number of Lost-Time Claims	Lost-time Claims Closed at End of Study %	Sum of Indemnity Paid	Sum of Medical Paid	Sum of Total Paid	Number of Employees	Payroll
1988	353	100.0%	\$2,011,046	\$733,739	\$2,853,032	15,936	\$457,146,824
1989	329	99.7%	\$2,481,585	\$1,103,727	\$3,676,808	17,159	\$515,253,515
1990	391	99.5%	\$2,759,584	\$1,844,026	\$4,828,824	18,381	\$548,455,424
1991	406	100.0%	\$2,662,760	\$2,679,708	\$5,556,288	19,604	\$589,537,723
1992	367	99.7%	\$1,641,071	\$1,227,365	\$3,005,789	20,850	\$618,153,192
1993	264	99.6%	\$1,991,909	\$1,188,803	\$3,308,815	21,528	\$680,361,404
1994	289	99.7%	\$1,435,376	\$1,133,024	\$2,691,103	22,093	\$711,854,783
1995	253	99.6%	\$1,615,383	\$1,284,893	\$3,073,211	23,501	\$781,016,315
1996	237	100.0%	\$932,080	\$556,936	\$1,604,499	24,031	\$793,348,843
1997	208	100.0%	\$1,806,580	\$1,014,257	\$2,977,314	24,916	\$821,479,637
1998	249	99.6%	\$1,667,772	\$961,092	\$2,819,458	31,979	\$879,071,164
1999	224	98.2%	\$3,624,020	\$2,894,333	\$6,730,576	31,629	\$1,003,955,700
2000	242	98.8%	\$3,051,770	\$1,855,726	\$5,080,026	33,581	\$1,088,100,964
2001	184	100.0%	\$1,591,404	\$1,098,042	\$2,832,130	34,754	\$1,209,435,983
2002	209	99.5%	\$2,166,036	\$1,514,918	\$3,902,548	35,571	\$1,346,519,611
2003	185	99.5%	\$1,945,273	\$1,235,727	\$3,344,444	37,665	\$1,360,263,179
2004	209	98.6%	\$2,662,084	\$2,031,092	\$4,972,869	39,193	\$1,551,264,587
2005	246	98.4%	\$2,004,253	\$2,348,160	\$4,516,231	40,418	\$1,627,918,737
2006	261	98.9%	\$3,820,498	\$2,513,798	\$6,607,698	39,817	\$1,722,425,374
2007	257	98.1%	\$3,719,674	\$2,468,661	\$6,473,164	41,212	\$1,690,706,616
2008	250	98.8%	\$2,794,660	\$2,654,377	\$5,733,388	42,735	\$1,805,010,776
2009	239	99.6%	\$1,841,445	\$1,447,444	\$3,447,894	43,887	\$1,877,918,405
2010	256	98.0%	\$2,602,939	\$2,137,491	\$4,989,560	44,581	\$1,949,663,316
2011	263	97.3%	\$2,507,736	\$1,619,658	\$4,347,048	47,693	\$2,056,091,409
2012	253	95.3%	\$2,161,629	\$1,923,234	\$4,267,789	47,637	\$2,153,951,538
2013	304	94.1%	\$3,420,850	\$2,696,193	\$6,392,578	48,298	\$2,180,690,444
2014	274	93.4%	\$2,515,658	\$1,674,801	\$4,442,759	47,650	\$2,199,214,409
2015	286	94.1%	\$2,662,847	\$1,723,966	\$4,619,059	49,304	\$2,435,262,967
2016	312	94.6%	\$2,626,050	\$1,725,805	\$4,577,305	50,079	\$2,717,353,992
2017	300	89.0%	\$2,650,604	\$1,913,495	\$4,707,366	51,572	\$2,825,070,030
2018	233	86.3%	\$2,030,312	\$1,769,604	\$3,938,172	52,065	\$2,977,515,037
2019	241	60.6%	\$1,125,108	\$1,584,854	\$2,808,737	53,517	\$3,087,287,974
2020	233	6.4%	\$782,148	\$739,417	\$1,538,194	53,970	\$3,087,287,974
Total	8807	94.2%	\$75,312,143	\$55,298,365	\$136,664,676		

in total claim costs as well as indemnity and medical costs for lost-time claims (serious injuries) as percentage of payroll. This population-based decrease in claim rates and costs per \$100 of payroll is felt to be linked in-part, to improvements in working conditions through the changes in safety programming specifically performing root cause analyses for all serious accidents. Some efforts, like needle safety initiatives appeared to only relate to a declines in reported medical-only cases. Also, while the widespread deployment safe lift devices and accelerated proper lifting training were expected to produce an acceleration of the decline of lost-time cases immediately after 2007, it was not observed. However, as with the safe needle program, the slope of decline in medical-only injury rates did accelerate immediately after the deployment of the safe lifting programs and assist devices. We may have missed detecting a relationship between safe lifting programs and lost-time injury rates because the study was not focused on specific injuries and costs of these injuries in the workers' compensation claim data. We intend to perform another study looking at low back injuries and workers' compensation claim submission rates by year in order to determine the efficacy of these safety innovations.

The decrease in workers' compensation costs we observed in relation to payroll is consistent with trends of other employers in the US over the last 2 to 3 decades. For example, between 1988 and 2018, medical and indemnity expenses decreased from \$1.34 per \$100 to \$0.77 per \$100 (an almost 2-fold decrease).¹⁶ This reduction

is also consistent with an observed 58% reduction in all claims accepted by private US workers' compensation carriers, a 59% reduction in medical-only claims, and a 60% reduction in lost-time claims during a substantial proportion of that timeframe (1996 to 2016).¹⁷ Importantly, in contrast to the lost-time claim rates for all industries, our observation was limited to claim rates in only two major industries, healthcare, and colleges. This limitation to two industries somewhat avoids the issue of controlling for alterations in occupational risk due to changes in the mix of industrial categories over time.

Other loss-control measures (safe and assisted lifting, ergonomic intervention, abatement of safety hazards as they are reported) may account for some of the differences in the reduction of rates observed nationally for all industries and at Johns Hopkins Health System and University. Prior to and after 1992, at the Johns Hopkins Health System acute care hospital in-patient, out-patient and laboratory facilities conduct inspections by safety professionals twice a year with plans of correction enacted after each of these inspections to resolve any deficiencies uncovered. Similarly, at schools of the University, inspections are conducted on a yearly basis with plans of correction constructed to address safety hazards identified during the inspections. We argue that the Johns Hopkins Institutions had a safety program comparable to best-in-class programs at other institutions and these additional efforts made a greater impact on injury rates than would have otherwise been achieved without these programs.

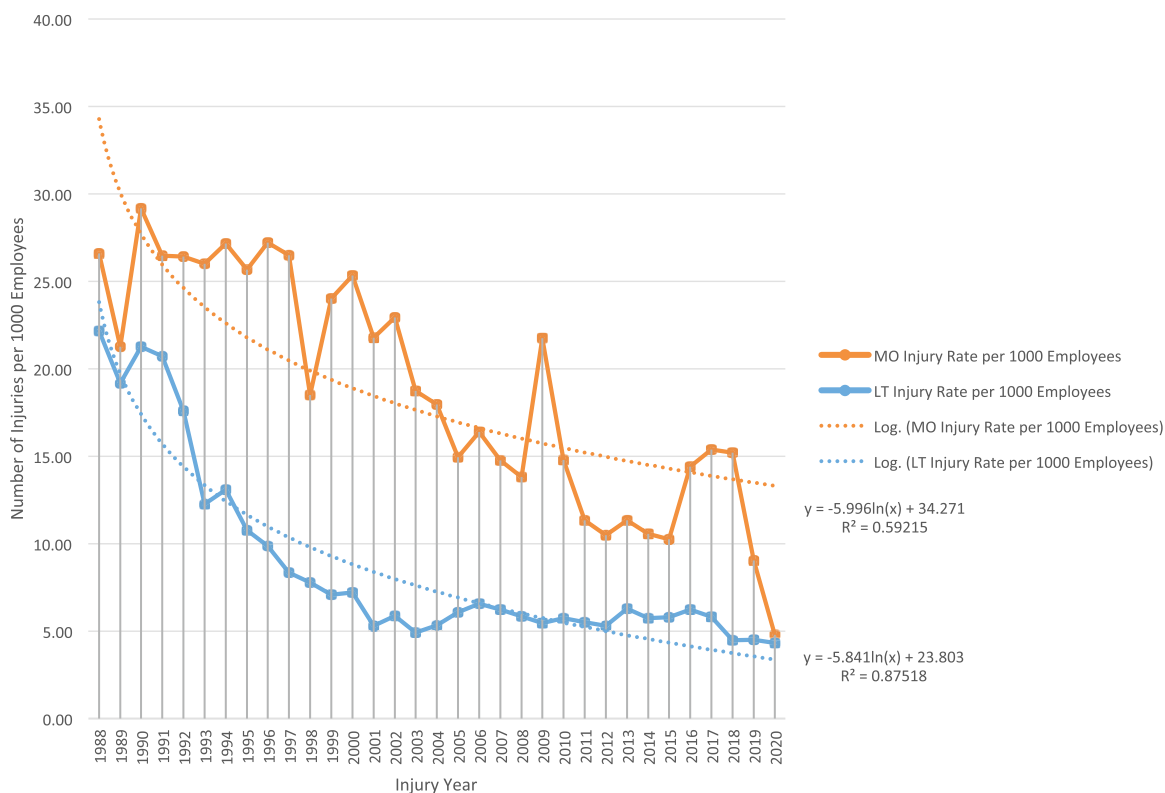


FIGURE 1. Number of injuries per 1000 employees by claim type.

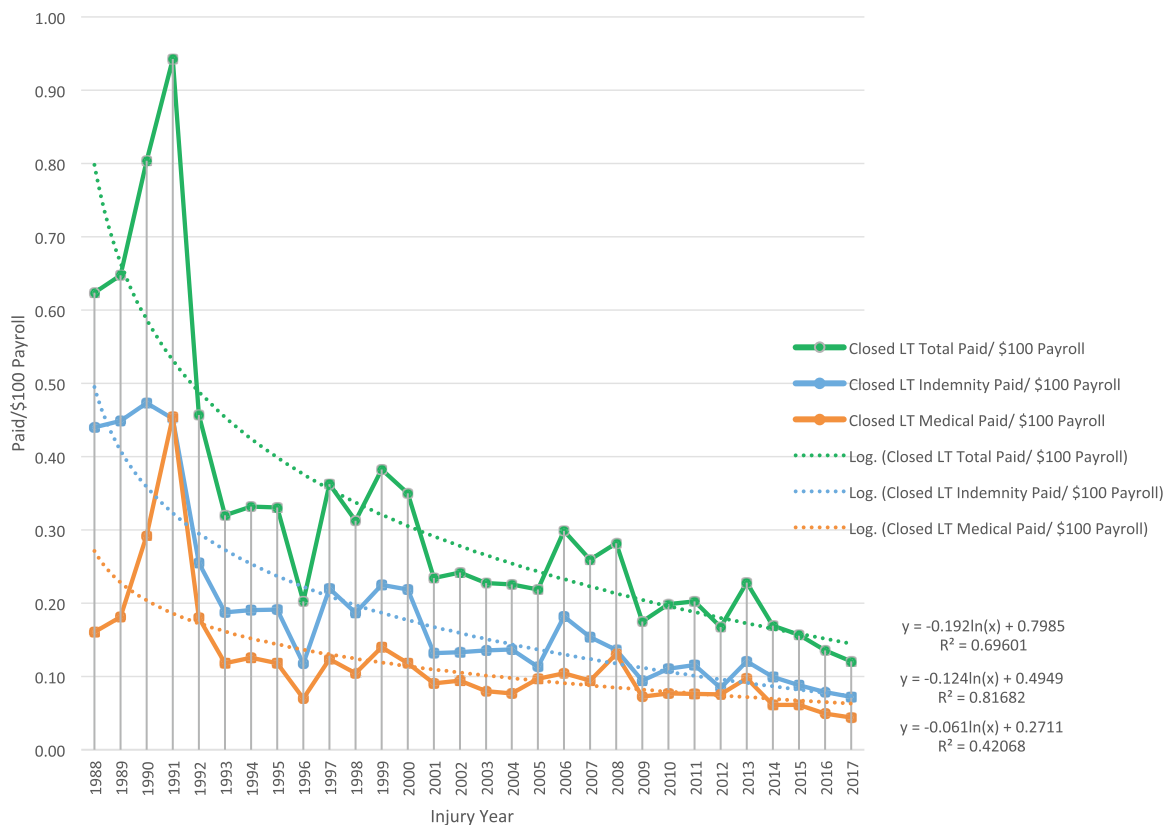


FIGURE 2. Paid for closed lost-time (LT) claims /\$100 payroll excluding the recent 3 years.

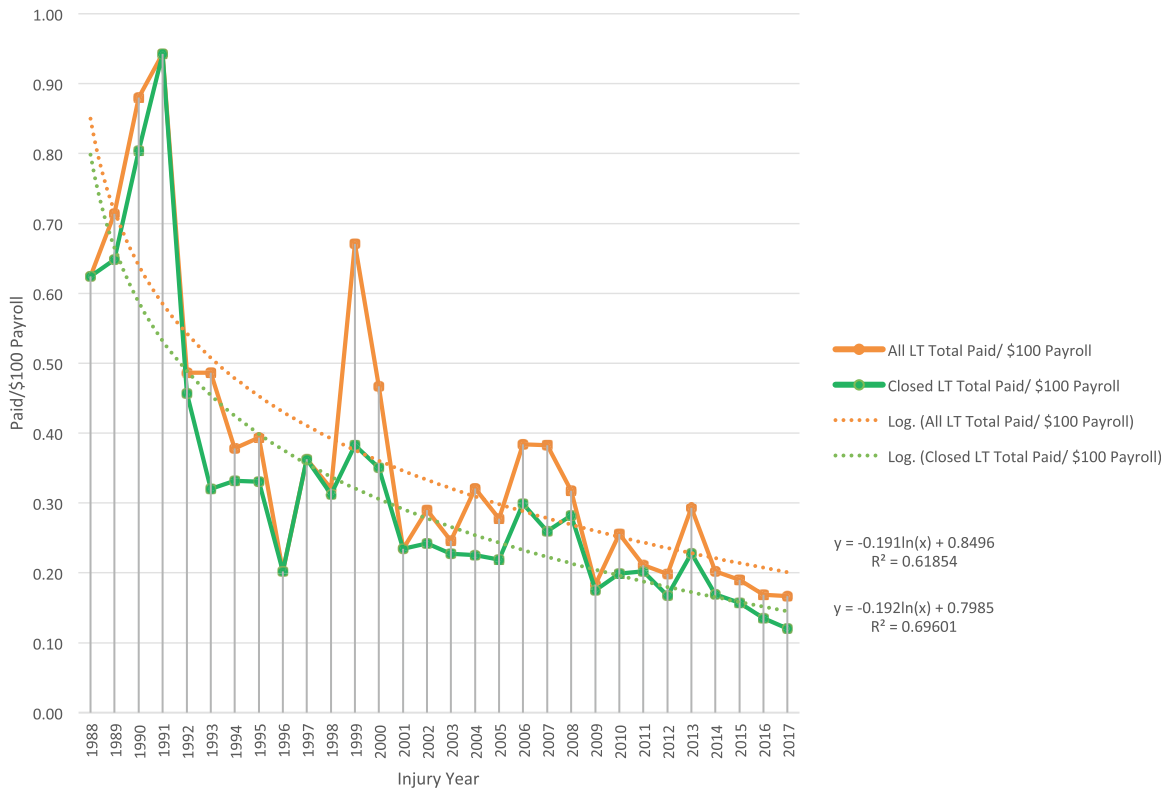


FIGURE 3. Paid for lost-time (LT) claims /\$100 payroll excluding the recent 3 years.

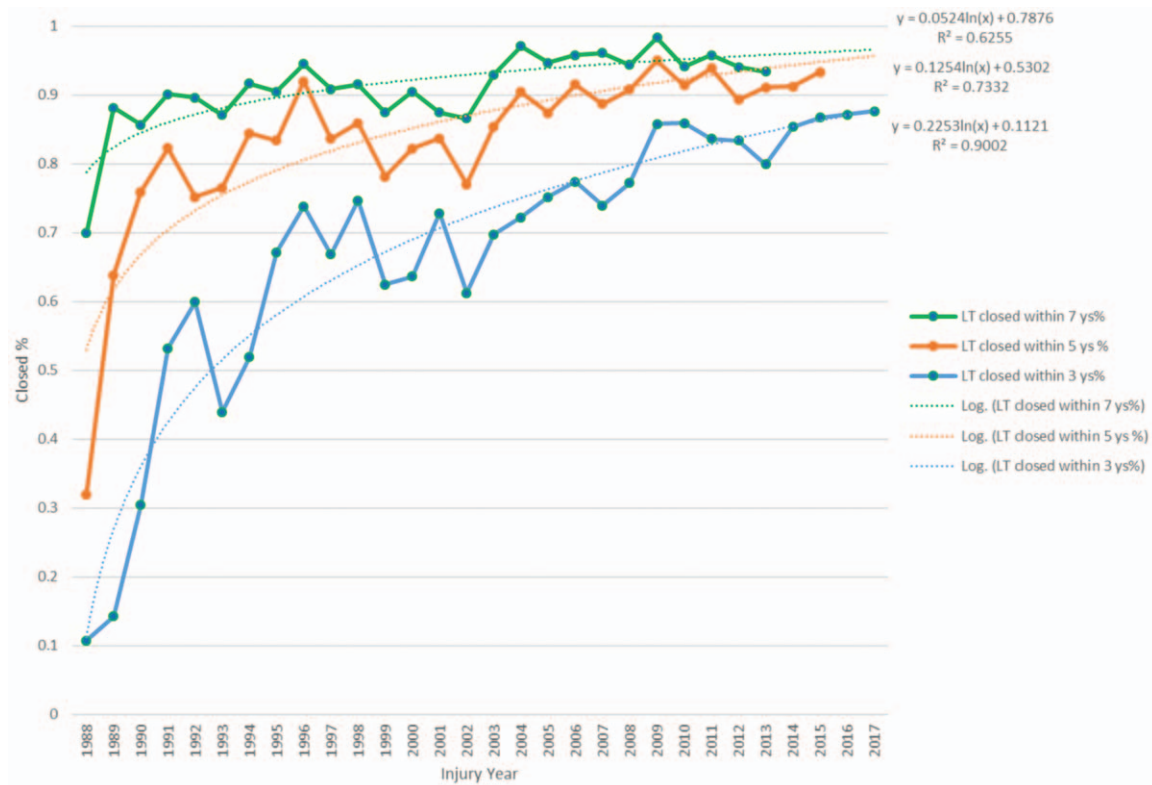


FIGURE 4. Percentage of lost-time (LT) claims closed within 3, 5, and 7 years post-injury.

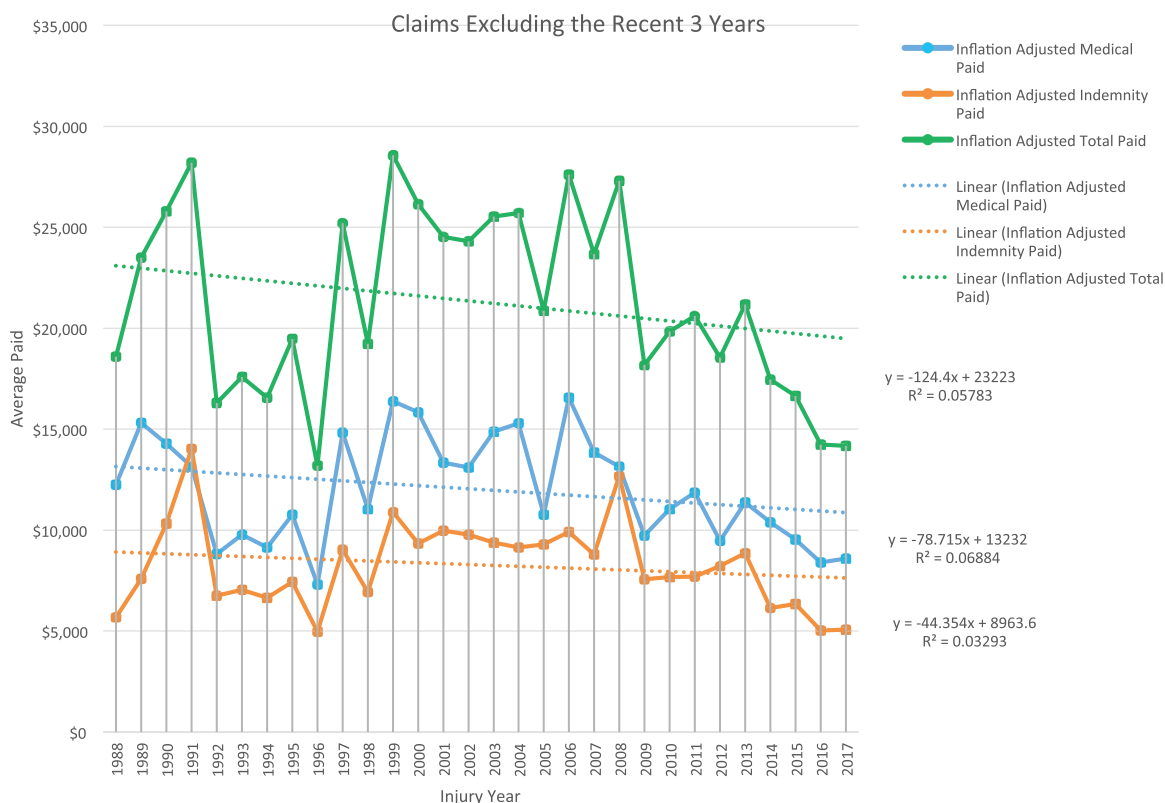


FIGURE 5. Inflation adjusted average paid in 2021 US dollar for closed LT claims excluding the recent 3 years.

Augmenting the safety centric programs (inspections, ergonomic programming, immediate correction of environmental deficiencies, etc.) in reducing the rate of lost-time claims are the programs designed to facilitate the delivery of appropriate medical care and manage time lost from work. These programs were designed to decrease workers' compensation claim severity by containing the average increase in medical and indemnity spending per claim. The National Academy of Social Insurance (NASI) reports that between 1998 and 2018, the average medical and indemnity expenses per indemnity WC claim increased by 196% and 230%, respectively.¹⁶ This increase is related to a number of factors, primarily medical and wage inflation, and to a lesser extent a decrease in the frequency of less costly claims. A Research Brief from the National Council on Compensation Insurance (NCCI) entitled "The 2015 Workers Compensation Medical Severity Decline" indicated that medical claim severity increased an average of 7.5% per year between 1995 and 2014 but decreased 1% between 2014 and 2015.¹⁷ These studies indicate that medical inflation in the workers' compensation system has been observed to be greater than the overall inflation rate for medical services during the study period.¹⁴ However, because we were not able to accurately determine workers' compensation medical benefit inflation over the entire study period, we utilized the Medical Care CPI changes to adjust for medical inflation. This action probably underestimates the effect of medical inflation on the cost of services in the workers' compensation environment.

The ability to expedite medical care and return to work after an accident resulted in the speedier claim resolution resulting in fewer temporary total days paid and decreased medical costs. This profoundly improved yearly medical and indemnity claim severity (average payments per claim Recall that the 3-year closure percentage increased from 10% in 1988, 3 years before the cost containment initiative began) to 89% in 2017. Also improving over the 32-

year study period, were the 5-year and 7-year claim closure percentages. Our previous studies indicate that longer claim duration is associated with increased workers' compensation medical and indemnity costs. Reductions in workers' compensation claim duration are closely related to decreased medical and indemnity costs on a per claim basis.^{18–24} The 9-fold improvement in claim closure rates was also linked to decreases losses per \$100 of payroll that we observed in our program in contrast to the losses per \$100 in payroll reported by private employers in the US. The ability to significantly improve the resolution of claims undoubtedly eliminated a large proportion of the tail liability in Johns Hopkins workers' compensation claims. Earlier claim closure is perhaps the best demonstration of the efficacy of the Johns Hopkins Workers' Compensation Program's ability to influence loss development by expediting the delivery of medical care and the return to work process, especially the nurse case management of complicated injuries treated by specialty medical providers in and outside, the "expert panel."

Another factor accounting for our findings may be relative (proportionate) amount medical to indemnity spending of the JHWCP. As seen in Figure 5, the average proportion of indemnity spending to medical spending per workers' compensation claim closed within 3-years, is about 20% higher than medical spending. In contrast, observed medical spending accounts for 60% of workers' compensation benefit costs among US employers.¹⁶ As medical inflation has been the principal driver of increasing workers compensation claim costs in the US over the majority of the study period, the favorable ratio of medical to indemnity spending obtained by the JHWCP is another factor accounting for its observed outcomes. The ability to improve the post-injury management of medical care may be a significant factor in the program's performance.

Satisfaction with the program was not assessed. However, our previous investigation referenced a 1994-survey of employees conducted by an independent consulting company to study the

satisfaction of workers' compensation claimants at the Johns Hopkins Health System.⁶ The survey, using a five-point scale (0 = poor and 5 = excellent) indicated that employees who used the Johns Hopkins' occupational clinics and expert panel of specialty physicians for their care rated these services at 4.36. This rating was 20% higher than the 3.64 point rating the employees gave to services they received at Johns Hopkins when being treated for non-occupational medical problems.

The age of injured workers was not included in the analysis, which was a limitation. The effects of age on the frequency of new claims could not be accessed without the age data on underlying employed population which was not available to the research team. However, the average age of the injured workers did increase over study period (from 39.93 in 1988 to 44.77 in 2018). Increasing age is associated with increases in the frequency of new lost-time workers' compensation claim filings. Aging workers sustaining injuries paid for under the workers' compensation system are costlier to treat and are out of work for longer periods of time than younger workers with the same injuries. This has resulted in older workers exhibiting higher medical and indemnity claim severity (average per claim costs) than younger workers. We plan to perform another investigation that studies this phenomena and implications regarding the interpretation of longitudinal analyses of workers compensation claim trends.

This investigation reveals that our first question regarding the durability of the JHWCP in maintaining the cost-reduction outcome observed in our 2003 publication was addressed. The program maintained its early cost containment successes augmenting gains with the addition of more safety programming particularly in the healthcare sector of employment at Johns Hopkins. However, after rapid declines in total, medical, and indemnity losses per \$100 of payroll seen in the first 10 years of the program, cost decreases improved at a much slower rate after that time period. Perhaps this indicates that there is an inherent risk in certain types of employment that is more difficult to be mitigated in order to achieve further reductions?

Except for a few programmatic interventions that were the subject of previous studies,^{1-3,7} it was difficult to isolate specific safety (preventive) or post-accident management (improved medical and claim management) interventions most responsible for the decreases in workers' compensation frequency rates and costs. The JHWCP incorporated many well-validated strategies and practices aimed at managing medical care costs and disability in workers' compensation between 1991 and 1995: preferred medical providers (networks), evidence-based practice guidelines, coordination of medical care or the return to work (medical case management programs, return-to work coordinators, disability management programs, etc.). These efforts have been successful both within single employer environments and among multiple employers.²⁵⁻⁴³ Because they were introduced at the same general time in the JHWCP or constantly refined, the relationship between any one of the programs and changes in medical and indemnity payments over time was difficult to assess. We did not study changes in the rates of workers' compensation lost-time claims for specific conditions such as carpal tunnel syndrome or low back disorders which would have been beyond the scope of this overall assessment of the program. This being said, we did establish two insights: 1) improvements in safety practices and case management and adjudication procedures, impacted claim costs for the population at risk (all employees) and 2) that declines in total, medical, and indemnity severity (costs per lost-time claim) were related to the JHWCP's ability to increase the rate of claim closures.

The involvement of the entire safety, medical, and administrative team in the management of an injured worker was the most enduring and unique feature of the revitalized JHWCP. The twice-monthly meetings by all participants (safety, medical, claim adjusters, etc.) to discuss the cause of the injury, institute workplace changes to prevent similar accidents, coordinating the medical care,

and recovery process was center point of all activities. This meeting permitted constant dialogue and planning for return to work, including determination of work-place accommodations that match the injured workers restrictions or temporary alternative job placement. The interaction was felt to be the key ingredient in preventing future accidents, expediting medical care, and decreasing disability. We believe this teamwork also accounted for observed increases in the rate of annual claim resolutions (closures), significantly reducing the number of active claims thereby reducing the amount of current and future JHWCP liability.

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