



Changes in the care of patients with cervical spine fractures following health reform in Massachusetts



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ABSTRACT

Introduction: There is a substantial concern among spine surgeons that healthcare reform efforts will alter the processes through which spinal care is delivered and decrease overall quality.

We used the Statewide Inpatient Dataset for Massachusetts to evaluate changes in hospital processes and quality of care for patients with cervical fractures following the implementation of health reform. **Methods:** This was a pre–post retrospective analysis of patients ($n = 9,387$) treated for cervical fractures in Massachusetts between 2003–2006 and 2008–2010. Changes in hospital processes (surgical intervention, length of stay (LOS) and environment of care) and quality of care (mortality, complications, reoperation and failure to rescue (FTR)) were the outcomes of interest. FTR is a quality measure that evaluates a hospital's capacity to avoid mortality following the occurrence of a sentinel complication. Patients treated between 2003 and 2006 were considered the pre-reform group. The post-reform cohort consisted of those treated from 2008 to 2010. Baseline differences between cohorts were evaluated using chi-square or Mann–Whitney U tests. Unadjusted comparisons between the dependent variables and the onset of healthcare reform were performed, followed by regression techniques that adjusted for differences in case-mix and whether a surgical intervention was performed. Multivariable logistic regression was used for categorical variables and negative binomial regression was employed for continuous variables.

Results: The rates of surgical intervention remained unchanged pre- and post-reform ($p = 0.25$). Hospital length of stay (RC: -0.18 , 95% CI: -0.22 , -0.14) and the FTR rate following surveillance insensitive complications (OR: 0.49, 95% CI: 0.25, 0.94) were significantly reduced following health reform. Post-reform, academic centers experienced a 22% reduction in mortality (95% CI: 0.61, 0.99) a 40% decrease in FTR (95% CI: 0.40, 0.89), a 30% decrease in surveillance insensitive complications (95% CI: 0.51, 0.96) and a 67% reduction in FTR after surveillance insensitive morbidity (95% CI: 0.11, 0.94).

Conclusions: In the period following Massachusetts healthcare reform, significant improvements were noted in hospital process and quality measures around the care of patients with cervical spine fractures. Such findings were particularly robust among academic centers. These results may forecast changes in the delivery of spine surgical care following other health reform initiatives.

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Introduction

The Affordable Care Act (ACA) and other efforts associated with healthcare reform intend to enhance access to medical services while improving quality and reducing costs [1–4]. Recently implemented provisions that strive to achieve such goals include the establishment of Accountable Care Organizations (ACOs),

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bundled-payment programs and pay for performance initiatives [1,2,4–7]. The impact of such attempts at health reform on surgical services has not been widely considered [1]. Furthermore, the effect of reform measures on the delivery of spine surgical care is largely unknown.

There is a concern that health reform efforts will adversely affect the delivery of spinal care, limiting the types of surgical interventions afforded to patients, impairing outcomes and penalising centers that treat largely underserved populations [4,7–12]. In addition, recent work has determined that certain reform initiatives, such as pay for performance, do not demonstrably improve results in the setting of surgical interventions [7]. Other studies have concluded that the integrated care benefits associated with ACOs may not extend to inpatient surgical practice [2].

Given the fact that most provisions of the ACA did not go into effect until 2014, a complete analysis of this legislation's effect on the field of spine surgery is not possible at this time. However, the state of Massachusetts, which passed comprehensive healthcare reform in 2006 [3,9,13,14,15], may be used to model the impact of these initiatives on the delivery of spine surgical care. The *Massachusetts Act Providing Access to Affordable, Quality, Accountable Health Care* paralleled the aims of the ACA in improving access to care, enhancing quality and decreasing costs [3]. In light of this, we endeavoured to employ the State Inpatient Dataset (SID) for Massachusetts from 2003 to 2010 to investigate changes in the care of patients with cervical spine fractures following the implementation of health reform. We sought to investigate alterations in the environments of care, hospital processes and quality. As a non-discretionary traumatic condition with relatively high rates of morbidity and mortality [16,17], cervical fractures were considered an ideal means to understand differences in hospital processes, quality and environments of care associated with health reform. The SID for Massachusetts has been used in previous research efforts evaluating the quality of healthcare, including works investigating outcomes following hospitalisation [12,18–21].

Methods

Prior to commencing, this study received an exempt determination from the University of Michigan institutional review board. This was a pre–post investigation, conducted using data reported to the SID by the state of Massachusetts for patients treated between January 1, 2003 and December 31, 2010. The dataset was queried by International Classification of Diseases, 9th Revision (ICD-9) codes to identify all adults (age 18 and older) who sustained a cervical spine fracture or fracture-dislocation (805.00–08, 805.10–08, 806.00–09, 806.10–806.19, 839.00–08, 839.10–18).

Demographic information was obtained for those individuals identified as having sustained a cervical spine fracture, including age, race and sex. Race was classified as white or non-white (African-American, Hispanic and other race). The year of injury was also recorded, as was the cervical level and the patient's insurance status at the time of presentation. Insurance status was defined as private insurance, Medicare, or underinsured (self-pay and Medicaid). Medical co-morbidities were abstracted using modified Charlson criteria [22].

Surgical data, hospital length of stay (LOS), in-hospital mortality, complications and the need for unplanned reoperation were evaluated for each patient in the study set. ICD-9 procedure codes were used to determine whether a patient had undergone operative intervention for their cervical fracture. In the absence of any of these codes, the patient was considered as having received non-operative treatment. Abstracted complications included

infection/sepsis, shock, neurologic compromise, acute myocardial infarction, other respiratory complications, urologic complications, acute renal failure, delirium, venous thromboembolic disease and haemorrhage/hematoma/seroma. Complications were categorised as surveillance sensitive or insensitive, with infection/sepsis, shock, neurologic compromise, myocardial infarction and haemorrhage/hematoma/seroma considered surveillance insensitive. Patients who sustained one or more complications and died during the hospital stay were also considered as failure to rescue (FTR). FTR is an accepted quality measure that indicates a hospital's capacity to prevent patient mortality following the occurrence of a sentinel complication [23,24].

The environment of care was determined using American Hospital Association identification codes and hospital designation provided by the Massachusetts Center for Health Information and Analysis [25]. Those medical centers designated by the state of Massachusetts as “Academic Medical Center” or “Teaching Hospital” were considered academic medical centers for the purposes of this analysis. Those defined as “Disproportionate Share Hospitals” by the state were considered safety-net hospitals.

The pre- and post-reform cohorts were defined by the year in which the patient was treated for cervical trauma. Individuals initially treated between January 1, 2003 and December 31, 2006 were considered the pre-reform group. The post-reform cohort consisted of those patients treated from January 1, 2008 to December 31, 2010. Akin to other studies [13,15,20], the year 2007 was considered a transitional period for the implementation of Massachusetts healthcare reform. As a result, all individuals who sustained cervical fractures during 2007 were excluded from further analysis.

Statistical analysis

Baseline differences between the pre- and post-reform cohorts were evaluated using the chi-square test and the Mann–Whitney *U* test for categorical variables and non-parametric continuous variables, respectively. Temporal differences in the rates of operative intervention and the environments of care pre- and post-reform were determined via chi-square testing. Healthcare reform was considered the primary independent variable, with subset analyses performed to determine the impact of reform on care within academic centers and safety-net hospitals. The dependent variables included in-hospital mortality, complications, reoperation, FTR and length of stay.

Unadjusted comparisons between the dependent variables and the presence of healthcare reform were performed first, followed by regression techniques that adjusted for differences in case-mix (age, sex, race, insurance status and number of medical co-morbidities) and whether a surgical intervention was performed. Multivariable logistic regression was used for categorical variables while negative binomial regression was employed for continuous variables. Results were reported using odds ratios (OR) for logistic regression and regression coefficients (RC) for negative binomial regression, along with 95% confidence intervals (CI) and *p*-values. Statistically significant findings in multivariable logistic regression were considered to be those that maintained *p*-values < 0.05 and 95% CIs exclusive of 1.0 after adjusting for case-mix and surgical intervention. Results with *p*-values < 0.05 and 95% CIs exclusive of 0.0 were considered significant after negative binomial testing. In the event that FTR and the incidence of complications were found to be significantly different in the periods before and after health reform, additional analyses were performed to evaluate whether the results were sensitive to changes in the rate of surveillance sensitive complications as opposed to surveillance insensitive morbidity. Statistical testing was conducted with STATA v13.0 (STATA Corp, College Station, TX, USA).

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