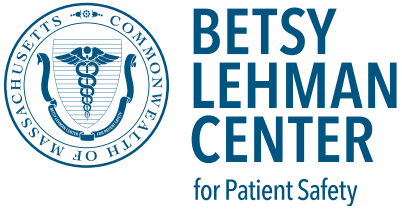
The Financial and Human Cost of Medical Error

... and How Massachusetts Can Lead the Way on **Patient Safety**

BETSY LEHMAN CENTER
for Patient Safety

JUNE 2019



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PREFACE AND ACKNOWLEDGEMENTS

This report, and the two research studies upon which it is based, aims to fill information gaps about the incidence and key risks to patient safety in Massachusetts, increase our understanding of how medical error impacts Massachusetts patients and families and, most importantly, propose a new, concerted effort to reduce medical error in all health care settings in the Commonwealth.

Many individuals and organizations made meaningful contributions to this work, for which we are extremely grateful:

- **Betsy Lehman Center Research Advisory Committee**, whose members offered insightful feedback on our methodologies and analyses including: David Auerbach, PhD, Health Policy Commission; Laura Burke, MD, Harvard Global Health Institute; Ray Campbell, JD, MPA, Center for Health Information and Analysis; Katherine Fillo, PhD, RN, Massachusetts Department of Public Health; Jose Figueroa, MD, MPH, Harvard Global Health Institute; Paula Griswold, Massachusetts Coalition for the Prevention of Medical Errors; Carol Keohane, MS, RN, CRICO; James Lee, Tufts University School of Medicine; Timothy O'Neill, Joint Committee on Health Care Financing; Barbra Rabson, MPH, Massachusetts Health Quality Partners; Mark Schlesinger, PhD, Yale University School of Public Health; Eric Schneider, MD, MSc, Commonwealth Fund; Joel Weissman, PhD, Center for Surgery and Public Health, Brigham & Women's Hospital; and Zi Zhang, MD, MPH, Center for Health Information and Analysis
- **Our survey advisory group**, which met regularly to assist in the survey's design and analysis, including: Sigall K. Bell, MD, Beth Israel Deaconess Medical Center; Rear Admiral Jeffrey Brady, MD, MPH, Agency for Healthcare Research and Quality; Caren Ginsberg, PhD, Agency for Healthcare Research and Quality; Patricia McGaffigan, RN, MS, Institute for Healthcare Improvement; Eric Schneider, MD, MSc, Commonwealth Fund; Mark Schlesinger, PhD, Yale School of Public Health; Eric Thomas, MD, MPH, University of Texas Health Science Center; Saul Weingart, MD, MPP, PhD, Tufts Medical Center; Joel Weissman, PhD, Center for Surgery and Public Health, Brigham & Women's Hospital
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We also want to extend special recognition to our survey respondents, in particular the 253 Massachusetts residents who were willing to speak with our research team at length and on multiple occasions about their recent experiences with medical error. Several of these individuals told us they were thankful for the survey, which allowed them an opportunity to reflect and communicate about a difficult period in their lives. They were especially motivated to share their thoughts and feelings in the hopes that it would spark change and prevent future harm to other patients. We, in turn, appreciate everyone who took the time to talk with the survey team. The experiences they shared—which ranged from mildly upsetting to life-altering—will continue to inform and inspire our work. All quotations that appear in this report are from medical error survey respondents, used with permission.

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About this report

There has been considerable progress on improving the safety of health care for patients over the past two decades. Much of this work has been done by hospitals in Massachusetts and across the country.

Yet, medical error continues to cause hundreds of thousands of deaths and injuries each year in the United States.[1,2] Preventable safety events now occur in 115 of every 1,000 hospitalizations,[3] costing payers an average of $8,000 per admission.[4,5] As more care is delivered outside of hospitals, risks to patient safety are an emerging concern in physician practices, dental offices, surgery centers, pharmacies, dialysis centers, patients' homes, nursing homes—anywhere patients receive care. Medication errors are among the most common errors in outpatient and inpatient settings.[6] And one in 20 U.S. adults who seek outpatient care will experience a diagnostic error each year, with about half of the errors considered potentially harmful.[7]

Massachusetts gets high marks for the overall performance of its health system on metrics such as access to care, children's vaccination rates, and 30-day hospital mortality.[8] Data specific to patient safety is more limited. In the only national ranking of safety, Massachusetts hospitals are highly rated[9] though similar rankings are not available for outpatient and long-term care.

To add to our knowledge about the impact of preventable medical error in Massachusetts, the Betsy Lehman Center undertook two studies.

The first study analyzed one year's worth of health insurance claims data to count the number of medical errors in a variety of health care settings using almost 100 diagnostic codes that previous studies have shown to be associated with preventable patient harm. It then measured the cost of health care services in the aftermath of the error.

The second study began with a random-sample survey of 5,000 Massachusetts households that identified almost 1,000 people who reported having experienced a medical error in their own care or in the care of a household or close family member within the previous five years. In a follow-up survey, 253 of these individuals shared detailed information about the impacts of those errors, and about the communication or support they received from health care providers in the aftermath of the errors.

In short, Massachusetts providers in every setting where health care is delivered face the same patient safety challenges that persist throughout the nation.

Our research uncovered almost 62,000 medical errors, which were responsible for over $617 million in excess health care insurance claims in a single year—just exceeding one percent of the state's Total Health Care Expenditures for 2017. Because some of the most common types of errors (for example, medication and diagnostic errors) cannot be reliably identified using health insurance claims data, these numbers underestimate both total incidence and cost.

From our surveys, we learned that many of the people who report recent experience with medical error are suffering long-lasting behavioral, physical, emotional, and financial harms. Individuals report that they have lost trust in the health system and some avoid not only the clinicians and facilities responsible for their injuries, but health care entirely. Moreover, most respondents expressed dissatisfaction with how their health care providers communicated with them after the errors.

An important and promising finding is that in instances where providers communicated more openly, patients report less emotional harm and health care avoidance.

The challenges are great, but so are the opportunities for improvement—particularly in Massachusetts. In addition to presenting the research findings, this report proposes a coordinated response through which the Commonwealth's providers, policymakers, and public can begin to accelerate safety and quality improvement, and once again lead the nation on an urgent health care challenge.

BETSY LEHMAN CENTER for Patient Safety

The Betsy Lehman Center is a non-regulatory state agency that catalyzes the efforts of providers, patients and policymakers working together to advance the safety and quality of health care in all settings. Established by Chapter 224 of the Acts of 2012, the Center's mandate includes:

- Facilitating agency and provider collaboration on system-wide patient safety improvement initiatives
- Administering a program of research and data analysis
- Developing mechanisms to include patients and families in safety improvement efforts
- Reporting on the Commonwealth's safety improvement progress

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Medical error was first recognized as public health challenge over 25 years ago

Betsy Lehman was a nationally recognized *Boston Globe* health columnist and mother of two young girls when she died of a massive overdose of chemotherapy while being treated for breast cancer at the Dana-Farber Cancer Institute on December 3, 1994. At the time, health care providers were not in the practice of reporting serious harm events to the state's regulatory agencies. Nor did they typically disclose errors to patients and families.

In Betsy Lehman's case, about two months after her death, Dana Farber staff discovered the medication error and informed her family. Her colleagues at the *Globe* made the decision to provide extensive, sustained coverage not only of the error leading to her death but of the broader risks to patient safety. The Department of Public Health was alerted to the overdose by the *Globe*'s coverage and launched an investigation.

In Massachusetts and nationally, Betsy Lehman's death catalyzed a movement to recognize that patient harm is not always caused by an indivudal clinician's negligence. Rather, preventable medical harm can be viewed as a consequence of institutional systems and culture that had not kept pace with the complexities of modern health care. The challenge and the opportunity, then, would be to apply interventions developed by other complex, high-risk industries that had succeeded in achieving high levels of safety and reliability.

At the national level, the Institute of Medicine's 1999 report, *To Err Is Human: Building a Safer Health System*,[1] drawing from the groundbreaking work of Lucian Leape[10] and others,[11] established medical error as a leading cause of death. The report was a call to action for the health care system to recognize and respond to systemic contributors to preventable medical harm. It also laid out a comprehensive path forward that could be driven through collaborative, multi-stakeholder efforts.

In Massachusetts, a group of regulators and health care providers joined together as the Massachusetts Coalition for the Prevention of Medical Errors to strategize over how to introduce a more collaborative and less punitive approach focused on learning from and preventing the recurrence of medical harm. Such an approach would emphasize identifying root causes of adverse events, developing corrective action plans, and disseminating this information across providers. The Coalition and Betsy Lehman's family also advocated for the legislature to create a non-regulatory state agency in her name to coordinate, support, and report on the patient safety improvement efforts of the state's provider organizations and health care agencies, and to engage the public.

Some of these patient safety pioneers believed that by adapting and implementing the high reliability and safety principles and practices of other industries such as aviation and nuclear power,[12,13] the health care system could eliminate most preventable patient harm.

CLICK HERE TO VIEW BETSY LEHMAN'S STORY.

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Progress has been made over the past 25 years, but the health care system remains prone to error and there are no easy fixes

Investments in safety improvement in Massachusetts and nationally are making a difference, particularly in hospitals. Earlier this year, the Agency for Healthcare Research and Quality and the Centers for Medicare & Medicaid Services (CMS) released data showing that nine types of hospital-acquired conditions (HACs) declined by nearly one million instances from 2014-2017, preventing over 20,000 hospital deaths and saving $7.7 billion nationally.[14] This set of HACs, which includes adverse drug events and healthcare-associated infections, had been targeted by CMS through a pay-for-performance program that reduces Medicare reimbursements to the lowest performing hospitals, as well as offerings of collaborative learning opportunities and other resources aimed at helping hospitals improve.

Other strategies that either are improving or have the potential to improve patient safety are documented in a recent special issue of *Health Affairs*. These include best practices and innovations for effective communication within care teams and between providers[15] and patients[16], leveraging electronic health records to enable early detection and response to errors,[17] and modifying the built environment to prevent patient harm.[18]

In Massachusetts, a variety of collaborative safety and quality improvement initiatives are underway, for example a Health Improvement Innovation Network led by the Massachusetts Health and Hospital Association and a Perinatal and Neonatal Quality Improvement Network administered by the March of Dimes. Past learning collaboratives have successfully targeted safety risks such as overdiagnosis of urinary tract infections, communicating critical test results, and medication errors.

However, many forces conspire against consistent and widespread implementation of safety plans and best practices, including:

- **Complexity.** The sheer complexity and pace of modern medicine generate new and evolving safety risks that demand never-ending, continuous cycles of improvement. The unintended safety consequences of electronic medical records[19] are but one example. Sometimes the underlying risks are not within the direct control of providers—for instance, unclear labeling of drugs or devices by manufacturers.[20]
- **Culture.** Providers and patients alike have prized individual skill, autonomy and responsibility over the teamwork and standardization needed to ensure safety in today's heath care system.[21,22] And some medical practices and organizations lack safety cultures in which every staff member feels responsible and empowered to speak up about risks and adverse events without fear of reprisal.[19,23]
- **Competing priorities.** Health care leaders are dealing with many competing pressures.[24] Making safety a top priority means taking on the difficult task of culture change.[25] Other barriers may include a sense that ambitious safety goals are unattainable, or that one's own organization is already as safe as it can be.
- **Factual foundation**. Current systems for detecting, reporting, and analyzing adverse events and safety risks do not always yield enough meaningful data to sufficiently inform leadership of health care organizations or to guide improvement at the system level.[19,23,26]
- **Misaligned incentives.** In many cases, providers are still paid not only for health care services that result in preventable harm, but for the additional services necessitated by the harm.[26] Moreover, the return on investment for implementing safety improvements at the provider level may seem too unreliable to executive leadership and their governing bodies.

PROGRESS OVER THE LAST 25 YEARS

1. The systems and cultural factors that contribute to preventable medical harm events are well understood, at least by patient safety and quality professionals.
2. An extensive array of evidence-based best practices for reducing the risk of human error and preventing patient harm when errors do occur are now available.
3. A number of transparency initiatives and financial incentives, mainly at the national level, now promote safety and quality improvement.

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What we know—and don't know—about medical error in Massachusetts, and why it matters

The systems Massachusetts uses to track instances of medical error are overlapping, fragmented, and incomplete. The resulting patchwork quilt of data is not always up to the task of informing policymaker and agency decisions about safety priorities at the state level. Nor does it help health care providers learn from the risks identified at peer organizations to identify their own vulnerabilities and take steps to prevent patient harm. Sparse information also contributes to low awareness among all parties—including the public—and a tendency to underestimate the risks and the need for investment in solutions.[21]

For the most part, state and federal reporting mandates apply to narrowly-drawn categories of providers (mostly hospitals, nursing homes and ambulatory surgery centers) and are designed to capture a subset of adverse events that result in serious injuries or death. For instance, if a dentist extracts the wrong tooth or a pediatrician gives a child the wrong vaccination, the data is not captured. In the case of hospitals and nursing homes, most errors that cause less serious harm are not required to be reported, even though critical information could be gleaned from these "near miss" or lower injury events.

Underreporting of errors is widespread.[27] But while some noncompliance with reporting may be intentional, much underreporting is attributable to problems with a provider organization's internal systems for identifying and tracking adverse events in the first place. Weaknesses include low staff awareness, a difficult or frustrating user interface, clinician and staff perceptions that reporting is a waste of time because no one will take action anyway, or a culture that leads clinicians and staff to fear that they or others will be punished for safety lapses that are reported.

To illustrate, Massachusetts mandates that hospitals and ambulatory surgery centers report medication errors resulting in serious injury or death. In 2017, facilities reported a combined total of 52 such errors.[28] Yet, in a recent study that followed patients through 277 surgeries at a single Massachusetts hospital, researchers observed that 1 in every 20 medications administered involved an error and/or harm event. Of over 150 errors found to be preventable, nearly 90 percent either caused or could have caused serious or even life-threatening consequences.[29] Studies like this show that if you look, you will find far more errors than providers detect and report.

Barriers to data-sharing among the various custodians of the data also reduce the value of information that the state currently receives. Data silos effectively prevent anyone from gaining a complete picture of the existing medical error landscape. Because we all touch different parts of the elephant, no one is positioned to answer such obvious questions as:

- How many preventable patient harm events are happening statewide?
- What are the most common and most costly types of error?
- What are the key contributors or risk factors for these errors?
- Which providers are performing better or worse than their peers on safety?
- Which safety risks have been successfully reduced and how?

This is not to suggest that patient safety will be achieved by more metrics and reporting alone. Indeed, sound arguments are being made for policies that would reduce reporting and measurement to just the right level to support improvement.[30] To do this will require new ways of thinking about how best to gather and use safety data in both centralized (at the state level) and decentralized (at the provider organization level) ways, and how to leverage data to maximize shared learning across provider organizations and to hold those organizations and their leaders accountable for quality and safety.

WHICH ERRORS ARE REPORTABLE UNDER CURRENT LAW?

WHEN A PATIENT ...	MUST THE PROVIDER REPORT IT TO A STATE AGENCY?
Is seriously harmed by a medication overdose in a hospital or nursing home	YES
Has the wrong eye anesthetized during cataract surgery at an ambulatory surgery center	YES
Attempts self-harm in the psychiatric unit of a hospital	YES
Has cancer, but freestanding lab does not transmit screening test results to ordering physician or patient	NO
Has wrong tooth removed in a dentist's office	NO
Visits the pediatrician for a flu shot and is given a vaccination intended for another child	NO

Visit the Betsy Lehman Center's **Patient Safety Navigator** to learn more about patient safety reporting requirements.

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Two new studies look beyond existing reporting systems to fill important gaps in what we know about the costs of medical error

Although our formal systems for collecting data about patient safety in Massachusetts may be fragmented, it is possible to supplement what we know. The Betsy Lehman Center recently undertook two studies that are the first to rigorously measure:

1. The annual incidence, types, and system costs of medical errors throughout the Commonwealth
2. The physical, emotional, behavioral, and financial impacts of preventable medical harm on Massachusetts residents

I. THE INCIDENCE AND FINANCIAL COSTS OF MEDICAL ERROR

- **Question**—How many preventable medical harm events occur in one year, what are the most common and costly types of errors, and how many dollars are spent on excess health insurance claims resulting from these errors?
- **Approach**—We applied an established methodology[31] used to estimate the national cost of medical error using the Massachusetts All-Payer Claims Database (APCD) (which includes both commercial health insurance and Medicaid claims) and Medicare claims data encompassing most reimbursable procedures or treatments. Under this approach, we identified patients for whom insurance claims had been submitted using any of 98 diagnostic codes known to be associated with preventable harm events, calculated the probability that these claims were related to preventable error, and estimated the additional health care costs resulting from those events. We used APCD and Medicare claims data for 2013 because of a subsequent change in the diagnostic coding system.[32] For preventable harm events that cannot be found in health insurance claims data, we partially supplemented our estimates using data derived from peer-reviewed literature and incident reporting systems [see Appendix A for detailed explanation of the methodology].

EXAMPLE: ESTIMATING THE ANNUAL COST OF FOREIGN OBJECTS LEFT IN THE BODY AFTER SURGERY

Identified 262 patients in claims data with retained foreign object diagnostic codes.

- Reduced to 236 cases (-10%) to account for potential false positives
- Estimated 224 errors based upon 95% probability that the event was preventable
- Calculated the total average cost of these patients' health insurance claims 1-year post-event

($) **Average costs 1-year after encounter**

–

Identified a larger control group of similar patients who did not have retained foreign object codes.

- Calculated the total average cost of their health insurance claims during the same 1-year period

($) **Average costs 1-year after encounter**

= **$2.4 million***

EXCESS HEALTH CARE COST ATTRIBUTABLE TO ERROR

*Adjusted to 2017 dollars.

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Two new studies look beyond existing reporting systems to fill important gaps in what we know about the costs of medical error

II. THE HUMAN COST OF MEDICAL ERROR

- **Question**—How does the Massachusetts public experience medical error? Specifically, if we ask a large, randomized cross-section of our state's residents about their experiences with medical error, what will we learn about:
  - The incidence and types of medical errors?
  - The health care settings where errors are happening?
  - The physical, emotional, and financial consequences of error to patients and families over time?
  - How providers respond after an error (e.g., do they disclose, apologize, offer help)?
  - The impact of open communication about errors on patient and family wellbeing?
- **Approach**—We identified and interviewed Massachusetts residents who have experienced medical error through two statewide telephone surveys. First, the Center for Health Information and Analysis' 2017 Massachusetts Health Insurance Survey, which reached 5,001 randomly selected households, included a brief set of questions to identify people who had experienced a medical error in the previous five years in their own care or in the care of a family or household member.

A total of 988 people reported medical error experience in the Massachusetts Health Insurance Survey. In 2018, we were able to conduct a 30-question "re-contact survey" with 253 respondents about the physical, emotional, behavioral, and financial impacts of the errors, as well as the communication and support offered by providers after the errors. Ten of the re-contact survey questions allowed for open-ended narratives through which we gathered the details of these individuals' experiences; the narratives were coded for the Center by a team of physician researchers at Yale University.

The re-contact survey also reached 371 respondents who had reported no recent experience with medical error to ask a brief set of questions regarding their perceptions of the health care system and patient safety [see Appendix B for a detailed explanation of the methodology].

All survey data and quotes contained in this report reflect the respondents' views of their experience with medical error at the time of the survey.

"Sometimes when people receive medical care, mistakes are made. These mistakes sometimes result in no harm; sometimes they may result in additional or prolonged treatment, disability, or death. These types of mistakes are called medical errors."

HOW "MEDICAL ERROR" WAS DEFINED IN THE SURVEY[33]

WHO DID WE SURVEY, AND WHAT DO THEY KNOW ABOUT MEDICAL ERROR?

Studies consistently show that patients and families are excellent observers of medical error. In some cases, they are more likely than their clinicians to detect errors, and are correct most of the time when they do report errors. But they are often reluctant to speak up or come forward out of a fear of offending their clinicians or out of a belief that their concerns won't be taken seriously or make a difference.[36,37]

We found that most people are willing to discuss their experiences when asked. In the initial survey, 736 of the 988 respondents who told us they had experienced medical error agreed to be re-contacted for in-depth interviews. Of the 253 we were able to reach, everyone was older than 18, and the oldest was 91. Almost one quarter of these individuals live in households earning less than 139% of the federal poverty level; nearly half had incomes equal to or greater than 400% of the federal poverty level. Over one in three live in a household where someone has a four-year college or advanced degree. Over 40% of the respondents were men and nearly 60% were women.

The largest group told us about errors that had happened in their own care (33%). Others told us about errors in the care of their parent (16%), child (15%), spouse (12%) and other family members (25%). Of the 67% who said the error happened to a family or household member, over one in four (27%) were responsible for making decisions about that person's care when the medical error occurred.

One in three (33%) respondents reported experiencing multiple medical errors in the past six years. We asked these people to focus in on the single error they remembered best when answering our survey questions.

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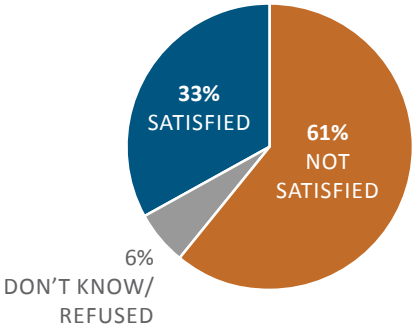
Key findings

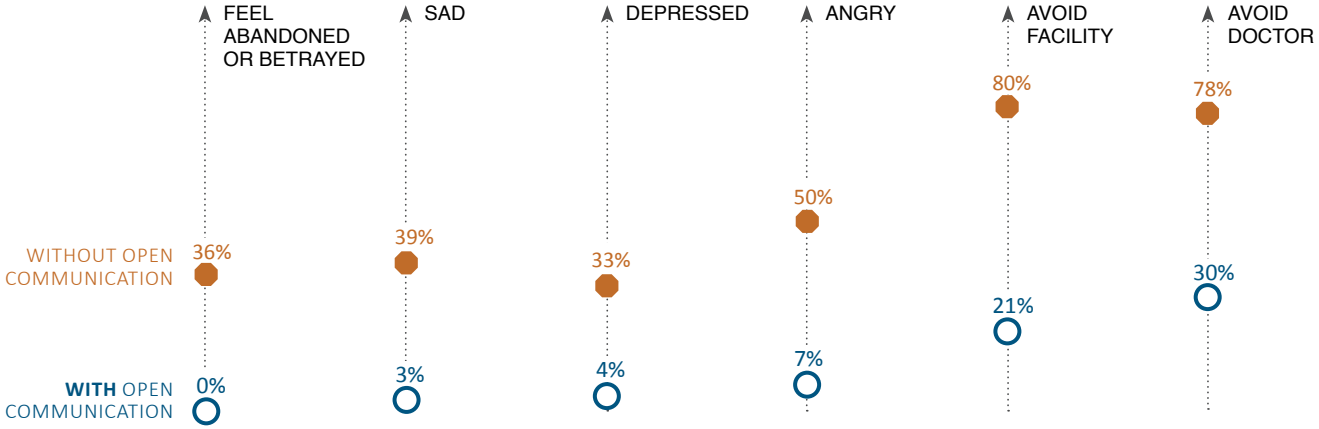
1 in 5 Massachusetts residents report recent experience with medical error

either in their own care or in the care of a family member, 2013-2018

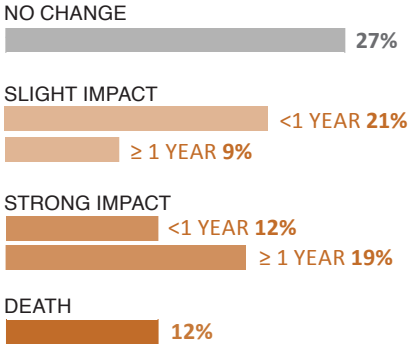
MOST PEOPLE ARE DISSATISFIED WITH COMMUNICATION AFTER AN ERROR



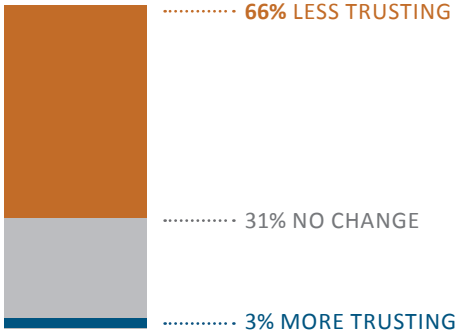
OPEN COMMUNICATION BY PROVIDERS IS LINKED WITH LOWER LEVELS OF HARM



ERRORS HAVE LONG-LASTING IMPACTS ON PHYSICAL HEALTH



MEDICAL ERRORS LEAD TO A LOSS OF TRUST IN HEALTH CARE



MANY PEOPLE EXPERIENCE FINANCIAL SETBACKS FROM MEDICAL ERRORS

33%
DECREASE IN INCOME

50%
INCREASED MEDICAL EXPENSES

33%
INCREASED HOUSEHOLD EXPENSES, SUCH AS ADDITIONAL CHILDCARE, TRANSPORTATION OR HOUSECLEANING SERVICES

MEDICAL ERROR IN MASSACHUSETTS **IN ONE YEAR**

61,982
MEDICAL ERRORS

$617 million
EXCESS COSTS ATTRIBUTABLE TO ERRORS

FINDING: Medical errors are frequent, harmful, and costly

Using one year of claims from the state's APCD and Medicare data from 2013,[32] we identified 42,927 preventable harm events that happened in settings that provide services covered by health insurance, primarily hospitals, ambulatory surgery centers, medical offices, and nursing homes. During the 12 months following each error, we also identified $518 million in excess health insurance claims associated with patient harm. For several common preventable harm events that cannot be fully identified in claims data or that the established methodology did not account for—falls, medication errors, MRSA and *C. difficile* infections—we were able to supplement the incidence figures with partial data from peer-reviewed studies and incident reports related to hospital inpatient admissions,[38-48] and apply other established cost estimates for these conditions.[49] This added 19,055 incidents and $99 million in excess costs to our calculations.

Overall, we found 61,982 preventable harm events and over $617 million in excess health insurance claims—just above one percent of the state's Total Health Care Expenditures.[50]

Of the 98 types of errors that can be found in claims data, the top 10 most frequent errors account for 71% of all errors. Seven of the top 10 most frequent errors were also among the top 10 most costly errors.

Our findings about the most frequent types of errors follow a pattern similar to the earlier national study on which it was based, with seven of the most frequent errors making the top 10 lists in both studies.[31] Such alignment suggests that not only do Massachusetts providers face many of the same safety challenges as their national counterparts, but that the methodology from the national study is valid as applied to Massachusetts. Our cost findings are, in turn, reinforced by the results from our survey of Massachusetts residents. Nearly two-thirds of survey respondents who reported experience with medical error also reported that the error resulted in a need for additional care, including longer hospital stays, rehabilitation services, or extra doctor visits.

THE TOP 10 MOST FREQUENT ERRORS

1.	Pressure ulcer ($)*	14,369
2.	Postoperative infection ($)	4,625
3.	Infection and inflammatory reaction due to internal prosthetic device implant and graft ($)	1,919
4.	Bleeding/blood loss (hemorrhage) complicating a procedure	1,628
5.	Chronic pain after back surgery	1,606
6.	Accidental puncture or laceration during a procedure ($)	1,511
7.	Medical treatment-induced abnormally low blood pressure (Hypotension Iatrogenic) ($)	1,367
8.	Substances causing adverse effects in therapeutic use ($)	1,238
9.	Abnormal collection of blood (bruise/contusion) complicating a procedure ($)	1,224
10.	Ventral hernia without mention of obstruction or gangrene	948

ACCOUNT FOR 71% OF ALL ERRORS IDENTIFIED IN CLAIMS DATA

*($) Also one of the top 10 most costly errors.

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Our incidence and cost calculations are conservative estimates

If we were able to analyze claims data from 2018, it is possible that we would find some change in the total incidence of preventable harm events, either from improvements that have been documented by several hospital metrics[14] or from differences in the way providers now code claims. Nevertheless, we believe that our approach, combined with the inherent limitations of claims data analysis, has resulted in findings that underestimate the full incidence and financial cost of medical error in the Commonwealth.

1. **We were conservative in our methodology.**
   - We decreased our counts of diagnostic codes associated with errors by 10 percent to account for potential false positives.
   - We made no such adjustment for potential false negatives or missing data.
2. **Some frequent and costly types of error cannot be easily identified through health insurance claims.** Data only reveal what a patient was treated for—not the underlying reasons for the treatment or whether the treatment was correct or timely; this precludes us from comprehensively including several known leading causes of patient harm, including:
   - Diagnostic error and delay in all health care settings[7,52]
   - Preventable patient falls in non-hospital settings[43]
   - Medication errors in non-hospital settings[6]
3. **Health insurance claims data are incomplete.** For example:
   - Providers are not entirely consistent in the way they code claims.
   - Providers may intentionally code in ways to avoid pay-for-performance penalties.
   - In a recent study that analyzed both Medicare claims data and patient medical charts to identify pressure ulcers, researchers found that chart review caught about 20 times more pressure ulcers than claims data analysis.[53]
4. **Our analysis misses costs that are not reimbursed through primary health insurance, including—**
   - Costs of services covered through other types of insurance (e.g., retail pharmacy, most dental)
   - Malpractice claims payments
   - Economic and quality of life costs
   - Other human toll

PATIENTS' EXPERIENCE OF MEDICAL ERROR SUPPORTS OUR CONSERVATIVE ESTIMATES

Around 60 percent of respondents described an error or delay in diagnosis.

- About two out of three of these errors had to do with errors in judgment made by clinicians, such as failure to perform simple diagnostic tests.
- About one out of three events stemmed from process breakdowns, such as a critical lab or radiology result that was not communicated.

Nearly half of respondents (49%) reported two or more financial impacts from medical error such as:

- Increased medical expenses (50%)
- Missed time at work (32%), leaving a job (21%), or decreased income (33%)
- Extra household expenses (33%)

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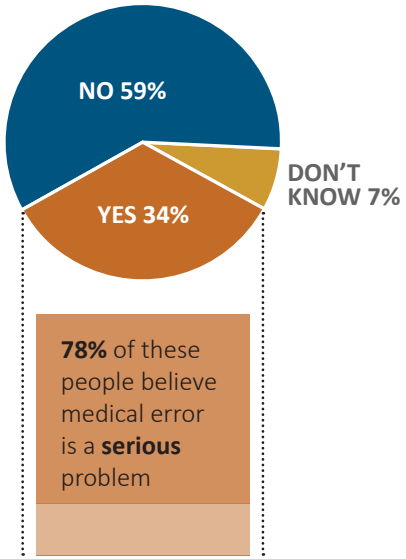
FINDING: Medical errors happen in all health care settings throughout Massachusetts and can happen to anyone

Public perception of medical error as a problem in Massachusetts is low. A majority of all respondents (including the group that did not have recent experience with medical error) believe that medical error is not a problem (59%) or do not know (7%). However, of those who report it is a problem, 78% feel it is a serious problem. These findings are virtually identical to those from a statewide survey conducted five years ago.[34]

Similarly, over half (55%) do not believe a medical error is likely in their own future care. But knowledge of past medical errors increases respondents' sense of personal risk. Almost two-thirds of respondents (63%) who were aware of two or more medical errors in their own or other people's care believed that a future medical error was likely.

DOES THE MASSACHUSETTS PUBLIC SEE MEDICAL ERROR AS A PROBLEM?

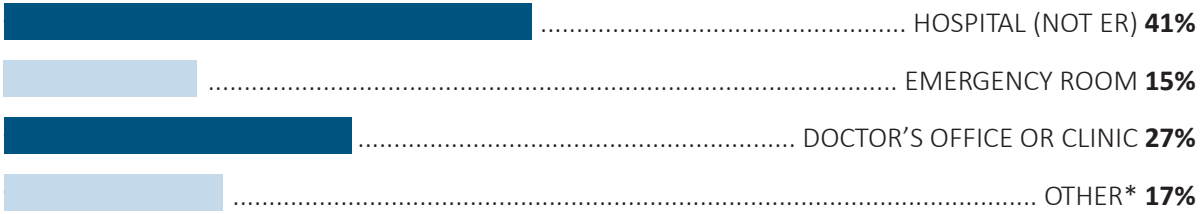


Our re-contact survey of the 253 Massachusetts residents who completed in-depth interviews about their medical error experiences shows that errors happen in all health care settings, including nursing homes, dental offices, emergency rooms, hospitals, urgent care, prison infirmaries, primary care practices, and retail pharmacies.

People who reported medical errors live in every part of the state. No inferences can be made about the relative safety of health care in different regions because we only asked people where they live, not where their errors occurred.

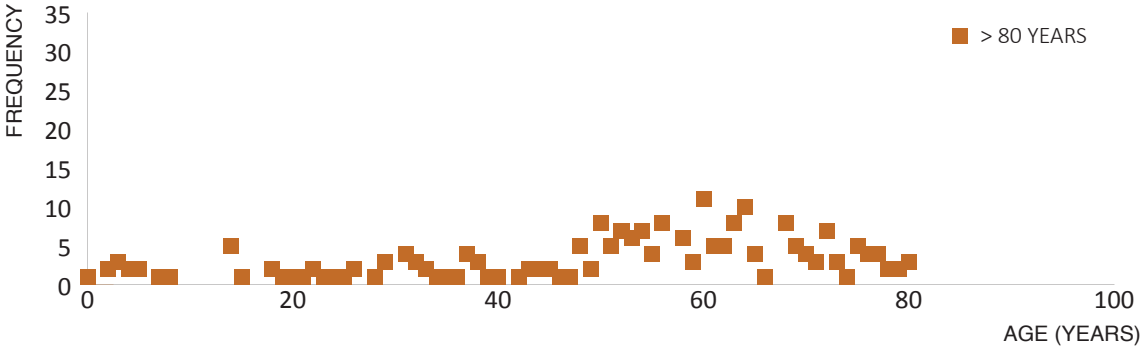
The age of the patient to whom the medical error happened ranged from less than one to over 90. Although median age at the time of the error was 53 years old, 15% of the errors described occurred to patients less than 18 years old and 18% of the errors occurred to respondents 75 or older.

MEDICAL ERRORS HAPPEN IN ALL HEALTH CARE SETTINGS ...



*E.g., pharmacy, dentist, nursing home

... AND TO PEOPLE OF ALL AGES



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FINDING: Medical errors are associated with long-lasting physical and emotional impacts

Survey respondents described significant, persistent physical harms from medical errors that had happened as many as six years before the survey.* Almost 30% stated that their physical health (or the physical health of the household or family member to whom the error happened) was impacted at least to some degree for one year or more. An additional 12 percent were family members of a person who reportedly died.

On the opposite end of the spectrum, over one in four respondents indicated that the error had no physical health impact at all. This suggests that respondents can identify errors when harm did not result, such as a retail pharmacy dispensing error where the person caught the mistake before taking the wrong medicine.

Medical error also was associated with long-lasting emotional health impacts. Among respondents who reported that the error happened three to six years before the survey, one-third reported that they still feel anxious, more than a quarter continue to feel sad, angry, and just over one in five say they are depressed. Respondents who reported an error three to six years earlier were also the most likely to feel as if they had been abandoned or betrayed by the providers involved. The only emotional impact that seems to steadily subside over time is anger.

*Because the re-contact survey took place almost one year after the larger statewide survey that identified people who reported having experienced medical errors during the previous five years, the reported errors occurred up to six years prior to the re-contact survey.

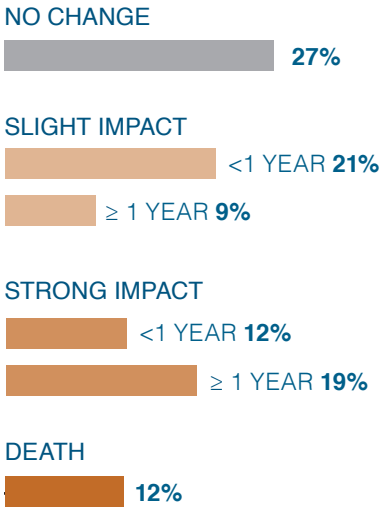
"The hardest one right now is dealing with the medical issues, the extra bills for the medicines. I just get stressed out constantly. And I am furious because this is the mess they created and they just threw me out the door, which was even worse."

– She suffered complications from an unnecessary surgery

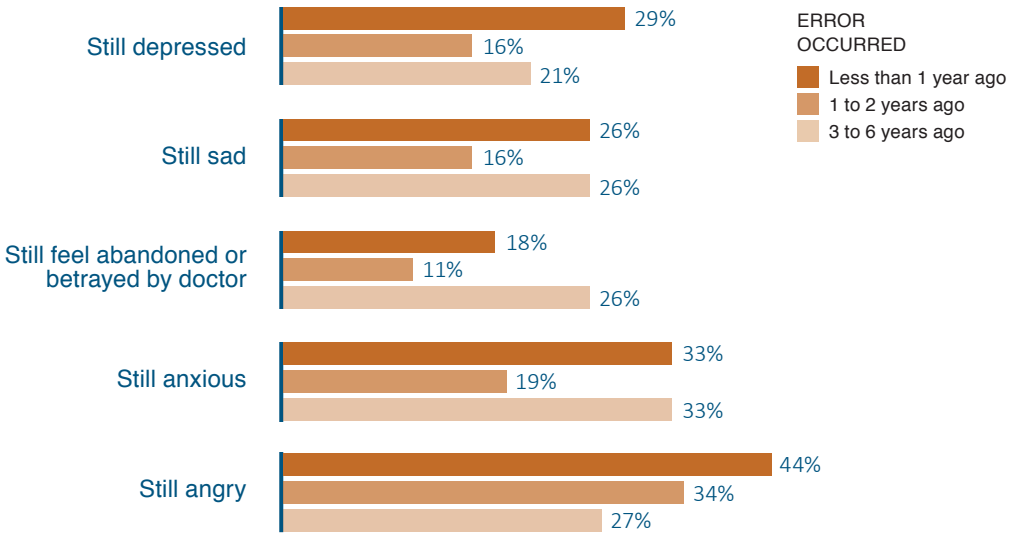
"It was quite painful. Well I had anxiety for quite a while, and I think depression, and overall, a loss of faith."

– An error during a home care visit necessitated an additional painful procedure

MEDICAL ERRORS HAVE LONG-LASTING IMPACTS ON PHYSICAL HEALTH



MEDICAL ERRORS HAVE LONG-LASTING IMPACTS ON EMOTIONAL HEALTH



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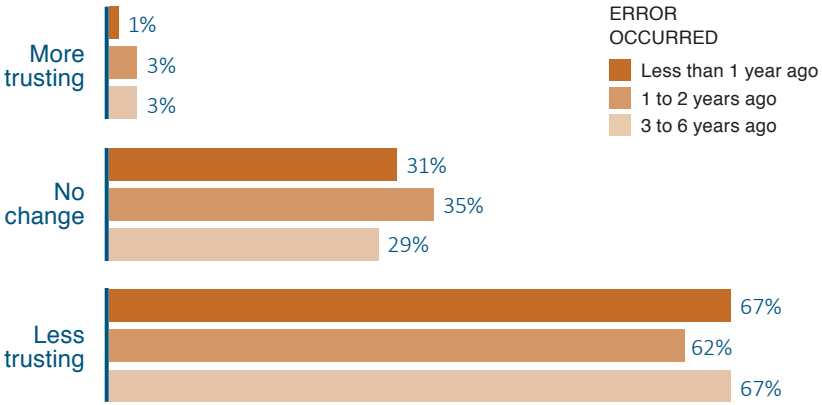
FINDING: Medical errors are associated with long-lasting loss of trust and avoidance of health care

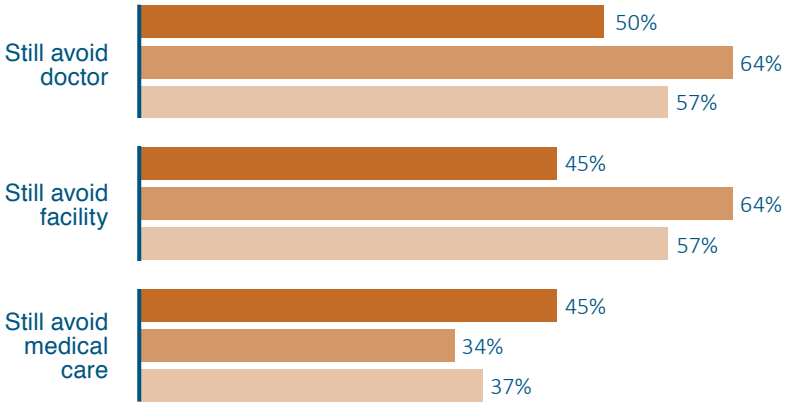
An experience with medical error is likely to have lasting effects on an individual's attitudes and behaviors regarding the health care system. Two-thirds of respondents expressed reduced levels of trust in health care no matter how long ago the error occurred.

Well over half of the respondents whose error happened 3-6 years ago say that they sometimes or always continue to avoid the doctors or the health care facility involved in the error. Of even greater concern is that more than one-third of all respondents report that they continue to sometimes or always avoid all medical care.

MEDICAL ERRORS CAUSE LONG-LASTING LOSS OF TRUST IN HEALTH CARE



PEOPLE OFTEN AVOID HEALTH CARE FOR A LONG TIME AFTER AN ERROR



"I stay away from medical [care]. I stay away from it as much as possible. I use alternative resources; try and go holistic."

– Repeated hospitalizations from a surgical error put this mother of young children out of work for months

The hardest part is the cynicism and guardedness I continue to have for everyone in the medical field. I have no trust left."

– A clinician refused to reconsider a diagnosis that turned out to be incorrect, leading to additional complications

"I feel the humanity is being taken out of the process."

– Her husband had trouble breathing and ended up in the emergency room after a missed diagnosis at his doctor's office earlier in the day

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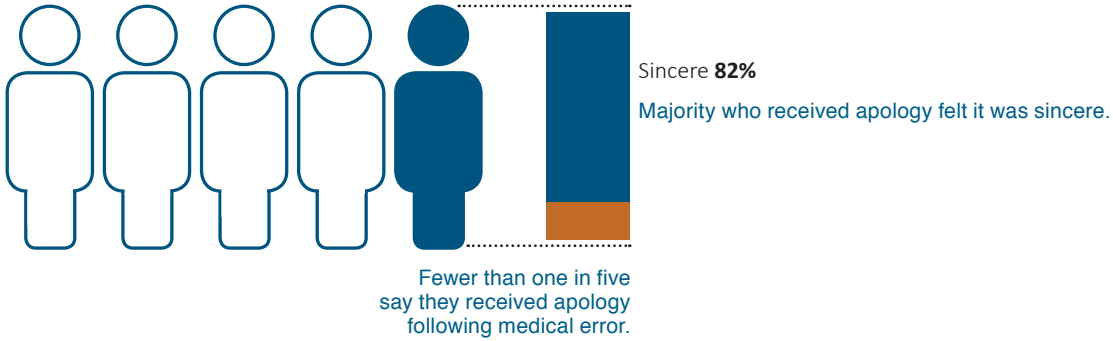
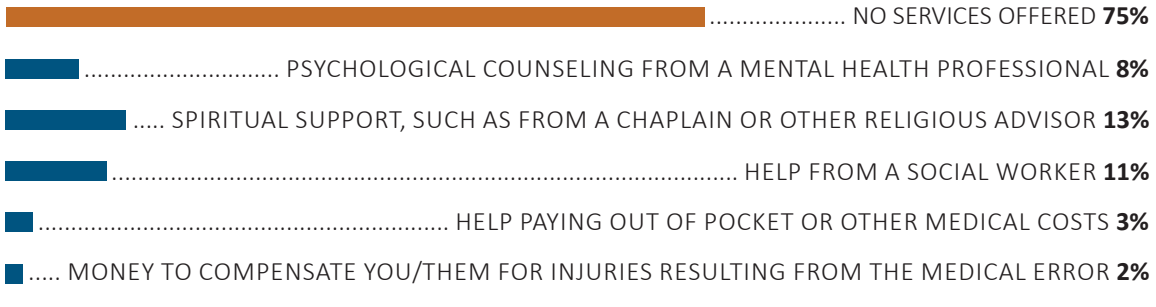
FINDING: Patients and families rarely receive an apology or offer of support following a medical error

Despite a Massachusetts law[54] that requires providers to disclose medical errors that cause significant harm and encourages apology, more than 60 percent of respondents expressed overall dissatisfaction with how providers communicated in the aftermath of an error.

Fewer than one in five (19%) of respondents say that they received an apology after the medical error. Most people (82%) who did receive an apology felt it was sincere.

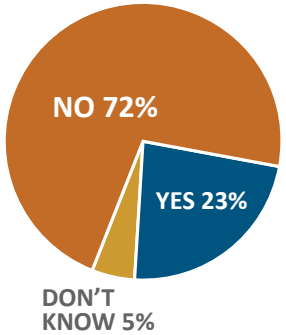


Only one quarter (25%) of respondents were offered one or more types of emotional, functional, or financial support services. The most common additional help offered among all respondents reporting experience with a medical error was spiritual support (13%). The setting in which their error occurred (e.g., hospital or medical office) did not significantly change the likelihood of receipt of an apology or offer of assistance.

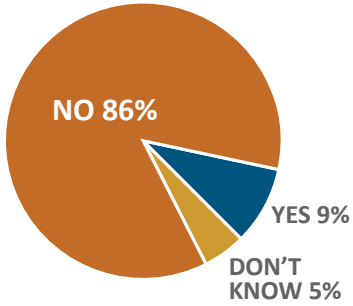


Among the 28 percent of respondents who reported receiving an acknowledgment of the error from the place where the medical error occurred, 23 percent reported also receiving an explanation of the actions being taken to prevent similar errors from happening in the future.

Did provider explain any follow-up actions to prevent similar errors in the future?



Did provider offer information about a review or investigation to determine what caused the error?



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FINDING: Most people are dissatisfied with the communication they receive from providers after an error

We also asked respondents a series of questions about six elements of communication:

Did anyone at the place where the medical error occurred…

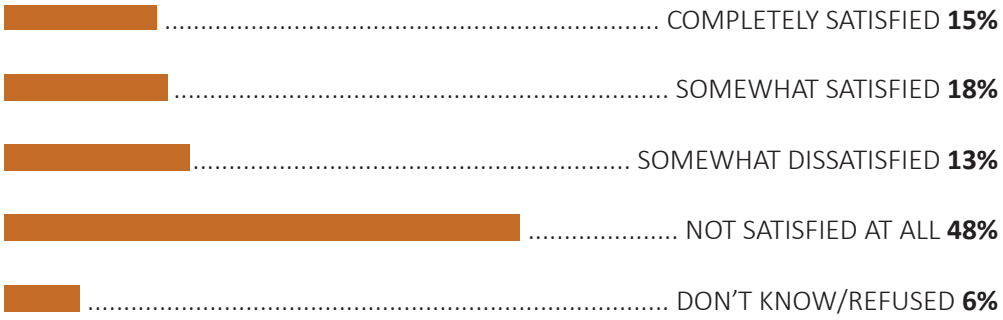
1. Acknowledge the error?

And did anyone on the care team...

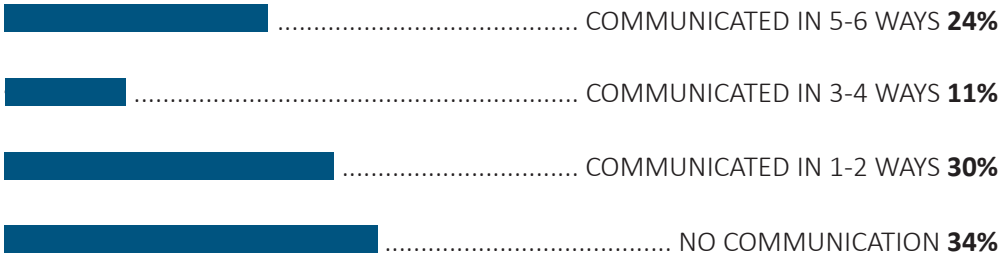
2. Speak openly and truthfully about the error?
3. Speak about the error in an easy to understand way?
4. Provide information needed to understand the health effects of the error?
5. Offer a chance to ask questions about the error?
6. Offer a chance to express feelings about the error?

One out of three respondents answered "no" to all six questions, reporting that they received no communication whatsoever (the "no communication group"). However, nearly a quarter of the respondents answered "yes" to five or all six of these questions, reporting that their care teams shared information about the error and invited further discussion in multiple ways (the "open communication group").

MORE THAN 60 PERCENT OF PATIENTS AND FAMILY MEMBERS ARE DISSATISFIED WITH CARE TEAM COMMUNICATION AFTER AN ERROR



OPENNESS OF COMMUNICATION BY PROVIDERS VARIES AFTER AN ERROR



"Well, first thing [that would have helped] would have been to acknowledge and apologize that mistake had been made. And I think secondly, I did incur out-of-pocket costs to have the procedure done again, and those should have been covered."

– He had to have a second procedure because of an error

"I guess the thing that made it worse was that there was zero communication with them. Zero."

– Her mother's physician did not relay information about a critical heart condition identified in tests he had ordered

"Any acknowledgment of their mistake, or a recognition that they need to be better listeners, would be nice."

– Clinician failed to recognize seriousness of infection despite patient's concerns, delaying treatment

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FINDING: For people who receive it, open communication is associated with lower levels of adverse emotional health impacts and health care avoidance[55]

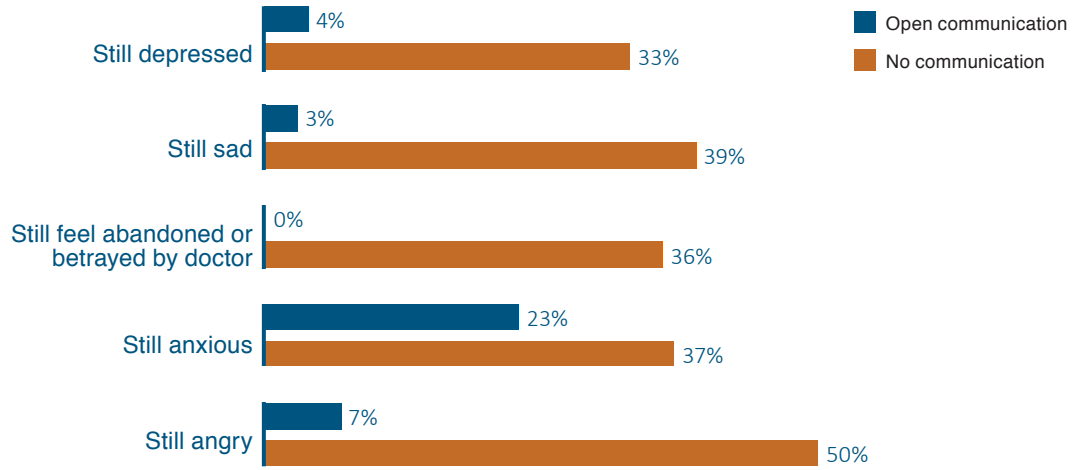
Open communication is linked to lower emotional harm. While up to half of respondents in the no communication group still felt sad, depressed, anxious, angry, or abandoned or betrayed at the time of the re-contact survey, the open communication group reported lower levels of all of these emotional impacts—and no lingering feelings of abandonment and betrayal.

While anxiety appeared to be lowered by open communication, that finding was not statistically significant, suggesting that there are additional challenges to regaining confidence in the health care system following a medical error experience.

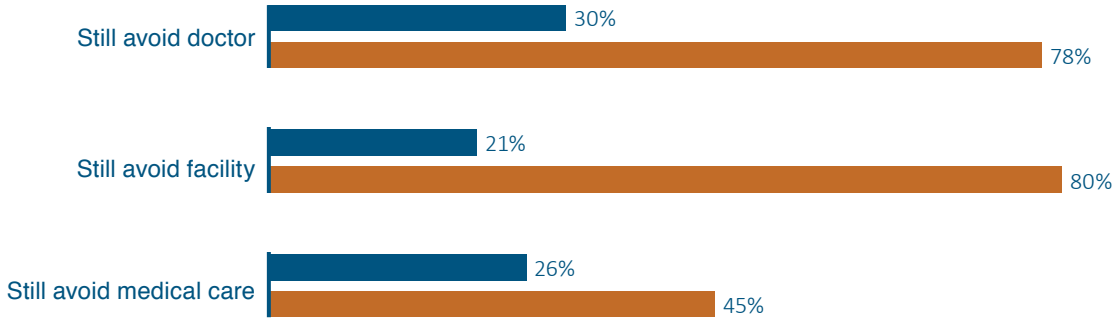
The effects of open communication remained significant for sadness and feeling abandoned or betrayed by doctors when we controlled for how long ago the error occurred, physical and financial severity of the error, and a number of other potential influences.[56]

Open communication can also reduce health care avoidance. The open communication group was significantly less likely to avoid both the doctors and the health care facility involved in the error when controlling for the same potential influences discussed above. Avoidance of medical care in general also declined for the open communication group, but not to a statistically significant degree.[57]

WHEN PROVIDERS COMMUNICATE OPENLY, EMOTIONAL HARM IS ALLEVIATED



OPEN COMMUNICATION ALSO ALLEVIATES HEALTH CARE AVOIDANCE



"And he even came in and apologized to me. And I've never had a doctor do that."

– Her bowel obstruction was missed during an emergency department visit

"I had an OB-GYN who was so phenomenal. At the end of my pregnancy, he was like, 'I need to call somebody else because I want somebody else to agree or disagree with me.' And I thought to myself, 'I have such respect for this man,' because he could say that on his own."

– She compared an earlier experience to a more recent one involving poor communication with a physician

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Patients and families are astute observers of what happened and why things went wrong

When answering a series of open-ended questions about the errors they had experienced, the 253 re-contact survey respondents described what happened and their perceptions of the underlying causes of those events. They also shared ideas for preventing similar events from happening again. Several major themes emerged from these narratives.

CHARACTERISTICS OF THE ERRORS

Although our sample included many cases of severe injury in the course of more intensive treatment, survey respondents often described preventable injuries that happened in the course of routine care, such as:

- A child given injections intended for another child in a pediatrician's office
- Extraction of the wrong tooth in a dentist's office
- An infusion overdose in a nursing home

Moreover, while patient harm can sometimes result from a singular error, it is often the by-product of a series of cascading events combined with missed opportunities to prevent injury. One woman reported undergoing surgery to remove kidney stones based upon a misread radiology report (no stones were found), only to have her appendix accidentally nicked, resulting in additional surgeries, a post-operative infection and more.

"I'm sure they're strapped. They're working hard, too. [But] that's just poor discharge planning."

– She was caring for a relative who was discharged with medications the provider should have known he could not swallow

UNDERLYING CAUSES OF THE ERRORS

SYSTEMS FACTORS

The absence of precautions or other fail-safes for preventing harm was a common theme among our survey respondents. These breakdowns included issues related to equipment maintenance, oversight of clinician and staff hand hygiene practices, and systems for preventing patient misidentification.

COMMUNICATION FACTORS

Another major theme expressed by respondents was that they were dismissed or not heard when trying to alert care team members that they had known reactions to a proposed medication, were at risk of falling, or their symptoms did not align with the doctor's diagnosis.

Unclear or incomplete discharge and follow-up instructions to patients were another frequent concern. More than a few respondents reported hesitating to seek additional help as their health worsened because they were given reassurances that they were fine during an urgent care or emergency department visit but no information about what should prompt them to seek help again.

Many respondents perceive the health care system as fragmented. They pointed to various breakdowns in teamwork or communication among clinicians and staff at a single organization or between health care organizations as they moved across the care continuum as contributors to the errors they experienced.

CONTINUED ON NEXT PAGE

"All I'm trying to say is that I've become acutely aware that in an age of increased specialization, the biggest challenge is the patient has to take responsibility for communication across all specialties."

– She was advised to undergo an unnecessary surgery when her symptoms were mistaken for something more serious

"You should not confuse one individual with another. Between social security numbers, addresses, previous addresses, guarantor on the account, everything else that they ask you. I found it very difficult to understand."

– Her son's medical records are entangled with another patient's

"I know she was sick and I know she wasn't going to live another 10 years. I get all that. A little bit of reasonable follow-through would've prevented so much."

– This nurse's mother's health deteriorated during a nursing home stay from a series of communication breakdowns and other missteps

"So I have to go to consult a specialist at another hospital and open up, basically, a new system of medical records, because the original hospital and this hospital don't talk to each other."

– A well-known complication of his medical condition was missed by a physician

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Patients and families are astute observers of what happened and why things went wrong

WORKFORCE FACTORS

Respondents frequently noted that the clinicians and staff seemed stressed, harried, burnt out, or otherwise unable to do their jobs well under current constraints.

Many also described their physician or other health care professional as either disinterested or inattentive.

Respondents described numerous instances where the health care professional lacked the knowledge or skill to appropriately treat the patient but did not communicate his or her limitations and did not consult or make a referral to another provider.

For others, perceived discrimination by clinicians and staff based on age, gender, or health status raised additional concerns about the safety of the care received.

PREVENTABILITY AND ACCOUNTABILITY

Some patients see medical error as an inevitable consequence of complex health care, leaving them feeling helpless. Most respondents expressed less interest in holding an individual accountable for the error than in advocating for a system that places higher value on spending more time with patients and quality of care. They often noted the humanity of the clinicians and staff, recognizing that people make mistakes.

"I happened to ask the right questions this time. But I don't always know even what questions to ask and it makes me feel vulnerable. And it makes me more vigilant."

– She avoided unneeded surgery by questioning an incorrect diagnosis

"My mother was in the hospital and something happened [injuries from a fall] that made her worse other than the condition she was in the hospital for."

– His mother was injured from a fall during a transfer from a wheelchair

"We felt less confident in the professional health care and felt more burdened by the need to be our own advocate and watchdog."

– His mother's heart condition was misdiagnosed in the emergency department

"I know that everybody is stretched and pinched for time and time is the new currency. But you know, seriously. If you are too tired … get a second opinion. Have somebody else look at it."

– Her mother's serious heart condition was missed

"And then this happened, and they didn't catch it. And I had to come in and point it out to them. That was the hardest part to think that, you know, an off-duty paramedic firefighter has to tell them what the diagnosis is."

– His wife experienced flash pulmonary edema after being moved from the ICU

PATIENTS AND FAMILIES DO NOT ALWAYS SPEAK UP

Nearly 40 percent of respondents indicated that the medical error had not been discussed with anyone other than the patient's family members or friends. Of this group, 71 percent gave as a reason that "it would not do any good."

Of those who did discuss the error with someone else, such as a health care professional, administrator, health insurer, government agency, or lawyer, 62 percent said they hoped to prevent harm to future patients by speaking up.

It is worth noting that lawyers were consulted in just seven percent of these cases. And errors were reported to government agencies only one percent of the time.

"I'm a nurse. It's a satisfying profession. And it's gratifying, you know what I mean? And that's part of it, too. That's why, professionally, I feel guilty. Professionally, it helped me grow, though. Makes you pay attention."

– She recognized an error made by another health professional in her relative's care

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How Massachusetts can lead the way on patient safety

The findings from these two studies demonstrate an urgent need for policymakers and providers to prioritize safety and quality and act to accelerate progress in reducing preventable patient harm in all health care settings throughout the Commonwealth.

While this research focused on measuring aspects of safety that are missing from our usual data sources, the reality is that we will never have complete safety metrics and data to track and react to all adverse events. Instead, a proactive systems approach is needed to identify and address risks before patients are harmed. Success depends on health care leaders who view their work as prioritizing and operationalizing activities that continually build effective teamwork, reliable processes, and strategies for prevention, early detection, and mitigation within their organizations.

Meaningful progress on patient safety at the state level will require a coordinated, sustained, inclusive effort with a wide range of stakeholders and experts assuming leadership and responsibility where they are best situated to contribute. Policymakers and state agencies—with public engagement—can help create favorable conditions for improvement. But real change will take leadership from within the provider community.

To create a forum where this work can take place, the Betsy Lehman Center is convening a Massachusetts Health Care Safety and Quality Consortium.

To create a forum where this work can take place, the Betsy Lehman Center is convening a Massachusetts Health Care Safety and Quality Consortium. This body will manage a process through which providers, payers, patient safety organizations, researchers, policymakers, and patients will develop a "Roadmap to Safety and Quality" for the state—a framework that establishes a vision and goals for improving safety in all health care settings in the Commonwealth and identifies and prioritizes key challenges and opportunities. Once the Roadmap is in place, the Consortium will identify actionable, measurable steps and coordinate a series of initiatives under four "pillars" or essential elements of patient safety:

- TRANSPARENCY
- CULTURE
- LEARNING SYSTEMS
- SUPPORT FOR PATIENTS AND PROVIDERS

1. TRANSPARENCY

Building the factual foundation through data is essential for understanding patient safety risks, for enabling providers to benchmark progress, and for health care system accountability. Yet, our current systems are not well aligned with the informational needs of providers, patients, and policymakers.

VISION: The safety/quality information landscape in Massachusetts allows for tracking and trending of key safety risks in all care settings and supports improvement.

2. CULTURE

Sustainable change can be driven by executive leaders and boards that prioritize safety and quality and adopt evidence-based management and leadership practices. A patient safety culture prioritizes identification of errors and near-misses, and implementation of system improvements to prevent future harm.

VISION: Executive leadership and governing bodies of health care organizations are informed and engaged in improving safety culture and outcomes.

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How Massachusetts can lead the way on patient safety

3. LEARNING SYSTEMS

Health care organizations face a continuous cycle of persistent and emerging risks. However, many health care organizations, particularly non-hospital providers, have yet to implement a comprehensive set of safety systems and management practices. These foundational structures, as well as improvement initiatives targeting specific risks, can be fostered through collaborative learning activities that convene peer organizations and engage patients and families. Yet there is currently no coordinated system for ensuring that all providers have access to these opportunities or that these activities are aligned to achieve Massachusetts' safety priorities.

VISION: Providers in all health care settings have a patient safety plan in place and the capacity to implement and sustain improvement. The role of patients and families in safety is recognized and embraced.

4. SUPPORT

Clinicians and staff do work that can take a physical or emotional toll, especially in cases of adverse events and even workplace violence. Patients and families also may be impacted by adverse events in their care. Open communication, peer support, and other best practices can improve well-being of patients and the care team alike. Yet few Massachusetts health care organizations have instituted comprehensive programs of support.

VISION: Patients and families are supported in the aftermath of adverse events; health care workers affected by adverse events and workplace stress and violence receive the help they need.

The Consortium's members will include Massachusetts health care provider associations and professional societies, health plans, patient safety research and advocacy groups, and state health care agencies.

THE MASSACHUSETTS HEALTH CARE SAFETY AND QUALITY CONSORTIUM WILL ...

- Establish a forum to amplify the efforts of the many organizations whose participation is needed to accelerate progress—and to support them in doing what they are best situated to do
- Provide the administrative backbone required to engage and support all essential public and private stakeholders
- Identify opportunities to reintegrate safety with ongoing quality improvement initiatives
- Identify opportunities to adapt safety management systems and culture of safety best practices from non-health care industries
- Facilitate state engagement in the National Patient Safety Steering Committee
- Keep safety and quality in the public eye

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Conclusion

Our research shows that despite the investments and gains of recent years, medical error remains a persistent challenge in all health care settings, even in Massachusetts. Preventable harm from these errors imposes significant costs on the state's health care system and lasting physical, emotional, and financial impacts on patients and families.

But opportunities to achieve measurable impact are within reach, and now is the time to scale proven strategies to accelerate safety improvement across the state. Our findings on the mitigating effects of open communication on emotional harm and health care avoidance strongly suggest that patients and providers alike would benefit from implementation of proven programs that facilitate difficult conversations following adverse events. Preventing these events from happening in the first place will require long-term commitment and coordination to ensure that the principles of safety culture and high reliability are woven into the fabric of health care delivery in every setting—from hospitals to medical offices, nursing homes, urgent care centers, and more.

Massachusetts faces the same challenges as other states when it comes to patient safety, yet our leadership in medical research and innovation and our achievements in the health policy arena make us unique. This dedication and know-how, combined with a history of collaboration on pressing health care challenges, positions Massachusetts to be a model for the nation on patient safety, too.

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55. Open communication had no effect on the physical impacts of the error. This is expected because communication cannot reverse physical harm. Open communication also did not significantly reduce loss of trust in health care.
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57. We applied the same controls we used in the case of emotional harm to our models for analyzing additional aspects of the error that might impact the likelihood of reporting health care avoidance or the perception of communication and found no significant differences.

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APPENDIX A: FINANCIAL COST OF MEDICAL ERROR METHODOLOGY

The incidence and cost of medical errors was estimated based on several administrative data sources. Health care claims from the Massachusetts All-Payer Claims Database (APCD) and Medicare fee-for-service from 2013 were extracted. The APCD is the most comprehensive source of health claims data from public and private payers in MA and includes data from commercial payers, their party administrators and public programs including MassHealth (Massachusetts's Medicaid program). Paid claims from the APCD medical claim file including inpatient, outpatient and long-term care claims from MassHealth were included.[1,2] For Medicare, inpatient, outpatient and carrier fee-for-service files were included.[3]

We followed methodology developed by Van Den Bos et al. (2011) to estimate the incidence and cost of medical error.[4, 5] In that study, 98 injuries were identified based on four diagnosis codes (primary and secondary) in the claims data. Since it was unknown exactly how many of the injuries were due to medical error an actuarial approach was used that estimated the probability that each type of injury was due to medical error. For example, the probability that a *Retained Foreign Object* is a medical error was estimated to be >90% while the probability that *Complications of Labor and Delivery* was a medical error was estimated to be <10%. These probabilities were originally determined through expert panels and chart review. To allow for a one year follow-up period before the transition to ICD-10 diagnosis codes, 2013 data was used. Since there is not a one to one relationship between ICD-9 and ICD-10 codes, the estimated probabilities of medical error would need to be revalidated if using ICD-10 codes.

In our study, the mid-point of each probability range (e.g. 95% if probability was >90%; 5% if probability was <10%) was applied to the number of events to estimate the proportion of each type of injury that was due to medical error. The total number of events in 2013 estimated to be due to each of the 98 injury types were summed together (see Table 1 for detailed listing of injuries and probabilities). Following, Van Den Bos et al. (2011), the number of events was adjusted down by 10% to adjust for potential false positives but a similar adjustment was not made for false negatives

To estimate costs, each case of an identified injury was matched to approximately four control cases who did not have the identified injury. Matches were based on patient age and gender, top three chronic conditions, and primary admitting diagnosis code for inpatient cases or the Current Procedural Terminology Health Common Procedure Coding System (CPT) code for outpatient cases. Costs for both cases and controls for each type of injury for one year past the encounter were calculated. The incremental cost attributed to medical error was estimated by subtracting the total medical costs of the matched controls from the costs incurred by the cases for each type of injury. This difference in costs across all 98 injuries was then summed and adjusted for inflation to generate an estimate for 2017 dollars. The midpoint between the historical consumer price index for urban consumers and the consumer price index for medical care was used.[6,7] Medicare and APCD costs were calculated separately. Due to concerns about data quality on cost among the smaller payers, APCD costs were extrapolated from the three largest commercial payers including Tufts Health Plan, Blue Cross Blue Shield and Harvard Pilgrim Health Care. These payers represent 67% of the commercial enrollees.[8] See Figure 1 for an example of how the methodology was applied and Tables 1 and 2 for a summary of results.

Other common preventable medical errors undercounted or underreported in health care claims were estimated based on a review of the academic literature and discussions with leading academic patient safety experts. These include falls, adverse drug events and certain healthcare-acquired infections (HAI).

Following Jha et al. (2009) we estimated the preventable rates of adverse drug events and falls for non-obstetric adult patients based on the number of inpatient days since the academic literature strongly suggests these events are proportional to a patient's length of stay (Table 3).[9] The preventable rate was the midpoint of the estimate cited by Jha et al. (2009) and is consistent with a variety of studies that cite the decrease in falls when prevention efforts are implemented.[9-14] The cost estimate comes from meta-analyses completed by Agency for Healthcare Research and Quality (AHRQ) on the attributable cost of falls and is largely based on the studies that Jha et al. (2009) cite when estimating cost of falls.[9,15,16] Costs were adjusted for inflation to reflect 2017 dollars.[6,7]

Estimating adverse drug events used a similar approach following Jha et al. (2009) and adjusted for inflation to reflect 2017 dollars (see Table 3).[6,7,9] Van Den Bos et al. (2011) include some types of adverse drug events in their list of 98 injuries (Table 1) so the frequency of these events were removed from the estimation based on inpatient days.[4] Since the claims data includes claims from inpatient, outpatient and long-term care and the Jha et al. (2009) estimate of adverse drug events is focused only on inpatient days, the adjustment of the frequencies to remove events found in the claims data leads to a conservative estimate of adverse drug events.

We extracted HAI data from the Center for Disease Control (CDC) on the incidence of central line associated bloodstream infections (CLASBI), catheter associated urinary tract infections (CAUTI), post-operative infections, clostridum difficile (*C. diff*) and methicillin-resistance staphylococcus aureus (*MRSA*). This data only includes hospital-acquired infection numbers from inpatient facilities.[17] CAUTI's, CLASBI's and postoperative infections were captured in the list of Van Den Bos et al. (2011) injuries. The frequency of these events was adjusted in the claims data to capture events that were reported by CDC but not captured in the claims data. Costs were estimated following the methodology applied to the other injuries identified using claims data. Preventable rates and costs for *C. diff* and MRSA were based on CDC action plans and a review of the academic literature including a meta-analysis by AHRQ that estimated the attributable costs and decrease in events if appropriate infection procedure controls were in place (Table 4).[15,18,19]

Whenever possible we adjusted estimates to minimize the potential duplication of events between different data sources but there still may be overcounting. For example, if a patient experiences an injury requiring extra hospital days and the individual then has a fall during those extra hospital days, the cost of these hospital days and the fall is included in the estimate of costs during the year following injury in the health care claims data. Independently, the number and cost of falls are estimated based on the number of inpatient days in Massachusetts and literature review. Even in the unlikely event that every injury we identified through the health care claims led to a fall, another adverse drug event or *C. diff* or MRSA, there would still be 43,000 preventable errors in Massachusetts at a cost of $518.4 million.

The overall estimates are conservative for several reasons. Following Van Des Bos et al. (2011) we decreased estimates by 10% assuming this false positive rate but made no similar adjustments for false negatives. The mid-points of the ranges of probability were applied. For example, even for Medicare Never Events like foreign object left in the body, we assumed this was preventable 95% versus 100% of the time.[4,5] For the patient safety risks not captured in the claims data including falls, adverse drug events, MRSA and *C. diff* the estimates are based only on inpatient care and do not include other health care settings. Furthermore, the major patient safety risk of diagnostic error and delay[20] cannot be reliably captured in claims data so this is not captured at all. Costs only include excess health care costs but do not include malpractice costs or estimates of loss of work or productivity.

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TABLE 1: INJURY TYPES, PROBABILITIES ESTIMATING MEDICAL ERROR AND FREQUENCY OF MEDICAL ERROR

INJURY #		PROBABILITY INJURY WAS DUE TO ERROR (%)	# OF ERRORS
1	Abnormal reaction due to other procedures without mentioning of misadventure	<10	137
2	Abnormal reaction due to surgery without mentioning of misadventure	<10	225
3	Accidental cut puncture perforation or hemorrhage	>90	66
4	Accidental puncture or laceration during a procedure	>90	1511
5	Acute reaction to foreign substance accidentally left in during procedure	>90	2
6	Air Embolism (Medicare Never Event)	>90	33
7	Amputation stump complication	<10	17
8	Blind loop syndrome	<10	2
9	Blood-Type Incompatibility (Medicare Never Event)	>90	0
10	Cataract fragments in eye following cataract surgery	>90	313
11	Catheter - associated urinary tract infection (Medicare Never Event)	>90	930
12	Colostomy and enterostomy complications	<10	50
13	Colostomy and enterostomy complications – Infection	>90	35
14	Complication of prosthetic joint	10-35	542
15	Complications affecting other specified body systems not elsewhere classified	<10	399
16	Complications affecting specified body systems not elsewhere classified	<10	218
17	Complications of labor and delivery	<10	3
18	Complications of medical care not elsewhere classified	<10	134
19	Complications of reattached extremity or body part	<10	1
20	Complications of the administration of anesthetic or other sedation in labor and delivery	<10	13
21	Complications of the Puerperium (670-677)	<10	47
22	Complications of transplanted organ	<10	77
23	Complications peculiar to certain specified procedures	<10	20
24	Contact dermatitis and other eczema	<10	64
25	Contaminated transfusion injection drug	>90	52
26	Dermatitis due to substances taken internally	<10	222
27	Disorders of the pituitary gland and its hypothalamic control	65-90	115
28	Disruption of operation wound	10 to 35	625
29	Dosage failure in shock therapy	>10	0
30	Emphysema (subcutaneous) (surgical) resulting from procedure	10-35	51
31	Encephalitis myelitis and encephalomyelitis	<10	1
32	Failure in suture and ligature during surgical operation	>90	2
33	Failure of sterile precautions during procedure	>90	2
34	Failure to introduce or remove other tube or instrument	>90	1

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TABLE 1: INJURY TYPES, PROBABILITIES ESTIMATING MEDICAL ERROR AND FREQUENCY OF MEDICAL ERROR, CONT.

35	Gastrostomy complications	<10	21
36	Gastrostomy complications - Infection	>90	61
37	Gastrostomy complications - Mechanical	10-35	125
38	Generalized vaccinia as a complication of medical care	10-35	24
39	Hematoma complicating a procedure	35-65	1224
40	Hemorrhage complicating a procedure	35-65	1628
41	Hypotension - Iatrogenic	35-65	1367
42	Iatrogenic cerebrovascular infarction or hemorrhage	>90	194
43	Inappropriate temperature in local application and packing	>90	3
44	Incorrect amount or dilution of fluid during transfusion or infusion	>90	3
45	Infection and inflammatory reaction due to internal prosthetic device implant and graft	>90	1919
46	Infection due to central venous catheter	>90	296
47	Infection following infusion injection transfusion vaccination	>90	0
48	Infection following other infusion injection transfusion or vaccination	>90	164
49	Infection of amputation stump	>90	106
50	Infusion or transfusion reaction	10-35	48
51	Late effects of other and unspecified external causes	<10	58
52	Malignant Hyperthermia	<10	2
53	Mechanical complication of cardiac device implant and graft	10-35	439
54	Mechanical complication of device implant or graft	10-35	906
55	Mechanical complication of genitourinary device implant and graft	10-35	875
56	Mechanical complication of other specified prosthetic device implant and graft	<10	157
57	Mechanical failure of instrument or apparatus	>90	3
58	Neuroma of amputation stump	10-35	7
59	Nonadministration of necessary drug or medicinal substance	>90	8
60	Non-healing surgical wound	<10	130
61	Noninfectious disorders of lymphatic channels	<10	31
62	Noxious influences affecting fetus or newborn via placenta or breast milk	10-35	205
63	Noxious influences affecting fetus or newborn via placenta or breast milk - anti-infectives	<10	0
64	Object left in body (Medicare Never Event)	>90	224
65	Other and unspecified disorders of the nervous system	<10	37
66	Other and unspecified extrapyramidal diseases and abnormal movement disorders	<10	2
67	Other and unspecified noninfectious gastroenteritis and colitis	<10	24
68	Other complications of internal (biological) (synthetic) prosthetic device implant and graft	<10	506
69	Other complications or adverse effects not elsewhere classified	<10	132

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TABLE 1: INJURY TYPES, PROBABILITIES ESTIMATING MEDICAL ERROR AND FREQUENCY OF MEDICAL ERROR, CONT.

70	Other failure in dosage	>90	3
71	Other specified types of cystitis	<10	17
72	Overdose or inadvertent exposure to radiation	>90	1
73	Persistent postoperative fistula NEC	<10	7
74	Pneumothorax	35-65	850
75	Poisoning	<10	801
76	Poisoning - Anesthetics	10-35	13
77	Postcholecystectomy syndrome	10-35	55
78	Postgastric surgery syndrome	10-35	92
79	Postlaminectomy syndrome	10-35	1606
80	Postoperative infection	>90	4625
81	Postoperative Shock	10-35	1
82	Pressure ulcer (Medicare Never Event)	>90	14369
83	Radiation Kyphosis or scoliosis	<10	1
84	Respiratory conditions due to other and unspecified external agents	<10	20
85	Seroma complicating a procedure	10-35	299
86	Serum reaction	10-35	1
87	Shock due to anesthesia	10-35	5
88	Substances causing adverse effects in therapeutic use	<10	1238
89	Surgery on the wrong limb / person (Medicare Never Event)	>90	0
90	Surgical complication of the respiratory system	10-35	0
91	Thyroiditis	10-35	12
92	Tracheostomy complications	<10	19
93	Tracheostomy complications - Infection	10-35	5
94	Unspecified adverse effect of drug medicinal and biological substance not elsewhere classified	<10	850
95	Urethral stricture	10-35	67
96	Ventilator associated pneumonia	>90	183
97	Ventral hernia without mention of obstruction or gangrene	10-35	948
98	Wrong fluid in transfusion	>90	0
	TOTAL	<10->90	42,927

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FIGURE 1: EXAMPLE: ESTIMATING THE ANNUAL COST OF FOREIGN OBJECTS LEFT IN THE BODY AFTER SURGERY

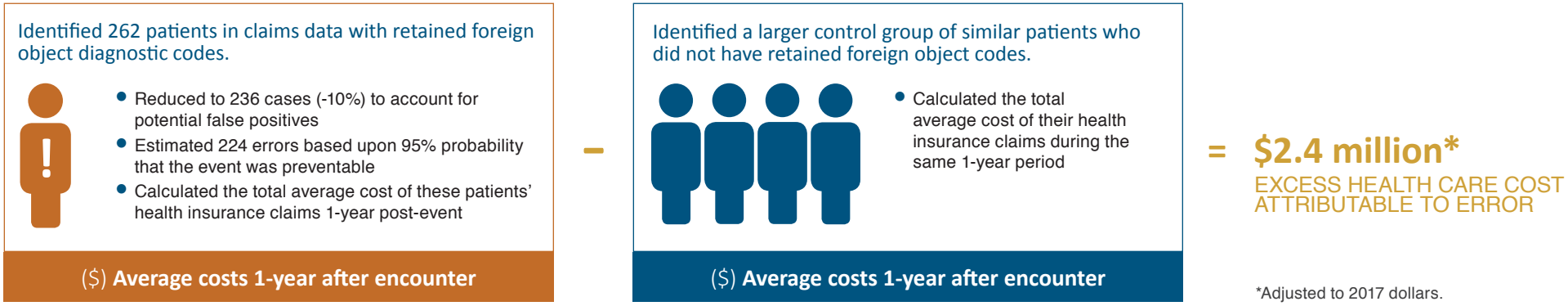

TABLE 2: TOP TEN MOST COSTLY ERRORS

INJURY TYPE	NUMBER OF INJURIES	% LIKELY DUE TO ERROR	NUMBER OF ERRORS	$ AVERAGE INCREMENTAL COST	TOTAL COST OF ERRORS ($ MILLIONS)
Pressure ulcer	15,125	95	14,369	13,195	189.6
Postoperative infection	4,868	95	4,625	11,546	53.4
Infection and inflammatory reaction due to internal prosthetic device implant and graft	2,020	95	1,919	16,988	32.6
Collapsed lung	1,701	50	851	31,139	26.5
Infection due to central venous catheter (CLABSI)	312	95	296	55,068	16.3
Substances casing adverse effects in therapeutic use	24,751	5	1,238	12,439	15.4
Mechanical complication of device implant or graft	4,026	23	906	14,790	13.4
Medical treatment-induced abnormally low blood pressure (Hypotension Iatrogenic)	2,733	50	1,367	9,583	13.1
Accidental puncture or laceration during a procedure	1,591	95	1,511	8,008	12.1
Abnormal collection of blood (bruise/contusion) complicating a procedure	2,447	50	1,224	9,395	11.5
All other injuries	121,704	5-95	14,621	9,199	134.5

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TABLE 3: FALLS AND ADVERSE DRUG EVENT CALCULATION

CALCULATION	FALLS	ADVERSE DRUG EVENTS
# of patient days at risk per 1000[a]	4,183,015	4,183,015
Incidence per 1000 patient days	4.65[9]	13.75[9]
% Preventable	33%[9-14]	26%[9]
Estimated number of Adverse Events	19,451=(4.65*4,183,015)/1000	57,516=(13.75*4,183,015)/1000
# of preventable events	6,419=19,451*0.33	14,954=57,516*0.26
Remove potential overlap of events identified in claims data[b]	N/A	11,769=14,954-3185
Cost per event adjusted to 2017 dollars[c]	$7,022[9,15,16]	$3,260[9]
Total cost	$45.1 million=$7,022*6,419	$38.4 million=11,769*$3260

[a]Hospital inpatient days per 1,000 population, MA, 2013=625[21]; Population of MA, 2013=6,694,824[22]; (625*6,692,824)/1000=4,183,015
[b]Injuries in the claims data that were removed from the estimate based on academic literature since they could be due to adverse drug events include complications of the administration of anesthetic or other sedation in labor and delivery, contaminated transfusion injection drug, incorrect amount or dilution or fluid during transfusion or injection, infection following infusion injection transfusion or vaccination, infection following other infusion, injection, transfusion, or vaccination, infusion or transfusion reaction, non-administration of necessary drug or medicinal substance, other failure in dosage, poisoning, poisoning-anesthetics, shock due to anesthesia, substances causing adverse effects in therapeutic use, unspecified adverse effect of drug medicinal and biological substance not elsewhere classified and wrong fluid in transfusion.
[c]To adjust for inflation the midpoint between the historical consumer price index for urban consumers and the consumer price index for medical care was used.[6,7]

TABLE 4: *C. DIFF* AND MRSA CALCULATION

CALCULATION	*C. DIFF*	MRSA
# of events	2643[23]	147[24]
% Preventable	30[a]	50[a]
# of preventable events	793=2643*0.30	74=147*0.50
Cost per event adjusted to 2017 dollars[b]	$18,106[15]	$16,897[19]
Total cost	$14.4 million=$18,106*793	$1.3 million=74*$16,897

[a]This is based on the target for HAI action plan[18] that was in place in 2013.
[b]To adjust for inflation the midpoint between the historical consumer price index for urban consumers and the consumer price index for medical care was used.[6,7]

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APPENDIX B: SURVEY DESIGN AND RESPONSE

SURVEY DESIGN

The Massachusetts Health Insurance Survey (MHIS), conducted by the survey research firm SSRS on behalf of the state's Center for Health Information and Analysis, is a biannual telephone survey of approximately 5000 Massachusetts adult residents selected at random. The MHIS tracks trends in health insurance coverage, health status and interactions with the health care system. At the request of the state's Betsy Lehman Center for Patient Safety, the 2017 MHIS added a short "medical error" module of items drawn from other patient safety surveys.[1-3] Respondents were asked if they or a household or family member had experienced an error during the previous five years (Table 1). All respondents were also asked for permission to re-contact them with follow-up questions.

In summer of 2018, SSRS conducted a re-contact survey largely focused on respondents who reported experience with medical error in the 2017 MHIS. SSRS made up to 29 attempts to contact each respondent by telephone. IRB approval for both surveys was obtained from Solutions IRB.[4]

SURVEY RESPONSE

All 5001 respondents in the 2017 Massachusetts Health Insurance Survey (MHIS) were asked if they could be re-contacted and 3,469 agreed (Figure 1). In the MHIS, 988 respondents (988/5001=20%) reported having experienced a medical error in the last five years and 74% of those (736/988) consented to re-contact. We found no significant differences in socio-demographics or experiences with medical error between respondents who agreed to re-contact and those who declined (Table 2).

SSRS completed interviews with 191 of the 736 (26%) who agreed to re-contact in the MHIS 2017 medical error group. Of the 545 MHIS medical error respondents who did not complete the re-contact survey, 95 declined when reached by SSRS. SSRS was unable to reach the remaining 450 largely due to disconnected numbers and no-answers. The socio-demographic characteristics of respondents who reported medical errors in the MHIS and then completed the re-contact survey did not differ significantly from respondents who did not complete the re-contact survey. SSRS was able to re-contact a higher percentage of respondents who had experienced medical error in their own care than those whose experience was related to an error that happened to a household or family member (Table 3).

SSRS also surveyed a random sample of MHIS respondents who reported no medical error experience on the initial survey, to capture more recently emerging errors and to serve as a comparison group for broader research questions beyond this study. In the MHIS, 2733 respondents reported no medical error and agreed to re-contact. The target was to obtain 350 respondents (13%- 350/2733) from the comparison group in the re-contact survey.

Once in the field, 123 of the originally targeted 350 respondents reported a medical error in 2018, crossing over to the medical error group. Thus, a total of 433 respondents who originally reported no medical error in 2017 were actually contacted to determine the comparison sample in 2018.

This study focuses on a medical error cohort of 253 respondents who reported a medical error in the 2018 re-contact survey. Of the 191 respondents who reported a medical error in the MHIS 2017 survey and SSRS re-contacted in 2018, 68% (130/191) reported a medical error in 2017. Sixty-one (32%) crossed over to the comparison group.

Of the 433 respondents who did not report medical error in MHIS 2017 and who were re-contacted in 2018, 72% (310/433) continued to report no medical error. Another 8% (35/433=8%) reported no error in the 2017 MHIS survey but reported an error occurred in the last year on the 2018 survey. The remaining 20% (88/433) reported no medical error in MHIS 2017 but a medical error in 2018 that occurred >=1 year ago.

There are no socio-demographic differences and few medical error characteristics differences between the respondents who consistently reported a medical error (either in both surveys (n=130) or no error in 2017 but error in 2018 and error occurred <1 year ago (n=35)) and inconstant reporters of medical error (reported no medical error in 2017 and a medical error occurring >1 year ago in 2018- n=88). Consistent reporters were significantly more likely to report that more than one error had occurred to their household or family member (Tables 4).

Consequently, the study sample focused on the 253 respondents who reported medical error in the 2018 survey. This includes 130 respondents who reported medical error in both surveys and 123 (88+35) respondents who reported no medical error in 2017 and crossed over to the medical error sample in 2018.

Since analyses focus on individuals reporting a medical error, we are reporting the response rate that is focused on the medical error group. The reported response rate is the American Association Public Opinion Research (AAPOR) R3.[5] In calculating this response rate, the dual frame telephone AAPOR R3 accounts for the rate at which sample records reach actual households (in the case of landlines) or people's personal (not business) communication devices (in the case of cellphones), and as well then assess the degree to which they are eligible to participate (for example, over 20% of cell phone owners are ineligible as they are under the age of 18). The calculation also uses data available to estimate the rate at which unconfirmed sample records (no answers for example) should be assumed to be eligible sample units. The response rate cannot take cross-over into account so it is focused on the 191 respondents who reported medical error in the 2017 MHIS and were re-contacted in 2018.

Consequently, the medical error group had an initial response rate of 41.0 % (see Response Rate Calculation). This response rate multiplied by 24.6% (the MHIS response rate) resulted in a final response rate of 10.1% which compares favorably with similar telephone health surveys.[6] The margin of error for the medical error group is +/-8.7 percentage points.[7]

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TABLE 1: QUESTIONS FROM 2017 MASSACHUSETTS HEALTH INSURANCE SURVEY AND 2018 MEDICAL ERROR RE-CONTACT SURVEY CONSIDERED IN ANALYSES

2017 MASSACHUSETTS HEALTH INSURANCE SURVEY	RESPONSE OPTIONS
In the past five years, have you [have Target] or someone in [your/Target's] household or someone in [your/Target's] family living outside of [your/Target's] household experienced a medical error when receiving medical care, or has that not happened?	Yes, medical error was made in someone's care No, this has NOT happened
Was an error made in [your own/Target's] care, or the care of someone else living in [your/Target's] household, or the care of someone in [your/Target's] family living outside of the household], or all the above?	Error was made in your own care, error was made in the care of someone else living in your household, error was made in the care of someone in [your/TARGET's] family living outside of the household
If there was more than one error, please think about the most recent one when answering the next question. Did the error have serious health consequences, minor health consequences, or no health consequence at all for the person who experienced the error?	Serious health consequences, minor health consequences, no health consequences
We may follow-up with some survey participants to gather more in-depth information on their health care experiences in Massachusetts. Could we contact you again to ask a few more questions?	Yes or No
2018 MEDICAL ERROR RE-CONTACT SURVEY	**RESPONSE OPTIONS**
MEDICAL ERROR CHARACTERISTICS	
In the past six years, that would be since about 2012, was a medical error made?	In your own care, in the care of someone else living in your household, in the care of someone in your family living outside of the household, someone else not in your family or not living in your household, or was no medical error made
About how long ago did this medical error happen?	< 1 year ago, 1-2 years ago, or 3-6 years ago
Who did the medical error happen to?	You, your spouse, your child who lives in your home, your child who lives outside of your home, a family member who is not your child or spouse, a person living in your home who is not related to you
What best describes the place where the medical error occurred?	An emergency room, hospital, doctor's office or clinic, nursing home or other long-term care facility, pharmacy, dental office, at home, or somewhere else
ELEMENTS OF OPEN COMMUNICATION	
Did anyone at the place where the error occurred acknowledge to [you/them] that an error had occurred?	Yes or No
Did anyone on the care team speak openly and truthfully about the medical error you have been describing to me?	Yes or No
Did anyone on the care team speak to [you/them] about the medical error in an easy to understand way?	Yes or No
Did anyone on the care team give [you/them] the information needed to understand how the medical error would affect [your/their] health?	Yes or No
Did anyone on the care team give [you/them] a chance to ask questions about the medical error?	Yes or No
Did anyone on the care team give [you/them] a chance to express feelings about the medical error?	Yes or No
INITIAL IMPACTS: PHYSICAL	
When the medical error occurred how was [your/their] physical health affected overall? Did [you/their] physical health	Stay the same, get somewhat worse, get much worse, or did they die
How was [your/their] physical health impacted?	Extremely impacted, strongly impacted, somewhat impacted, or slightly impacted

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TABLE 1: QUESTIONS FROM 2017 MASSACHUSETTS HEALTH INSURANCE SURVEY AND 2018 MEDICAL ERROR RE-CONTACT SURVEY CONSIDERED IN ANALYSES

INITIAL IMPACTS: EMOTIONAL	
Did you experience any of the following feelings as a result of the medical error?	Sadness, anger, anxiety, guilt, depression, feelings that the doctors abandoned or betrayed you or your family, or any other feelings
IMPACTS AT TIME OF SURVEY: PHYSICAL	
How long was [your/their] physical health worse for?	< a week, between a week and a month, between a month and a year, more than a year but [you/they] are recovered now, or [Your/Their] health is still being impacted
IMPACTS AT TIME OF SURVEY: EMOTIONAL	
Which of these emotions are you still experiencing?	Sadness, anger, anxiety, guilt, depression, feelings that the doctors abandoned or betrayed you or your family, or any other feelings
HEALTH CARE AVOIDANCE	
Since the medical error occurred, how frequently have [you/they] avoided the doctor involved in the care when the error occurred?	Never, sometimes, or always
Since the medical error occurred, how frequently have [you/they] avoided the health care facility where the error occurred?	Never, sometimes, or always
Since the medical error occurred, how frequently have [you/they] avoided getting medical care in general?	Never, sometimes, or always
HEALTH CARE TRUST	
How do you feel after your experience with the medical error?	More trusting, less trusting, or is there no change in the level of trust you feel when you receive health care
FINANCIAL	
Because of the medical error were [your/their] household finances affected by increased medical expenses?	Yes or No
Because of the medical error were [your/their] household finances affected by increased household expenses, such as for additional childcare, transportation, or household cleaning services?	Yes or No
Because of the medical error were [your/their] household finances affected by missed time at work?	Yes or No
Because of the medical error were [your/their] household finances affected by leaving a job for health reasons or to meet caregiver responsibilities?	Yes or No
Because of the medical error were [your/their] household finances affected by trouble paying bills?	Yes or No
Because of the medical error were [your/their] household finances affected by a decrease in income?	Yes or No
Because of the medical error were [your/their] household finances affected by any other way?	Yes or No
HEALTH CARE TRUST: QUESTIONS USED FOR VALIDATING OPEN COMMUNICATION	
Did [you/they] feel cared for by the care team?	Yes or No
All in all, how satisfied were [you/they] about the way the care team communicated about the medical error? Would you say…	Completely satisfied, somewhat satisfied, somewhat dissatisfied or not satisfied at all

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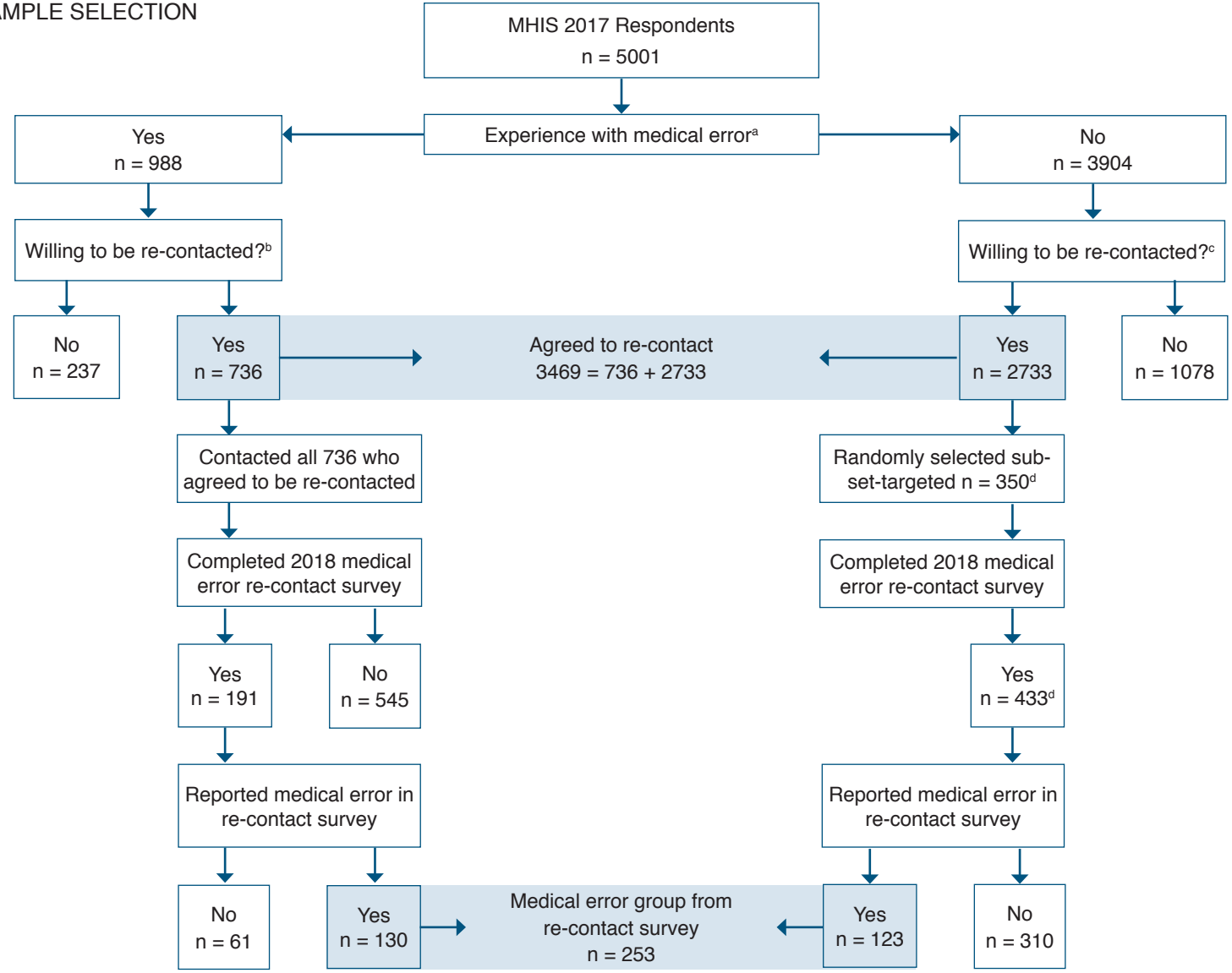
FIGURE 1: SAMPLE SELECTION



a) n = 109 Don't Know or Refused
b) n = 15 Don't Know or Refused
c) n = 93 Don't Know or Refused
d) Among respondents who reported no medical error in the 2017 survey, 350 were randomly selected for the 2018 re-contact survey. Once in the field, 123 of these respondents reported a medical error in 2018 and crossed over to the medical error group. Consequently, a total of 433 respondents who originally reported no medical error in 2017 were actually contacted to determine the comparison sample in 2018.

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TABLE 2: CHARACTERISTICS AMONG THOSE WITH MEDICAL ERROR EXPERIENCE WHO AGREED TO RE-CONTACT VERSUS NOT IN 2017 MHIS SURVEY (N=988)

	AGREED TO RE-CONTACT	
Age (years) (n=967)[a]	Yes (%)[b]	No (%)
<18	12	9
19-64	63	62
≥65	25	29
Gender (n=986)		
Male	45	49
Female	55	51
Education (n=898)		
Less than high school	6	5
High school	21	22
Associates degree or some college	26	25
College graduate	25	25
Postgraduate	22	23
Race/Ethnicity (n=946)		
Non-Hispanic white	83	85
Non-Hispanic black	3	6
Non-Hispanic other	5	3
Hispanic	9	5
Income (n=863)		
<139% federal poverty level	22	26
≥139% to <300% federal poverty level	20	20
≥300% to <400% federal poverty level	9	13
≥400% federal poverty level	49	41
MEDICAL ERROR CHARACTERISTICS		
Medical error was in own or MHIS target's care (n=988)		
Yes	27	28
No	73	72
Health consequences of the error (n=970)		
Serious health consequences	61	62
Minor health consequences	29	26
No health consequences	10	12

[a]Sample sizes vary due to respondents responding don't know or refusing to answer the question.
[b]Unweighted percentages

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TABLE 3: CHARACTERISTICS OF RESPONDENTS WHO ORIGINALLY REPORTED MEDICAL ERROR IN 2017 MHIS SURVEY AND WERE RE-CONTACTED VERSUS NOT RE-CONTACTED (N=736)

	AGREED TO RE-CONTACT	
Age (years) (n=727)[a]	Yes (%)[b]	No (%)
<18	13	12
19-64	60	64
≥65	27	24
Gender (n=736)		
Male	47	45
Female	53	55
Education (n=662)		
Less than high school	6	6
High school	22	21
Associates degree or some college	23	27
College graduate	30	23
Postgraduate	20	22
Race/Ethnicity (n=710)		
Non-Hispanic white	85	82
Non-Hispanic black	3	4
Non-Hispanic other	7	4
Hispanic	5	10
Income (n=680)		
<139% federal poverty level	21	22
≥139% to <300% federal poverty level	24	19
≥300% to <400% federal poverty level	11	8
≥400% federal poverty level	44	51
MEDICAL ERROR CHARACTERISTICS		
Medical error was in own or MHIS target's care (n=736)		
Yes	35*	25
No	65	75
Health consequences of the error (n=970)		
Serious health consequences	66	59
Minor health consequences	22	31
No health consequences	12	10

[a]Sample sizes vary due to respondents responding don't know or refusing to answer the question.
[b]Unweighted percentages
*Chi-square is significant at P<0.05.

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TABLE 4: CHARACTERISTICS OF CONSISTENT AND NON-CONSISTENT REPORTERS OF MEDICAL ERROR IN 2018 RE-CONTACT MEDICAL ERROR SURVEY (N=253)

	AGREED TO RE-CONTACT	
Age (years) (n=246)[a]	Yes (%)[b]	No (%)
<18	11	8
19-64	64	63
≥65	25	29
Gender (n=986)		
Male	45	51
Female	55	49
Education (n=237)		
Less than high school	8	4
High school	18	18
Associates degree or some college	25	18
College graduate	29	30
Postgraduate	20	30
Race/Ethnicity (n=248)		
Non-Hispanic white	84	90
Non-Hispanic black	4	3
Non-Hispanic other	7	3
Hispanic	5	3
Income (n=236)		
<139% federal poverty level	22	17
≥139% to <300% federal poverty level	22	24
≥300% to <400% federal poverty level	9	10
≥400% federal poverty level	47	49

MEDICAL ERROR CHARACTERISTICS		
Who medical error happened to (n=251)		
Self	41	41
Spouse/Child	21	30
Other	38	29
Did more than one medical error happen to you or a household or family member? (n=252)		
Yes	40*	18
No	60	82
Where medical error happened (n=253)		
Hospital (not ER)	43	47
Ambulatory care/doctor's office	30	30
ER	9	12
Other	18	11

[a]Sample sizes vary due to respondents responding don't know or refusing to answer the question.
[b]Unweighted percentages
*Chi-square is significant at P<0.05

RESPONSE RATE CALCULATION

Completes / Completes + Confirmed Non-respondents + (Confirmed Unscreened Households * e1) + (Unconfirmed Households * e1 * e2).

Where:

E1 = estimate of screener eligibility = Confirmed eligible respondents / (Confirmed eligible respondents + confirmed not eligible respondents)
E2 = estimate of household eligibility = Confirmed eligible households / (Confirmed eligible households + confirmed not eligible households)

Thus:

Medical Errors sample:

RR3 = 191 / 191 + 0 + (146 * .81) + (245 * .79 * .81) = 0.409
E2 = 191 / 191 + 45
E1 = 382 / 382 + 100

0.409*0.246 (MHIS response rate) = 0.101

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For more information, please visit BetsyLehmanCenterMA.gov/MedicalErrorCosts.

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