

Innovation Series 2003

Move Your Dot™

Measuring, Evaluating, and Reducing Hospital Mortality Rates (Part 1)



We have developed IHI's Innovation Series white papers to further our mission of improving the quality and value of health care. The ideas and findings in these white papers represent innovative work by organizations affiliated with IHI. Our white papers are designed to share with readers the problems IHI is working to address; the ideas, changes, and methods we are developing and testing to help organizations make breakthrough improvements; and early results where they exist.

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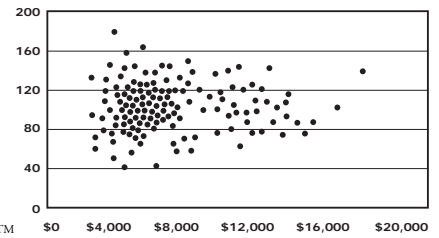
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Executive Summary

Move Your Dot™ is an effort to help hospitals know more about their organizational performance as it relates to mortality. A new statistical methodology has been developed to standardize hospital mortality rates in order to fairly compare them. Further, a simple analytical tool has been developed to help hospitals evaluate their mortality rate — their “dot” on a scatterplot of mortality rates for U.S. hospitals — and analyze the factors that contribute to it. This analysis can lead to targeted quality improvement projects that can “move the dot” — that is, reduce hospital deaths.

Move Your Dot is one of many current approaches being used to improve health care safety throughout the health care system. This movement is in large measure the result of studies published in the last decade revealing the extent of harm caused to patients by medical errors, and outlining a broad prescription for change.

Concurrent with the industry’s efforts to improve care, purchasers and consumers are increasingly focusing on information about quality to choose providers. “Report cards” detailing process and outcomes data are increasingly available at the health plan, hospital, and provider group levels.

In addition to feeling the professional imperative to provide the highest quality care, hospital executives are also feeling competitive pressure to demonstrate quality by publishing outcomes data. A measure that carries significant emotional weight, as well as important implications about quality, is a hospital’s mortality rate.

As part of its effort to foster improvement in the U.S. health care system, the Institute for Healthcare Improvement (IHI) in Cambridge, Massachusetts, is offering the newly developed Move Your Dot analytical tool to any hospital interested in using it to measure and analyze their mortality rate. IHI also has mortality rate data for all U.S. hospitals and can provide a hospital with its mortality rate on request.

The tool, used to date by more than 25 hospitals to assess and analyze their mortality rates, has proved useful in helping institutions identify opportunities for improvement. Aggregate data compiled by the hospitals participating in this effort will be sent to all hospitals that provide their data to IHI.

Health care leaders are driven by an intrinsic commitment to excellence. Through this Innovation Series paper, IHI hopes to support this commitment by helping health care leaders understand how reducing hospital mortality rates can improve health care safety and the quality of care delivered to all patients.

Introduction

More than a decade ago *The New England Journal of Medicine* published the results of a study designed to determine the incidence and the nature of adverse events in hospital patients.^{1,2} Based on a review of more than 30,000 randomly selected medical records, the authors concluded that there is “a substantial amount of injury to patients from medical management, and many injuries are the result of substandard care.”³ The authors recognized both the need and the opportunity to address this problem, saying that “reducing the incidence of these events will require identifying their causes and developing methods to prevent error or reduce its effects.”⁴

This seminal work launched other studies, the most notable of which was published in 1999 by the Institute of Medicine (IOM). Called *To Err Is Human: Building a Safer Health System*, this milestone report included the sobering news that from 44,000 to 98,000 Americans die each year as the result of medical errors. Since that time, many health care organizations have engaged in pioneering and innovative work, many with significant success, to reduce adverse medical events and the harm they cause.

In 2001, the Institute of Medicine published *Crossing the Quality Chasm: A New Health System for the 21st Century*. This report outlined fundamental changes that must be made to the American health care system in order to produce badly needed improvements in care. The IOM suggested that improvement efforts be organized around six primary aims: to make care safer, more effective, efficient, patient-centered, timely, and equitable.

That patients die every day in hospitals is both an accepted fact of medical care delivery and a cause for organizational reflection and continuous assessment. Some, perhaps many, deaths might be prevented if all the factors that contribute to them are better understood.

As in most improvement efforts, a hospital whose aim is to prevent avoidable deaths must begin with the collection and analysis of data. Hospital death rates, appropriately adjusted for variables such as population characteristics and diagnoses, can serve as important quality indicators, and are an essential starting point in a journey to improve care and reduce mortality.

This paper describes Move Your Dot, a recently developed methodology that helps hospital leaders understand their organization’s death rate and how it compares to the national average, as well as tools for analyzing factors that contribute to the rate, and guidance for planning potential improvement efforts related to reducing overall mortality.

Background

Measures of health care performance at the organizational level and increasingly at the individual provider level have become more commonly produced and used by providers, purchasers, and consumers in recent years. As these measures grow in reliability and utility, they are serving as important guides for improvement efforts, as well as decision-support tools for consumers and purchasers.⁵

The imperative for evaluating, reporting on, and improving quality has been widely recognized by all sectors of the health care industry, including the nation's hospital leadership. In its July 2002 report on quality and patient safety, the American Hospital Association called on hospitals to provide quality data to the public.

Hospital mortality rates are already beginning to appear in "report cards" and other evaluation tools used by purchasers and consumers to help them choose among health care providers.⁶ (In November 2002, The Centers for Medicare and Medicaid Services announced a pilot project to test the most effective ways to communicate with consumers about hospital quality of care, with a goal of placing hospital ratings on its website.⁷) The mortality rates published in these report cards vary according to the methodology used to produce them. However, when properly standardized and analyzed, mortality rates are important indicators of quality for providers, consumers, and purchasers.

Death rates make effective outcome measures for a number of reasons: death is a definite, unique event (unlike morbidity which is continuous and difficult to measure consistently); deaths are recorded by law, rendering the records relatively complete and accurate; and death rates are easily understood by the public.⁸ The science of measuring mortality rates, adjusted for variations in population, diagnoses and other factors, has progressed significantly in recent years, thanks in large measure to the work of Sir Brian Jarman, Emeritus Professor of Primary Health Care at Imperial College School of Medicine in London, U.K., who is the developer of the Jarman Index (a measure of the extent to which specific locales are underprivileged and at risk of poorer health outcomes) and also a Senior Fellow at the Institute for Healthcare Improvement (IHI) in Cambridge, Massachusetts.

Hospital Standardized Mortality Ratios in the United Kingdom

In 1999, Jarman and colleagues published the results of a comprehensive study of inpatient deaths in the United Kingdom, based on four years' worth of existing discharge data from the Hospital Episode Statistics (HES) database.⁹ The same group has since analyzed a five-year dataset from more recent years.) They applied a weighted linear regression analysis to the data, with hospital standardized mortality ratios (HSMR) as the dependent variable. Cases were included in the analysis if the primary diagnosis on admission was one of about 80 primary ICD diagnoses that accounted for 80% of all hospital deaths in England. Small hospitals — those with fewer than 9,000 admissions during the four-year data period, or fewer than 15,000 during the five-year period — and specialty institutions were excluded, as were hospitals whose data were judged to be of poor quality.

HSMRs were calculated as the ratio of actual number of deaths to the expected number of deaths multiplied by 100. For each of the approximately 80 diagnoses, the researchers stratified patients by age, sex, admission type, and length of stay. They also used socioeconomic factors based on patients' place of residence, as well as severity of illness and a range of other variables, to determine which factors significantly explained the variation of HSMRs among hospitals. (For a more detailed technical description of the Jarman methodology for calculating HSMRs, see Jarman et al., Explaining differences in English hospital death rates using routinely collected data. *British Medical Journal*. 1999; 3318:1515-1520.)

The researchers found that the crude death rates varied across U.K. hospitals from 3.4% to 13.6% (the national average being 8.5%), with hospital standardized mortality ratios ranging from 53 to 137 (with a national average of 100).

An analysis of the data revealed that, after adjusting for age, sex and primary diagnosis, the best predictor of the variation in mortality was the percentage of cases that were emergency admissions (which accounted for 60% of admissions and 93% of deaths), followed by the number of hospital doctors per bed and the number of general practitioners per capita in the localities from which the hospital admissions came.

HSMR in the United States

Jarman spent 2002 in residence as a Senior Fellow at the Institute for Healthcare Improvement in Cambridge, Massachusetts. His work focused on analyzing U.S. hospital mortality data, using the U.S. national death rates from the Agency for Healthcare Research and Quality (AHRQ) and the Medicare data sets (MedPar) for 1997 to 2001. (The Medicare data is more current, more comprehensive, and in the public domain, so it was used for most of the analyses.)

For the U.S. data, the Clinical Classification System (CCS), a group of related ICD-9 diagnoses developed by AHRQ¹⁰, was used and only 30 CCS groups are needed to cover the diagnoses leading to 80% of all deaths. It was found that death rates varied significantly with age, sex, race, payer (in the AHRQ data), admission type, admission source, length of stay and diagnosis, and these variables were used to indirectly calculate hospital standardized mortality ratios. Again, the HSMRs were calculated as the ratio of observed deaths to expected deaths multiplied by 100.¹¹

The standardized values of HSMRs were then used in regression analyses as the dependent variable in order to find which of a number of independent variables best explain the variation of HSMRs. The independent variables include social factors, and a large number of Dartmouth Atlas variables for the 306 Hospital Referral Regions (HRRs) covering a wide range of relevant factors. Work is currently ongoing using the Dartmouth Atlas variables for the 3,436 Hospital Service Areas (HSAs) — a finer degree of geographical stratification.

Jarman's research showed that, in the U.S., the top factors explaining variation in HSMRs are the percentage of Medicare deaths occurring in hospitals, hospital admission rates, and the percentage of discharges to short-term hospitals, skilled nursing facilities or intermediate care facilities.

Directly standardized charges, costs, and reimbursements were also calculated for each hospital, adjusting for age and diagnosis within the diagnoses leading to 90% of all charges.

IHI's Call To Action for Hospitals

The Institute for Healthcare Improvement has developed a process and methodology for hospitals to use in assessing and understanding their mortality rate and the influencing factors. As part of its effort to foster improvements throughout the health care system, IHI invites hospitals to engage in this process, called Move Your Dot, using tools and guides IHI has recently developed. The process and action steps are described in the following sections.

Step 1: Plot Your Dot

Figure 1 shows hospital standardized mortality rates for 1,739 U.S. hospitals, adjusted using Jarman's method, plotted against the charge per admission (standardized for age and diagnosis). Note the 450 percent variation in a patient's chance of dying depending on which hospital he or she enters, as well as the 800 percent variation in standardized reimbursement.

Action: "Plot your dot" on this graph using your hospital's existing mortality rate data, or contact IHI at moveyourdot@ihi.org to request your data.

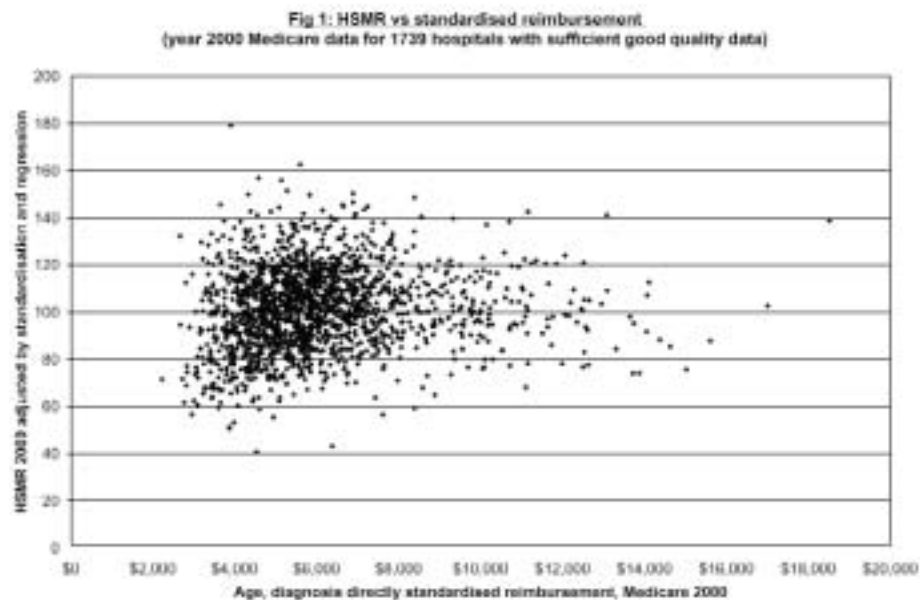


Figure 1

Figure 1. U.S. hospitals' standardized mortality rates plotted against the reimbursement per admission (standardized for age and diagnosis)

Step 2: Examine Your Dot

Determining the HSMR for a hospital is an important step, but should be followed by analysis of what the rate means, and what factors contributed to its value. The ultimate goal, of course, is to identify and implement system-level changes that can reduce mortality.

Under the direction of IHI, a group of more than 25 hospitals has been working with an evaluation tool designed to aid in understanding their HSMR and determining the contributing factors. These groups are part of IHI's IMPACT Network, a growing network of more than 95 health care organizations that have joined together as a "community of improvers" to make dramatic improvements in care. Some of these organizations are also part of Pursuing Perfection, a \$20.9-million initiative of The Robert Wood Johnson Foundation intended to help physician organizations and hospitals dramatically improve patient outcomes by pursuing perfection in all of their major care processes. The Institute for Healthcare Improvement is the National Program Office for this initiative. Understanding and reducing HSMR — "moving your dot" — is part of both IMPACT and Pursuing Perfection.

An early outcome of the HSMR work by these groups has been the development of a process for chart review of patient deaths and a simple but effective Hospital Mortality Review Tool for analyzing the results of the review. The Hospital Mortality Review Tool, along with simple instructions for the patient record review, are attached as Appendices A and B.

Action: Review patient records for 50 consecutive patients who died in your hospital.

Step 3: Evaluate Your Dot

Information from the patient records can help reviewers begin to see patterns and answer questions such as:

- For how many patients was it possible to identify a major diagnosis cell on admission (pneumonia, for example)?
- For how many patients could a minor diagnosis cell (staph pneumonia for example) be identified?
- In how many cases did admission and discharge diagnoses match?
- Could these patients have been placed into risk categories on admission?

After reviewing the patient records, a simple 2x2 matrix asks reviewers to determine what percentage of patients who died fell into each of four categories. The matrix looks like this:

		ICU Admission	
		Yes	No
Comfort Care Only	Yes	A	B
	No	C	D

Action: Use the Hospital Mortality Review Tool and the 2x2 matrix to begin analyzing the chart data.

Note: To date, IHI has collected aggregate matrix data for more than 25 hospitals, representing more than 1,250 patient records. Hospitals that submit their matrix data to IHI (moveyourdot@ihi.org) will receive the aggregate data in return.

Step 4: Understand Your Dot

Each box of the 2x2 matrix represents important potential improvement strategies.

Box A, patients admitted to the ICU for comfort care only, suggests overuse of ICU beds and corresponding flow issues in the ICU. This might represent, for example, physicians admitting patients to the ICU for comfort care because they trust only the ICU nurses to administer effective pain management. This box highlights a need to identify more appropriate resources for end-of-life care. (For more resources on end-of-life care, see www.ihi.org/IHI/Topics/LastPhaseofLife/.)

Box B, patients admitted to non-ICU beds for comfort care only, may also indicate inadequate hospice or other end-of-life care resources in the community. Work here could involve examining the resource capacity of the community and/or long-term care facilities, as well as changing the culture around appropriate end-of-life care. (For more resources on end-of-life care see www.ihi.org/IHI/Topics/LastPhaseofLife/.)

Box C, patients admitted for care in the ICU, represents the potential for applying known improvement techniques to ICU care such as ventilator bundling (a group of processes that provides a robust picture of quality in ventilator care) and multidisciplinary rounds. (For an in-depth report on improving ICU care, see “Care in the ICU: Teaming Up to Improve Quality,” produced by ACT: Accelerating Change Today, a collaborative effort of the National Coalition on Health Care and the Institute for Healthcare Improvement. The report, along with related information, is available at www.nchc.org.)

Box D, suggests that, since the outcome was death, these patients were in fact high risk but possibly not assessed as such. Work here might involve addressing core systems issues such as in patient safety and specifically, in medication safety. (See www.ihl.org for resources on improving patient safety.) Work here might also involve improving risk assessment on admission for all patients. By understanding what factors are most strongly associated with a likelihood of death, your institution can assess and follow these factors more closely during their patients’ stay.

Action: Use data from the 2x2 matrix to identify areas in need of further investigation.

Step 5: Test Changes

An analysis of the implications of the data should lead to the identification of improvement projects.

Typical “next tests” devised in response to data such as that shown above might include:

- Identifying high-risk patients on admission (i.e., develop systems to identify high-risk patients and apply corresponding protocols);
- Increasing nursing care and physician contact for high-risk patients;
- Standardizing patient handoff processes;
- Identifying an attending physician for all patients;
- Establishing partnerships with the community to promote care for patients before they become critically ill;
- Reviewing influenza vaccine status of patients with pneumonia; and,
- Using remote monitoring of ICU patients with intensivists and nurses to decrease mortality by lowering cycle time between receipt of information and action.

Multidisciplinary teams should be created to focus on specific areas, and those teams should use Plan-Do-Study-Act improvement cycles to test ideas for improvement. These ideas might range from significant changes such as the implementation of computerized prescriber order entry to changes on forms or admission evaluation processes.

For more information on how to conduct rapid-cycle testing of improvement ideas, visit www.ihi.org/Improvement/.

Action: Initiate improvement projects based on the implications of the mortality data.

An Example Using the Move Your Dot Methodology and Tools

A 178-bed acute care hospital in the northeast U.S. created a Mortality Review Team led by the hospital's president and CEO. The team performed the chart review and created a 2x2 matrix that revealed the following statistics:

		ICU Admission	
		Yes	No
Comfort Care Only	Yes	2%	48%
	No	20%	30%

Using the guide for Exploring Box D, the team determined the following:

	Yes	No	Maybe
1. Evidence of planning failures	38%	53%	7%
2. Evidence of lack of responsiveness to nursing concerns by physicians	15%	84%	
3. Was lack of responsiveness a factor?	7%	84%	7%
4. ICU transfer prior to death	38%	61%	
5. Change to “No Code” or comfort care	53%	46%	
6. How many days into admission did “No Code” or comfort care occur?	1 @ 3 days 4 @ 4 days 1 @ 12 days 1 DNR @ 3 days		
7. Evidence of adverse events	53%	38%	
8. Evidence of miscommunication	30%	69%	

As a result of this work, the team identified the top three issues related to mortality rates:

1. Evidence of adverse events;
2. Evidence of planning failures; and
3. Evidence of miscommunication.

The team examined each of these areas and identified specific causes and categories of causes within each of the three areas. This is an essential step toward identifying areas for further evaluation and potential improvement efforts.

Conclusion

Health care quality has been defined as “the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge.”¹² Discovering, evaluating, and analyzing standardized hospital mortality data — finding your dot — is an effective and essential first step toward the foremost goal: reducing avoidable deaths — that is, moving your dot.

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Appendix A

Hospital Mortality Review Tool Rules for Patient Record Review to Collect Data for the 2x2 Matrix

1. Review 50 consecutive patient records for patients who have died in your hospital. Start the collection back far enough (generally one month from the current date) to have discharge summaries and diagnoses on the records. Pull enough extra (generally 5 records should be sufficient) patient records to discard those that may not meet the criteria.
2. It is strongly recommended that a physician be involved in patient record review process.
3. Use a privacy-sensitive identifier, as it may be necessary to go back and review the patient records in more depth. A medical record number might be appropriate.
4. Indicate risk factors of age and sex.
5. Indicate admission diagnosis *without looking at the discharge diagnosis*.
6. Use *only* the admission information to answer the next two issues about ICU and comfort care admissions. If a patient is transferred from a non-ICU bed to the ICU or becomes “comfort care only” later in the hospitalization, answer the ICU question “no.” *Only* the admission information is relevant here. However, if the patient went to surgery, radiology, dialysis, etc. prior to admission to the ICU this does count as an initial admission to the ICU.

Definitions:

An ICU is a traditionally functioning Intensive Care Unit. Specialized care units are not ICUs regardless of their sophistication, unless they are specifically defined as ICUs. (If, however, there are a lot of admissions to these units and overuse is suspected, they could be broken out into another 2x2 matrix.)

Comfort (or palliative) care is generally defined as care provided near the end of life to provide comfort both physically and psychologically. Admission orders and progress notes found in patient records generally make clear when patients should be deemed “comfort care” patients. Note: A DNR patient is not necessarily a comfort care patient unless it is reflected in the notes.

7. Hospice units using standard hospital rooms that other patients could use must be counted in Box D as comfort care in non-ICU beds. If there is truly a separate unit where *only* hospice patients are admitted, then these patients should not be counted.
8. Patients placed in beds for observation must be counted. Patients who die in the emergency room before they are admitted to the hospital do not count.
9. After reviewing the patient records for the criteria above, fill in the 2x2 matrix with the appropriate data.

Appendix B

Hospital Mortality Review Tool: Patient Record Review Data Collection Sheet for 2x2 Matrix

Complete a separate data collection sheet for each patient record reviewed.

1. Fill in the Blanks or Circle Where Appropriate:

Patient Record Identifier _____

(Use a privacy-sensitive identifier, such as a medical record number.)

Age_____

Male / Female

2. Admission Diagnosis (without looking at discharge Dx): _____

3. Based on the Admission Data Only:

Was the initial admission to an ICU?	Yes	No
--------------------------------------	-----	----

Was the patient admitted with a terminal disease for “comfort care”?	Yes	No
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4. Principal ICD-9 Code and Dx on Discharge: _____

5. Did the admission and discharge Dx match? Yes No

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