THE VALUE OF HOSPITAL DISCHARGE DATABASES

Final Report

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This study was funded by the Agency for Healthcare Research and Quality
under contract number 282-98-0024 (Task Order Number 5).

May 2005

Dedication

The health care data community mourns the loss of Elliot Stone, member of our Advisory Group, who passed away April 4, 2005. Mr. Stone was the Executive Director and CEO of the Massachusetts Health Data Consortium since its establishment in 1978. He was also an active member of the Public Health Data Standards Consortium and the National Association of Health Data Organizations. Elliot believed in broad collaboration around health data issues. He worked tirelessly to promote the creative use of health care data for research, policy, and market purposes and was a leader in advancing the development and adoption of health data standards to improve the comparability and utility of health data.

Acknowledgements

We would like to thank Anne Elixhauser, our AHRQ Project Officer, who had the original vision for this study and provided thoughtful input and guidance throughout the project. In addition, we thank Roxanne Andrews for her helpful comments on an earlier draft of this report. We also gratefully acknowledge the members of our study Advisory Group for their contributions in identifying leads on data uses and key informants, and for their careful review of study products. Likewise, we greatly appreciate the time and substantive contributions of our key informants, who answered our many questions about their work and provided a richer contextual understanding of selected data applications and the utility of discharge data. Finally, we'd like to thank our NORC colleagues Jennifer Benz, Jason Williams, and Nicole Brunda for very capable assistance in conducting the literature review and designing and populating the electronic database, and Bernadette Abeywickrama for design and formatting of this report.

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Executive Summary

Nearly all states currently collect hospital discharge data in some form. Differences among the states abound, however, with regard to the specific data elements collected, how they are defined, data completeness, voluntary vs. mandatory data submission, and policies regarding data release. States also differ in the ways they are using and disseminating these data, with some states serving solely to collect data for use by others, while others perform a wide range of analyses and disseminate results broadly.

The governance and financing of these data collection efforts likewise varies across states. While the majority of state data programs are run by a state agency (Consumer-Purchaser Disclosure Project, 2004), some states rely on private organizations such as the state hospital association. The fiscal constraints of recent years have caused some state legislatures to take a hard look at their publicly-funded data collection efforts, and the data collection agencies in these states have had to demonstrate their utility in order to secure continued funding. Private funders are also eager to ensure that their investments in data systems are of maximum utility.

This study seeks to improve our understanding of how state discharge data are being used and to identify opportunities to improve both the data and the way they are used in the future. We relied on multiple avenues to gather information, including: holding meetings with numerous representatives of the statewide data organizations at the December 2003 annual conference of the National Association of Health Data Organizations and the April 2004 annual meeting of the Healthcare Cost and Utilization Project (HCUP) Partners, convened by the Agency for Healthcare Research and Quality (AHRQ); soliciting input from an 8-member Study Advisory Group; conducting a wide-ranging review of the published literature and the internet sites of all state health data agencies and state hospital associations (and related sites); and conducting telephone interviews with 23 key informants. In the end, we hope that this study will help the statewide data organizations and other interested parties to support the continuation and enhancement of the state hospital discharge databases.

Hospital Discharge Data are Used in Many, Diverse Applications

Information collected from all study sources indicates that inpatient discharge data are used in a remarkably wide range of applications. The database users are similarly diverse, including various government agencies, provider associations and individual health care providers, consumer organizations and individual patients, health care insurers and other health care purchasers (e.g., large employers), policymakers, researchers, and private-sector interests such as database vendors and consultants.

Below, we organize our discussion of database applications around several broad topical headings designed to capture the most prevalent uses of discharge data that we identified and to group similar types of applications, recognizing that many of the applications could have easily been presented under a different heading. Key findings for each grouping are summarized below:

- ***Public Safety and Injury Surveillance and Prevention*** - Hospital discharge data are routinely used to address issues of public safety, including the tracking of injury rates, inpatient costs, patient characteristics, and outcomes for specific types of injuries, and informing the development of injury prevention programs. One prominent application used by many states is the Crash Outcomes Data Evaluation System, which combines inpatient discharge data with motor vehicle accident data and information from other sources to examine myriad issues related to motor vehicle safety.

- ***Public Health, Disease Surveillance and Disease Registries*** - Hospital discharge data provide critical information for a variety of public health uses, including: disease surveillance; chronic disease prevention and control programs; tracking the effects of environmental conditions (e.g., air quality) on health; and public health reporting – such as to disease registries and as part of federal reporting requirements for certain grants.

- ***Public Health Planning and Community Assessments*** - Discharge data can be used to understand patterns of inpatient care for a specific market area, identify services that are lacking in a community, plan for better future allocation of resources, and assess the potential impact of hospital conversions, mergers, and closures. A number of states also use hospital discharge data as one component of larger community health assessment systems that incorporate data from other health care settings as well as data on vital statistics, behavioral risk factors, morbidity, health resources, environmental conditions, and socioeconomic characteristics.

- ***Public Reporting for Informed Purchasing and Comparative Reports*** - Many statewide data organizations and other private-sector organizations have used discharge data to publicly report measures of hospital performance, with the aim of helping consumers to make informed purchasing decisions. These tools range from fairly basic tables, reports, or consumer brochures that compare hospitals in terms of volume, utilization, or charges for specific procedures or conditions, to much more sophisticated tools that compare hospitals in terms of their risk-adjusted outcomes. This information is often available through web-based query systems that allow users to generate customized reports.

- ***Quality Assessment and Performance Improvement*** - Increasingly, the discharge data are being used for quality assessment and performance improvement activities. These assessments may pertain to a single hospital or a broader health care system. Examples include assessing the performance of a specific hospital or an entire state in treating specific conditions; designing and evaluating quality improvement initiatives; and analyzing hospitalization rates for ambulatory care sensitive conditions.

- ***Health Services and Health Policy Research Applications*** - Hospital discharge data are used extensively in health services and health policy research. Among many other diverse topics examined, these applications include numerous studies of: the effect of health care financing and delivery systems on hospital use, costs, or outcomes; racial and geographic variations in use and outcomes; the impact of state and federal policies; and what procedures/interventions and provider practices produce the best clinical and economic outcomes.

- ***Private-Sector and Commercial Applications*** - Private-sector and commercial applications relying on inpatient discharge data range from market share, patient origin, and other studies that help hospitals with strategic planning and marketing, to the development of proprietary tools that supply information for purchasers, providers, and consumers. These types of applications can lead to stronger price competition in a market area, community-wide and hospital-specific quality improvement initiatives, and more aggressive purchaser negotiations.

- ***Informing Policy Deliberations and Legislation*** - Hospital discharge data hold the potential to be of great value for informing policy decisions and legislation, and we found several examples illustrating this use. Additionally, some of the traditional health services research studies have tried to anticipate policy decisions, or have considered whether a law passed by one state should be adopted on a wider basis.

Strengths and Limitations of Hospital Discharge Data

Discharge data have a number of important strengths that enable them to be of use for the wide range of applications described above. Specifically, they are relatively inexpensive to obtain and use when compared to the cost of similar data collected through surveys or medical record abstraction; are more reliable than other sources of data, such as patient self-reporting of medical expenditures or physician reporting of specific conditions for disease surveillance; are superior to data obtained from third-party payers due to the inclusion of information on patients without insurance;

and are usually available for multiple years, supporting trend analyses. Additionally, due to their coverage of large populations, they can be used for analyses of rare conditions or population subgroups, and because they typically cover entire populations, they support a range of population-based applications.

Despite these considerable advantages, two key weaknesses of the discharge databases may limit their utility for certain applications. First, inconsistencies across states and across providers in the way they report specific data elements, as well as hospital-specific errors in data reporting, may lead to data quality problems. Second, other data elements that would support more sophisticated analyses are currently lacking from many state data systems. These elements include E-codes, race/ethnicity information, detailed clinical information such as test results, whether a condition was present on admission, whether the patient had a do-not-resuscitate order in effect, functional status, severity of illness, behavioral risk factors, and unique identifiers for patients and for all physicians involved in the episode.

A Look to the Future

The demand for health information has risen sharply over the past decade. At the same time, state health data programs continue to face fiscal, political, and technical challenges in meeting these evolving information needs and in justifying the work they do. We believe that most statewide data organizations are eager both to improve their data systems and to have their data used in ways that are most helpful and informative – thereby solidifying support for their continued activities. Below, we describe a multi-faceted strategy to achieve these dual goals. Key features of this strategy include:

1. ***Improve Inpatient Discharge Databases*** - As discussed above, two key limitations of the currently-available hospital discharge databases are that certain data elements that could be helpful analytically are not included on most state databases, and that some existing data elements may not be of high quality. The adoption of the new Uniform Bill (UB-04) is expected to help address the first concern, although technical assistance (TA) and education are very likely to be required to ensure that providers submit the new elements correctly. Suggestions for addressing concerns about existing coding errors and reporting inconsistencies include promulgating data standards, providing training in coding for hospitals' front-line workers, and monitoring compliance in data reporting.

2. ***Build More Comprehensive Data Systems*** - The utility of existing discharge databases could also be considerably enhanced by adding data from other health care sectors, and by building

data systems that integrate health data with data from sectors such as education, welfare, and housing. Outpatient, emergency department, and ambulatory surgery data are already becoming more widely available, and adding information from laboratories, pharmacies, and physician offices can be envisioned in the longer term – particularly if a national system of electronic health records (EHRs) becomes a reality. We would not, however, expect the availability of a universal EHR to supplant the need for inpatient and other administrative databases since these latter databases are well suited to population-based analyses and readily accessible to researchers.

3. ***Provide Technical Assistance to Enhance Analytic and Reporting Capacity*** - Much could also be gained by providing the statewide data organizations with TA so that they can do more with the data that are presently available to them. A broad range of TA topics can be envisioned – ranging from help in improving the data submission and editing processes, to the development and sharing of analytic tools and reporting templates, to primers on key health policy issues, to tips on effective dissemination of information. We suggest that a collaborative model, in which private, state and federal health data organizations partner to develop a nationwide network for improving data, may be the most effective means for delivering this technical assistance.

It is important to realize that progress on these fronts may require resources that could strain the already tight budgets of some statewide data organizations. As is the case with the provision of technical assistance called for above, a combination of federal, state, and private contributions and efforts may be necessary to secure the needed resources.

1. Project Overview

Study Motivation and Goals

This study seeks to improve our understanding of how state discharge data are being used and to identify opportunities to improve the data and the way they are used in the future.

Nearly all states currently collect hospital discharge data in some form, and some states have been collecting these data for many years. The consistency and quality of these efforts vary greatly by state, however, with many differences in the specific data elements collected and how they are defined, the completeness of the data, whether submission of data is voluntary or mandatory, and policies regarding release of the data. States also differ in the ways they are using and disseminating these data – some states serve solely to collect data for use by others, while other states perform a wide range of analyses and disseminate results broadly. Decisions about the role played by the statewide data organization are likely affected by the availability of resources as well as by philosophical considerations regarding the entity's mission and the degree of visibility it wishes to assume.

There is also state-to-state variation in the governance and financing of these data collection efforts. While the majority of state data programs are run by a state agency (Consumer-Purchaser Disclosure Project, 2004), some states rely on private organizations such as the state hospital association. Financing may be derived from a combination of state funds, membership or provider fees, charges to data users, and grants and contracts. Ultimately, however, most of these costs are borne by taxpayers and health care consumers. The fiscal constraints of recent years have caused some state legislatures to take a hard look at the continued financing of their publicly-funded data collection efforts, and the data collection organizations in these states have had to demonstrate their utility in order to secure continued funding. This scrutiny seems likely to continue in the future. Citizen concerns about patient confidentiality may also threaten these databases in some states (Majeski, 2002), as may consumer concerns about rising health care costs, especially if the value arising from the data is not seen as outweighing the data collection costs. Private funders are also eager to ensure that their investments in data systems are of maximum utility.

In this report, we hope to build a broad constituency of support for the continuation and enhancement of hospital discharge databases by:

1. cataloging the wide variety of uses for and users of these data;
2. documenting the value of these applications; and
3. identifying opportunities for data im-

provements that will enhance the future utility of the databases.

This review focuses on state-level inpatient data systems, but also includes studies that use the Nationwide Inpatient Sample (NIS), the State Inpatient Databases (SID), or the Kids' Inpatient Database (KID) – all of which are compiled from the state databases as part of the Healthcare Cost and Utilization Project (HCUP) administered by the Agency for Healthcare Research and Quality (AHRQ). The HCUP databases have improved steadily since the project began in the early 1990s, as more states have begun contributing data, standardizing data elements, and facilitating access to their files through AHRQ's central distributor. There is room for further improvement, however, through the participation of additional states and enhanced data quality and uniformity across states. In the end, we hope that this study will help state data organizations and other interested parties to support the continuation and enhancement of the state hospital discharge databases, and improve the HCUP data through increased state participation and coordination.

Study Methods

Consistent with the study goals identified above, this project relied on multiple avenues to gather information on: (1) the ways hospital discharge data have been used, (2) the value of these applications, and (3) the strengths and shortcomings of the discharge data for the application. Each of these avenues is described below.

Gather Information from Data Experts. We began the study by soliciting information about the ways discharge data are being used from attendees of the December 2003 National Association of Health Data Organizations (NAHDO) annual conference. This information was gathered during a roundtable discussion with approximately 30 representatives of the state data agencies and state hospital associations that attended the pre-conference "State Invitational" workshop. Depending on the state, the state data agency or the hospital association is typically the entity responsible for the collection and maintenance of discharge data for the state (hereafter referred to by the generic term "statewide data organization"). Prior to that session, we sent participants an overview of the study and asked them to complete a short questionnaire that asked for information on up to three applications (by either their own organization or others who used their data). Requested information included a description of the use, the products that resulted from the use and any evidence of value arising from the use, the target audiences for these products, and the name of a contact person responsible for the work. During the session, participants described these sample uses in further detail.

In addition to this workshop, we also prepared a poster presentation describ-

ing the study and talked with conference attendees who stopped by the display during the two days of the NAHDO conference, asking for leads and other information on database applications.

The second avenue for collecting information on the range of database applications was through our study's Advisory Group. Based on input received and contacts made during the NAHDO conference, as well as on other insights of study and AHRQ personnel, we formed an Advisory Group consisting of eight representatives of state data agencies and hospital associations, legislative and consumer interests, and other data experts (see Appendix A for a complete list of members). The purpose of this panel was to provide guidance and review at critical points during the study. In February 2004, we convened the Advisory Group via a conference call, and spent the time brainstorming a long list of database application types. After the call, this broad typology was circulated to Advisory Group members, who were asked to provide specific examples, report or article citations, and contacts for any applications they could identify illustrating any of these types of uses.

The third avenue through which we collected information from data experts was through a working session at the annual meeting for the HCUP Data Partners, convened by AHRQ in April 2004. The data partners are those statewide data organizations that currently contribute their data to the HCUP database, or that are interested in moving in that direction. As was done previously for the NAHDO conference, we asked the state representatives to come to this session prepared to discuss at least one example of a data use from their state, preferably with a focus on applications that had reached a large audience or had a demonstrable and valuable outcome. This session, too, resulted in a lengthy list of potential leads for subsequent investigation.

Review of the Published Literature. Concurrent with these activities, we conducted a review of the published literature. This literature provided information not only on the range of ways discharge data have been used, but also on the advantages and disadvantages of using discharge data for that particular application (usually in the discussion or study limitations section of the paper) and - occasionally - on the value arising from the use. The goal of this review was not to compile a comprehensive listing of relevant articles, a task that would have required all of the study's resources, but rather to identify a representative set of articles describing uses of discharge data.

To guide the literature review, it was first necessary to establish a working definition of "discharge data." To this end, we defined discharge datasets as being comprised of all-payer inpatient records that have been summarized from abstracts as reflected in the Uniform Bill (UB). Al-

though both discharge and claims data are created for purposes of billing and share many of the same data elements, we excluded studies using payers' files (e.g., Medicare claims) since these files would exclude patients without insurance. Likewise, studies that relied on surveys of inpatient discharges, such as the National Hospital Discharge Survey, and studies that used data abstracted from the medical records of a single hospital (or small number of hospitals), were considered to be outside the scope of this project.

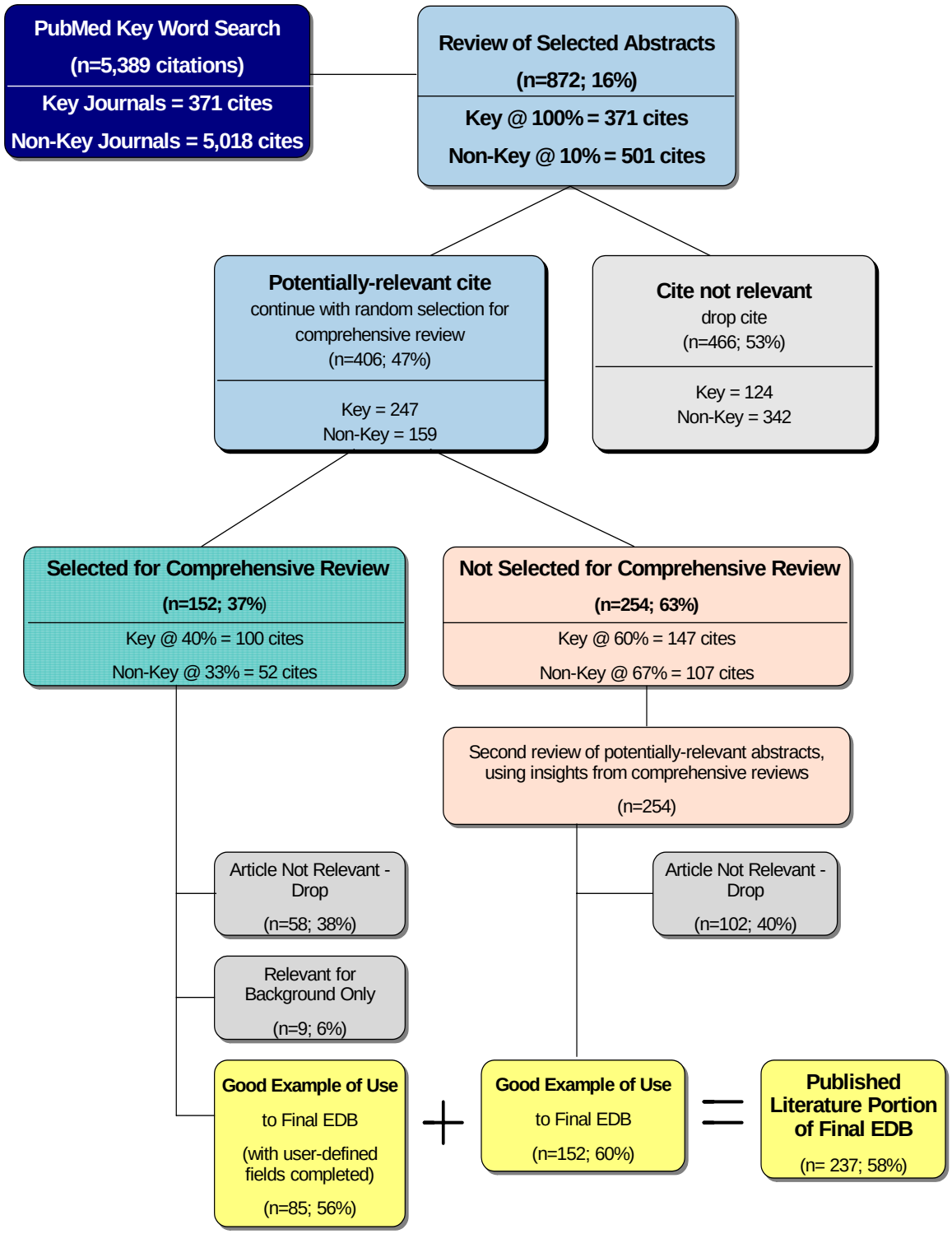
We began this review by conducting a Medline search using the following search terms: "hospital discharge abstract," "patient discharge data," "hospital discharge data," "administrative discharge data + hospital," "nationwide inpatient sample," and "state inpatient data / database(s)." This search was not limited to specific years or journals, and yielded approximately 3,400 English-language citations. We assessed the relevancy of these search terms by determining how many of the known articles published from studies using the HCUP data (as identified on AHRQ's web site) were identified through our initial search, and found that only 56 of the 126 HCUP articles were on our list.

After reviewing the abstracts and MeSH headings from some of the HCUP articles that we failed to identify, we expanded our list of search terms to include the terms "discharge database" and" hospital administrative data." This expansion identified more than 1,700 additional citations, only 10 of which were HCUP articles, indicating very marginal returns to the expanded list of search terms. The remaining non-identified HCUP articles had either very general MeSH headings or headings that related to a very specific type of use. We decided against further expansions to our list of search terms along these lines because we wanted to avoid including huge numbers of irrelevant cites (as would have occurred using the more general search terms), and did not want to bias our results by seeking out specific types of applications. We did, however, run one final search using the terms "HCUP" and related derivatives provided to us by AHRQ, and identified approximately 250 additional articles. The final master file resulting from these searches included 5,389 citations.

As depicted in Figure 1.1, this master list of citations was then subdivided according to whether or not the cite was from one of five journals deemed to be "key".[1] All 371 entries from key journals were selected for abstract review, along with a 10 percent random sample of the remaining 5,018 articles from non-key journals.

[1] The New England Journal of Medicine and the Journal of the American Medical Association were selected as key journals due to their position as leading clinical journals. Health Affairs and Medical Care were included as key health services research journals because of their high ranking with regard to the 2000 citation impact factor, as calculated and published by ISI (http://www.in-cites.com/research/2002/may_13_2002-2.html). Additionally, we included the American Journal of Public Health due to the importance of public health uses for hospital discharge data and the fact that this journal was a common source of articles found in our Medline literature searches.

Figure 1.1 Tracking the Review of the Published Literature



NORC research staff reviewed the electronic abstracts for the 872 citations selected in this way (16 percent of the citations identified through the literature search) to determine whether the article represented a valid use of hospital discharge data. More than half of the articles (n=466, or 53 percent of the abstracts under review) were eliminated from further consideration at this stage because the abstract indicated that the article was not relevant for the study. Common reasons for being judged irrelevant were that the article used data other than inpatient discharge data (most typically, the National Hospital Discharge Survey, medical records, or claims from insurers) or reported on a study outside of the United States. This high degree of irrelevancy indicates the difficulty of accurately determining search terms *a priori*. Additionally, many of the abstracts were so vaguely written that it was not possible to determine relevancy based solely on the abstract; citations were retained as "potentially relevant" unless a clear determination of irrelevancy could be made from the abstract.

A portion of the 406 articles judged to be potentially relevant was then randomly selected for comprehensive review. We selected approximately 40 percent of the citations from key journals (n=100) and approximately one-third of the citations from non-key journals (n=52), resulting in a total of 37 percent of the potentially relevant citations being selected for comprehensive review. A hard copy of these articles was retrieved, then reviewed by a senior-level NORC researcher. Following each comprehensive review, the reviewer completed five data fields summarizing the name of the database used in the work, the state(s) to which the work applied, the dependent variables, the type of database application, and a comments field for noting strengths and weaknesses of using the discharge data for this purpose. Of the 152 articles reviewed in this way, we found 85 (or 56 percent) representing a valid use of discharge data, 9 that provided useful background information (e.g., a methodological study assessing the accuracy of injury or racial coding) but that did not represent a valid use (6 percent), and 58 that were not relevant to the study for the reasons identified above (38 percent).

In light of the high percentage of articles deemed not relevant after comprehensive review, we performed a second review of the abstracts of the 254 potentially-relevant citations that had not been randomly selected for comprehensive review, attempting to apply insights gained during the comprehensive review as to what types of articles are relevant vs. not relevant. This second review of the abstracts found 102 articles that were not relevant (40 percent), and 152 that appeared to represent a valid use of discharge data (60 percent).

Review of the Unpublished Literature through Internet Searches. We also conducted a systematic search of the internet sites of all statewide data organizations in order to identify ways their hospital

discharge data have been used and the products that have resulted from these uses. These products include a range of chart books and descriptive tables, data and issue briefs, unpublished reports, consumer information materials, and web-based query systems designed to facilitate access to statistics generated from the databases per user specifications.

The relevant organizations and web addresses were identified through lists available from AHRQ (for the current HCUP states) and in a report from the Consumer-Purchaser Disclosure Project (2004). When the statewide data organization was not the state hospital association, we also searched the site of the state hospital association to determine if additional information was available. When relevant information was located on any site, we followed all links to related sites searching for additional information. In a small number of instances, no information could be located for a state, or sites were accessible only to members (primarily, for some state hospital associations). Additionally, we may have missed some relevant web sites that were not linked to the primary sites we initially accessed. For example, in some states, agencies other than the department responsible for collecting the data (e.g., Office of Minority Health, Public Health Department) may also use the data, either for ad-hoc studies or regular reports, and these uses were not captured in any systematic way. Finally, this review reflects the information posted on the web sites at the time the work was conducted (summer and fall of 2004); it is possible that states have generated other products that were not made available electronically at that time. State-by-state results for these investigations are summarized in Appendix B.

Review of Other Materials. The AHRQ and NAHDO staff also provided NORC staff with reams of other potentially-relevant materials from their own archives. These materials included a mixture of unpublished reports, published articles, web site addresses, and press clippings discussing results or availability of a study. NORC staff assessed all of these materials for their relevance and incorporated relevant items into the project files. Many items had already been identified using the methods described above. In the case of press clippings, we attempted to locate the primary source and add that to the files.

Interviews with Key Informants. The final source of information for this study was a series of telephone interviews that NORC and NAHDO staff conducted with key informants. The list of potential interview candidates was complied from the many leads received at the 2003 NAHDO conference and the 2004 HCUP Data Partners meeting, from our Advisory Group, and from the literature review. Since these other sources had already provided us with a rich array of database uses, our focus in selecting key informants was on finding people who could speak about some of the more compelling applications already identi-

fied rather than on identifying still more types of uses. That is, we used the key informant interviews to obtain more contextual information on the value of specific applications and on the pros and cons of using the hospital discharge data for that purpose. Interviews were organized around the following topic areas, selected either because they represented a pervasive use of discharge data or appeared to hold potential for demonstrating value:

1. injury / disease surveillance;
2. public reporting of data for quality improvement and informed purchasing;
3. public health planning;
4. legislation and policy development;
5. commercial applications; and
6. other unique applications that seemed particularly intriguing or potentially valuable.

Possible respondents were identified for each topic area, then contacted by NORC and NAHDO project staff to assess their willingness to participate in an interview. Frequently, these contacts referred us to other people thought to be better suited to answer our questions. Once reaching the appropriate person, staff also asked for any written background materials that could be provided in advance of the interview to assist in preparation. In some instances, either this initial conversation or the review of written materials revealed that the application did not, in fact, merit further investigation via a full interview. For example, we sometimes learned that the discharge data were used only tangentially or not at all, or that the planned study had never been funded or was still at too early a stage to have generated products of value or lessons on database strengths and weaknesses. In the end, we completed interviews with 23 key informants, representing a mix of data users and developers (see Appendix C). A list of the type of questions asked during the interview is presented in Appendix D; these questions were tailored for each interview based on information we had gathered about the use prior to the interview.

In the remaining chapters of this report, we first provide an overview of the ways hospital discharge data are being used, complete with many examples from the literature and selected states. Chapter 3 includes a discussion of the strengths of hospital discharge databases, and describes some of their shortcomings. In the final section, we close with some thoughts on how hospital databases might be made more valuable in the future and how statewide data organizations may be able to make better use of the data currently available to them.

2. Uses of Hospital Discharge Data

Information gathered from the literature review and interviews with key informants suggests that inpatient discharge data are used in a remarkably wide range of applications. At the most basic level, these applications are rooted in simple analyses of utilization and inpatient treatment patterns, such as documenting mean charges by DRG or differences in inpatient care by patient characteristics. At a more advanced level, these applications require the development of complex data systems, often integrating discharge data with data from other health and non-health programs, and use of advanced statistical methods such as for risk adjustment.

To some extent, the range in sophistication in the ways discharge data are used mirrors the level of development of the state data organizations. Organizations that are in the early stages of database development are generally focused on collecting and compiling the data and producing basic utilization statistics. These statistics and analytic capabilities are the building blocks on which future applications are built. Once the basic profiles and capabilities are developed, the agency can progress to more sophisticated applications, including web-based data dissemination of utilization statistics, population-based studies, and risk-adjusted outcomes studies.

Classification of the wide-ranging database applications into a meaningful typology is complicated because of the high degree of overlap between the database uses that we identified. Depending on the variables studied and the way results are used, any number of groupings is possible. For instance, applications that use discharge data to study outcomes of care could be considered as either a "quality assessment / improvement" or a "patient safety" initiative. Or, if the outcomes data are publicly reported so as to aid consumers' decisions about selecting providers, the same analysis of outcomes statistics could also fit under a heading such as "informed purchasing." Of course, an informed purchasing category would also include applications that report measures other than health care outcomes – such as patient volume or charges.

Despite this challenge of classifying data uses, we have organized our discussion of data applications around several broad topical headings:

- public safety and injury surveillance and prevention;
- public health, disease surveillance and disease registries;
- public health planning and community assessments;
- public reporting for informed purchasing and comparative reports;
- quality assessment and performance improvement;
- health services and health policy research applications;
- private sector and commercial applications; and

- informing policy deliberations and legislation.

These topical headings are not intended to serve as a formal typology of uses. Rather, in organizing our findings, we attempted to capture the most prevalent uses of discharge data that we identified and to group similar types of applications, recognizing that many of the applications could have easily been presented under a different heading. For each topic, we provide specific examples drawn from the literature and interviews. These examples are intended to be representative of the uses we found, not a comprehensive enumeration of all identified uses. (Interested readers can access the electronic database to find still other examples of database uses.)

Public Safety and Injury Surveillance and Prevention

Our analysis indicated that hospital discharge data are routinely used to address issues of public safety, including injury surveillance and prevention.[2] We found many examples where discharge data have been used to track rates of injury and associated costs of injuries, as well as to provide data to assist in development of injury prevention programs.

- In North Carolina, hospital data are being used to track rates of suicides and suicide attempts (North Carolina Department of Health and Human Services, 2004).

- Rhode Island has examined rates of hospitalization for spinal cord injury, including the demographic characteristics of spinal cord injured patients and their discharge dispositions (Rhode Island Department of Health, 2000).

- In Colorado, discharge data have been used to document the underreporting of injuries related to lightning strikes (Lopez et al., 1993).

- The Massachusetts Injury Surveillance Program monitors the incidence and risk factors associated with injuries resulting from weapons, falls, drowning, and motor vehicle accidents (Massachusetts Department of Health, 2003).

- Numerous states have used inpatient discharge data as part of their Crash Outcomes Data Evaluation System (CODES), which is used to monitor injuries from motor vehicle crashes (see Case Study 1 for more information).

Public Health, Disease Surveillance and Disease Registries

Hospital discharge data provide critical information for a variety of public health uses, including disease surveillance, bur-

[2] It is important to note that while inpatient discharge data are a valuable resource in the surveillance of non-fatal injuries that result in a hospitalization, surveillance of fatal injuries is typically performed with death records.

Case Study 1. The Crash Outcomes Data Evaluation System (CODES)

Initially funded by the Intermodal Transportation and Efficiency Act, the CODES project was designed to assess the effectiveness of seat belt and motorcycle helmet use on medical outcomes and economic costs. With funding from the National Highway Traffic Safety Administration, states participating in CODES link motor vehicle accident data with health care utilization data in order to address a variety of questions related to motor vehicle safety. Hospital discharge data are but one of the files that are used to assess accident victims' use of health services; others include emergency department data, ambulance run records, and post-acute health care data. As patient-identifying information contained in these multiple sources is not uniformly collected or may frequently be missing and inaccurate, probabilistic matching is used to link data. Studies using the CODES data have examined a range of issues, including motor vehicle related traumatic brain injuries, crashes involving elderly or young drivers, and automobile-related hospitalizations among uninsured persons. CODES data also have been used to support the enactment of automobile injury prevention and control legislation (e.g., mandatory seatbelt laws and motorcycle helmet laws) and to evaluate the effectiveness of this legislation.

den of illness studies, environmental monitoring, and public health reporting. Passive approaches to disease surveillance, such as those that rely on physician reporting, have been criticized because it is believed that providers tend to underreport the occurrence or presence of a condition (Backer, 2001). Hospital discharge data are particularly useful for surveillance of conditions that always or frequently result in hospitalization and, because of the large number of persons represented in the data, for monitoring conditions that are rare.

- The Vermont Department of Health, for example, used the uniform state hospital discharge database to estimate the incidence of Guillain-Barré syndrome, a relatively rare neurological disorder (Koobatian et al., 1991).
- In Massachusetts, hospital discharge data also played an important role in the epidemiological investigation of the tularemia outbreak that occurred on Martha's Vineyard in 2000 (personal communication with Judy Parlato, Massachusetts Center for Health Information, Statistics, and Research, April 27, 2004).

Chronic disease prevention and control programs measure the burden of chronic disease on a population and assist in planning for and monitoring the effectiveness of chronic disease interventions.

- As one example, with the goal of reducing the burden of cardiovascular disease (CVD) in the state, the New York State Department of Health (2004) compiled a report that esti-

mates CVD hospitalization rates and costs, in addition to statistics on the prevalence of and mortality rate from CVD.

- Georgia also used its discharge data to examine the prevalence of and conduct epidemiological studies on arthritis in the state. Results are being used to increase awareness of arthritis and to develop a state action plan to reduce the burden of this disease in the state (Arthritis Foundation and the Georgia Department of Human Resources, 2002).

More broadly, the discharge data are commonly used to estimate the financial burden of specific illnesses or conditions. Many states have conducted these types of studies, and the HCUP family of databases has been used to conduct national-level studies. For example:

- As part of its efforts to track private and public spending on mental health and substance abuse services, the Substance Abuse and Mental Health Services Administration uses data from the NIS to estimate differences in spending for substance abuse and mental health services vs. spending for all other medical conditions (SAMHSA, 2005).

- The March of Dimes has used NIS data to estimate the costs of premature births as part of its national Prematurity Campaign (March of Dimes, 2003).

Another area in which hospital discharge data have proven of value is in monitoring or tracking the effects of environmental conditions on health. For instance, as one component of a more comprehensive surveillance system, some states have linked air quality data from the Environmental Protection Agency to hospital discharge data (using geographic identifiers and date of admission) to assess the impact of poor air quality on inpatient admissions for asthma (Trust for America's Health, 2001). The types of questions that these data may be used to address include:

- How do asthma hospitalization rates and costs compare in areas with good vs. poor air quality?

- How does air quality affect asthma morbidity in the state or region?

- Do clean air standards affect rates of asthma hospitalization and costs?

Case Study 2 showcases an innovative example of a study that incorporated data from a multitude of sources to examine how traffic abatement procedures adopted during the 1996 Olympics affected asthma hospitalizations and ED visits among children in the Atlanta area.

Several informants indicated that they were using hospital discharge data as a source of information for their public health reporting systems. The demographic, clinical, and charge information

Case Study 2. Studying the Effects of Vehicle Exhaust and Air Quality on Childhood Asthma: The 1996 Summer Olympics

During the 1996 Summer Olympics, the city of Atlanta implemented a variety of strategies to reduce traffic congestion and assist attendees in getting to the many different venues, including expanding operating hours for public transportation systems, imposing restrictions on vehicular traffic, and encouraging flex time and telecommuting. These traffic reduction activities presented epidemiologists at the CDC with an ideal opportunity to conduct an ecological study of the effect of air quality on asthma morbidity in children (Friedman et al., 2001).

The Georgia Hospital Association Discharge Database was used to measure the number of asthma hospitalizations that occurred in the metropolitan area for the 4 weeks before and after the Olympics as well during the Games. Medicaid claims, HMO data, and records from selected pediatric hospitals were used to determine whether an asthma-related emergency or urgent care visit occurred. This information on utilization was combined with asthma morbidity data, air pollutant and meteorological data; traffic count data; public transportation ridership data; and information on statewide gasoline sales to create a profile of environmental conditions before, during, and after the Olympics.

routinely collected in discharge data can fill gaps in the data collected in disease registries. For example:

- Iowa hospital discharge data have been linked to tumor registry data from the Surveillance, Epidemiology and End Results (SEER) program in order to obtain supplemental information on cancer patients' comorbidities and insurance status (Brooks et al., 2000).

- Connecticut hospital discharge data were linked to data from the state Cancer Tumor Registry in order to obtain an estimate of cancer-related charges (Polednak and Shevchenko, 1998).

The extent to which discharge data are able to supplement or serve as the basis of a registry system depends largely on whether the reportable condition results in hospitalization. Discharge data may be of particular use for registries related to severe trauma. Having a reliable and efficient means of identifying specific types of patients can not only facilitate reporting to registries but can also permit a state to reach out to these populations with the goal of providing better services to them. For example, both South Carolina and Georgia are using discharge data to identify persons with traumatic brain and spinal cord injury (TBI/SCI) and are conducting outreach to these populations (see Case Study 3).

Just as hospitals use the discharge data to satisfy requirements to report to state disease registries, states use the discharge data to meet federal program reporting requirements. Among examples cited by

Case Study 3. Using Discharge Data to Identify Specific Populations and Conduct Outreach

The state of Georgia is currently in the process of migrating from a system where hospitals were supposed to file manual reports with a central registry for each inpatient with a traumatic brain or spinal cord injury (yet often failed to do so) to a system where such reporting is automatically fulfilled via the submission of discharge data. In addition, the central registry function has been moved from the state's Division of Rehabilitation Services to a state agency called the Brain and Spinal Injury Trust Fund Commission. The Georgia Hospital Association will provide inpatient data on TBI/SCI patients to the Commission, along with information from hospital emergency departments (ED) and hospital-based ambulatory surgery facilities. The inclusion of ED data, in particular, is important for identifying TBI patients because a portion of these patients are never seen in the inpatient setting.

This Commission is financed through a surcharge on DUI fines, and makes awards to TBI/SCI patients who have applied for funds for uses such as the purchase of assistive technology and home modifications, rehabilitation and training, and recreation. Once the Commission begins receiving information on TBI/SCI patients, it will be able to "market" its services to these patients with the goal of increasing the number of people who can be helped by receipt of these funds. Previously, no outreach has been conducted, and patients learned of the availability of these funds only by word of mouth. In addition, the Commission will inform patients about the range of other state and private resources that are available to assist in their care and rehabilitation, including Medicaid Waiver programs, vocational rehabilitation programs, community services, and organizations such as the Brain Injury Resource Foundation. The Commission will also use the data on TBI/SCI patients for descriptive analyses and to plan for future activities (personal communication with Kristen Vincent, Brain and Spinal Injury Trust Fund Commission September 14, 2004).

South Carolina also uses its inpatient discharge and ED databases to identify TBI patients. Several agencies within the state, working in conjunction with a state medical school, have used this identification mechanism as the basis for a "TBI Follow-Back Study" that is funded by the Centers for Disease Control and Prevention. A sample of patients from the identified population are contacted for study participation, and consenting patients are followed for three years through annual telephone surveys, medical record abstraction, and linkages with data from a wide array of other state agencies (made possible by South Carolina's unique statewide data system). The study is designed to track what happens to TBI patients, including the degree to which and at what point following their injury they access the services of various state agencies. Answers to these questions are used to improve the services provided by the state to TBI patients (personal communication with Mary Tyrell, South Carolina Office of Research and Statistics, October 14, 2004). State funding for TBI services and resource planning has increased steadily as study results have become available, including a large number of community grants aimed at prevention of traumatic brain and spinal cord injury. Additionally, the strength of this research has garnered continued extramural funding for the state (Tyrell, 2004).

several study informants, states routinely use their inpatient discharge data to meet the reporting requirements of the Maternal and Child Health (MCH) Block Grants program, which requires states to develop a major needs assessment report every five years. For example:

- Washington state uses its hospital discharge database to compute rates of hospitalizations for asthma and nonfatal injuries among children for the health status indicators portion of the needs assessment report, and updates these rates annually to track performance and outcomes (Washington State Department of Health, 2003).

- New Jersey uses its state discharge database to monitor maternal and child health status as a core function of their MCH Epidemiology Program. Their MCH indicators are consistent with federal requirements for standard performance measures in the MCH Block Grant (MCH Epidemiology Program, 2004).

Public Health Planning and Community Assessments

The inpatient discharge data are also an important source of information for public health planning and community health needs assessments. Included within this heading are applications such as evaluating progress in meeting *Healthy People 2010* goals; assessing the potential impact of hospital conversions, mergers, and closures; and planning for future needs regarding trauma systems, hospital beds, or other types of health care resources.[3] Although some applications rely exclusively on inpatient data, more robust planning and assessment applications incorporate a wealth of data from other health care settings (especially emergency departments and outpatient settings) as well as other indicators related to health (e.g., vital statistics, behavioral risk factors, morbidity information, availability of health resources, environmental statistics, and socioeconomic characteristics).

A number of states are currently using hospital discharge data as one component of much larger community health assessment systems that include these other types of indicators as well. These systems use the discharge data to determine the number of hospitalizations in a given geographic area for particular conditions or populations and, when combined with information on area population, to compute hospitalization rates. For example:

- Washington state offers a downloadable software package (VistaPHw) that uses the state's discharge files to produce customized counts of hospitalizations and hospitalization rates

[3] Individual hospitals may also use the discharge data for market analyses and strategic planning; these applications are discussed below under the "Private-Sector and Commercial Applications" heading.

by diagnosis, diagnosis severity, and cause of injury for regions, zip codes and census tracts in the state (Washington State Department of Health, 2004).

- North Carolina produces a County Health Data Book that draws upon discharge data and many other sources to compile statistics that can be used for community health assessments; all data can be downloaded electronically, as well (North Carolina Department of Health and Human Services, 2003). Inpatient utilization and charges are shown for a variety of diagnoses, along with hospitalization rates.

- Missouri's Community Data Profiles provide data on 15 to 30 indicators, including hospitalizations (Missouri Department of Health and Senior Services, 2000). These on-line profiles compare each community to the state as a whole, and highlight indicators for which the community deviates significantly from the state average. Each table is cross-linked with resource pages that provide more information about the indicator, possible intervention strategies, available community and state resources, and published reports on the issue. There is also a "Leading Problems" profile that identifies the issues that are most pressing for the community.

- New Hampshire has produced a series of community assessment reports that include statistics on hospitalizations for particular diagnoses and ambulatory care sensitive conditions for each of the state's hospital service areas (New Hampshire Department of Health and Human Services, 1999).

Case Study 4. Use of Discharge Data for Community Health Assessments

The Florida Department of Health provides web-based access to the Community Health Assessment Resource Tool Set (CHARTS), which can be used to derive the number and rates of hospitalizations in each county and for the state for several chronic conditions (Florida Department of Health, 2004). The data can be displayed for specific years or averaged over several years, and graphs can be created to show temporal trends for a given county compared to the state. Users can also produce a map of all counties in the state, showing the differences among counties at a glance. Illustrative output compiled from the CHARTS website is presented in Figure 2.1.

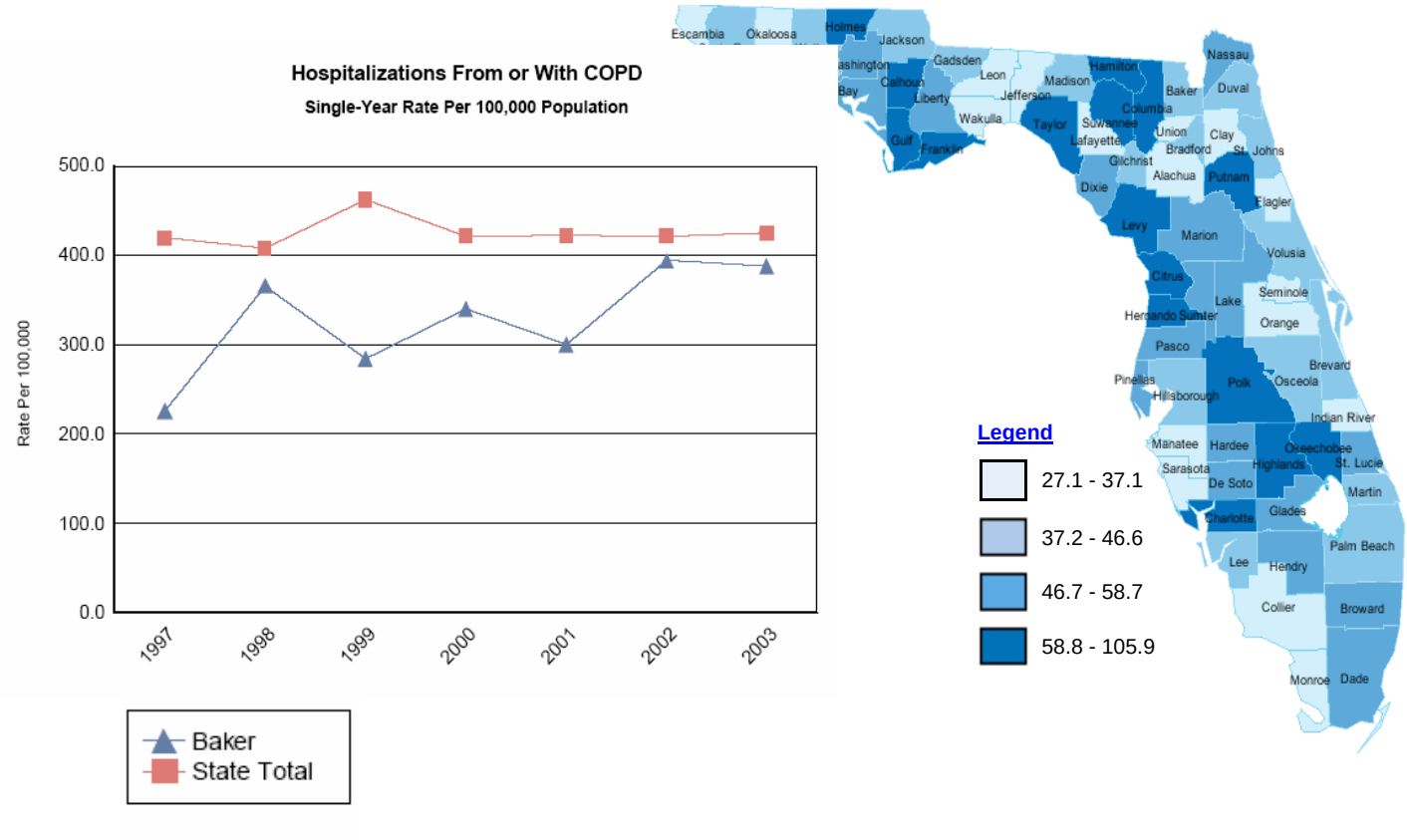
States and other localities occasionally have the need to assess the likely impact of changes to the existing hospital infrastructure in their jurisdiction. These infrastructure changes might be related to the conversion of a non-profit hospital to for-profit status, to the acquisition of one hospital by another competing hospital, or to the closure of a facility. In the case of hospital conversions, for example, states typically are concerned about whether populations that had been

Figure 2.1 Sample Reports from Florida's CHARTS

Hospitalizations From or With COPD

Rolling Three Year Rates for All Races All Sexes

	Average Number of Hospitalizations			Average Number of Total Population			Rate Per 100,000		
County	**1999-2001**	**2000-2002**	**2001-2003**	**1999-2001**	**2000-2002**	**2001-2003**	**1999-2001**	**2000-2002**	**2001-2003**
State Total	69,802	69,212	70,932	16,055,599	16,419,798	16,782,899	434.7	421.5	422.6
Alachua	626	622	639	218,994	224,387	228,677	286	277.2	279.3
Baker	68	78	83	22,176	22,711	23,073	308.1	344.9	361.2
Bay	809	835	847	148,838	150,753	152,993	543.5	553.9	553.8
Bradford	97	101	110	26,004	26,298	26,623	374.3	385.3	411.9
Brevard	1,994	2,000	2,064	478,396	487,700	498,394	416.8	410.2	414.1
Broward	6,894	6,907	7,295	1,625,576	1,653,447	1,678,419	424.1	417.8	434.6
Calhoun	73	80	83	13,001	13,142	13,293	561.5	608.8	626.9
Charlotte	822	844	854	142,290	145,775	149,277	577.7	578.7	572.3
Citrus	826	825	806	118,658	121,157	123,752	695.8	680.7	651.6
Clay	405	397	400	140,950	145,746	151,077	287.6	272.6	264.8
Collier	595	620	650	254,870	267,784	281,543	233.6	231.5	231



Case Study 5. Analyses Related to a Hospital Conversion to For-Profit Status

In an example from Connecticut related to a hospital's proposed conversion to for-profit status, the state's hospital discharge data were used to develop a detailed profile of the inpatient care that had been provided to residents of the hospital's market area in prior years. This analysis included services provided by the hospital in question, as well as services that area residents had obtained from hospitals outside their home community. This information was used as the baseline in determining what services needed to remain available if conversion was permitted. Important features of this work were a focus on care provided to Medicaid and uninsured patients, and an analysis of where residents would have to go for certain types of services if they were no longer available locally. Based on this work, the state permitted the conversion but imposed several conditions designed to ensure that low-income and other residents continued to have convenient and affordable access to the services they had enjoyed in the past. The hospital discharge data will be helpful in the future for monitoring this hospital's compliance with these requirements (personal communication with Susan Cole, Connecticut Office of Health Care Access, October 15, 2004).

served by the non-profit hospital will continue to be served by a for-profit facility, and what options patients have if they must seek services from alternative hospitals. (See Case Study 5 for an example of this type of application.) Similar access questions arise when a hospital is facing closure, particularly if it is a "safety net" facility that serves a large number of low income or uninsured patients. Antitrust considerations and preservation of non-profit assets may also come into play when competing hospitals combine forces, either through acquisitions or mergers.

Hospital discharge data can be used to identify services that are lacking in a community, and to plan for better future allocation of resources. Case Study 6 describes one such application that enabled a Colorado community to expand the medical services available locally to area residents. Case Study 7 relates how hospital discharge data have been used to plan for acute-care bed needs on Maui. In a third example, we found a metropolitan area that used its state's CODES database (incorporating inpatient data, ED data, and police reports on motor vehicle accidents) to identify all crashes resulting in an inpatient stay or otherwise identified with a serious injury via an injury scoring system in the police report. Records for these accidents were geocoded and mapped to the nearest intersection to depict the locations where quick response by emergency medical personnel was frequently needed. This map was overlaid with a map showing the location and staffing of EMS stations. The juxtaposition of these two sets of information revealed clearly that the stations were often not located near the

Case Study 6. Improving Local Access to Care through a Community Needs Assessment

Commerce City is an industrialized area near Denver, Colorado with no local hospital and only one outpatient clinic. Although traditionally lower-income with a large Hispanic population, the city has experienced a rapid transformation in recent years due to its proximity to the new Denver international airport. Concerned about anecdotal reports of poor local access to health care, the city was considering a public investment to open an urgent-care clinic or wellness center. To inform this decision, the city used Colorado's inpatient and outpatient databases to document which types of services city residents received locally and which were received outside of the community. A critical component of this work was an examination of these patterns of care by the patient's expected payer. In contrast to the conventional wisdom about this area's population, the analyses revealed that the majority of area residents had third-party insurance. The analyses also identified particular types of outpatient services for which patients were traveling out of the area, as well as the nearby hospitals that were serving the largest numbers of patients from the area.

The city approached these hospitals with the data on identified needs and insurance status to assess their interest in providing services in Commerce City. A large Denver hospital is now working with Commerce City to establish a comprehensive outpatient clinic in the city, and the clinic will focus on providing services that were identified as needed by area residents, including occupational health and maternal and child health services. In the end, this success story was made possible by the strength and accessibility of the data and by the fact that information was available for the entire patient population not just through the anecdotal evidence from small surveys and focus groups that had previously been used to inform city leaders about health care access (personal communication with Carla King, private consultant, September 14, 2004).

critical response intersections, due in large part to recent growth of new subdivisions and roads built without attention to EMS needs. These maps were presented to city officials, along with recommendations for redistributing existing EMS resources and adding new stations and staff. The city eventually adopted the recommended changes to its EMS resources.

In all of these examples of health planning, our contacts indicated that the richness of the patient-level discharge data – with its information on diagnoses, procedures, and patient characteristics – provided the details they needed to explore inpatient utilization patterns in depth. If these data had not been available, they would have had to use very aggregate utilization statistics collected through hospital financial reports (e.g., total number of days of care provided in surgical vs. medical beds), and would have had only a cursory understanding of the care being provided by the hospital. All contacts also indicated that supplementing the inpatient information with data from outpatient settings and emergency departments provides an even more complete picture of the area's health care use.

Public Reporting for Informed Purchasing and Comparative Reports

As a way to assist consumers and purchasers to make informed purchasing

Case Study 7. Planning for Hospital Bed Needs

The island of Maui, in Hawaii, has only one large acute-care hospital, and it typically operates at full capacity, leaving little flexibility for dealing with unexpected events. Community planners wanted to understand the forces that were driving this high use of inpatient resources, and to plan for the future bed needs of the island's growing population. The study's research team used 8 years of the Hawaii inpatient discharge data to document utilization trends and to build an econometric model to explain and predict bed use. Representatives of the hospital, the local physicians, the area's largest health plan, a citizens' association, and the mayor's office served on a study advisory panel and identified a number of structural influences that needed to be considered in the modeling. For example, the hospital was able to flag inpatients whose discharge had been delayed because they were awaiting a long-term care placement, so that their utilization patterns could be analyzed separately and the number of acute-care beds that were being used unnecessarily for these patients could be computed.

The team also was able to document the much longer inpatient stays for patients who had a certain drug-resistant staph infection, and to explore issues related to residents seeking services off the island—largely explained by the lack of particular types of specialties and facilities on Maui. Other weaknesses in the local primary care system were identified by examining the high number of admissions for ambulatory care sensitive conditions, and the high proportion of patients who are admitted through the ED. The combined weight of this evidence suggested areas for future improvements in the local health care system, and planners were able to account for many of these factors in their projections of future bed needs (personal communication with Susan Forbes, Hawaii Health Information Corporation, September 21, 2004; Hawaii Health Information Corporation, 2004).

decisions, public- and private-sector organizations have developed a variety of tools that use discharge data to profile hospital performance. Key features of these types of applications are that the data are publicly reported, information is presented for individual hospitals, and the reported measures may capture utilization and charge information as well as quality and outcomes. At the most basic level, these tools consist of tables, reports, or consumer brochures that compare hospitals in terms of volume, utilization, or charges. In some instances, this information is also available through web-based query systems that allow users to generate more customized reports from the available data. For example:

- Indiana has produced a series of tables showing charges and length of stay (LOS), by hospital and by hospital peer groups, for selected categories of hospitalization and frequently-performed procedures (Feldman et al., 1998).

- Nevada publishes an annual report, "Personal Health Choices," showing charge and LOS data by hospital for major DRGs (Nevada State Health Division, 2003).

- Illinois (Illinois Health Care Cost Containment Council, 2000), Utah (Utah Department of Health, 2004) Virginia (Virginia Health Information,

1998), and Washington (Washington State Department of Health, 2001) have all produced documents showing each hospital's average charge and other statistics for various types of childbirth stays, intended to help expectant parents select a hospital.

- Missouri reports hospital- and surgeon-specific volumes for selected surgical procedures, and measures each against volume thresholds shown in the literature to be associated with better outcomes (Missouri Department of Health and Senior Services, 2002).

At a more sophisticated level, these decision tools include measures of quality of care or outcomes (in addition to LOS), and in the best systems these measures are risk adjusted to account for underlying differences in the patient populations served by the hospitals, permitting more legitimate comparisons across providers. Typically, these comparisons along quality dimensions can be accessed through web-based query systems.

- Maryland provides hospital-specific information on risk-adjusted LOS and risk-adjusted readmissions for a long list of conditions, as well as information on each hospital's attainment of certain AHRQ Quality Indicators for pneumonia and heart failure (Maryland Health Care Commission, 2004).

- New Mexico has produced a report showing readmission rates by hospital for gall bladder surgery and pneumonia, marking the first time hospital-specific comparison data have been publicly released in that state (New Mexico Health Policy Commission, 2002).

- Colorado has just released an on-line version of the AHRQ Quality Indicators, severity adjusted by APR-DRGs, by hospital. This release is the first time these measures have been publicly reported on a voluntary basis in this state (Colorado Health and Hospital Association, 2005).

- The Pennsylvania Health Care Cost Containment Commission (PHC4) maintains a path-breaking query system that provides hospital-specific data on 28 conditions (Pennsylvania Health Care Cost Containment Council, 2004). In addition to basic information on volume and charges, the available outcome measures include risk-adjusted LOS, risk-adjusted mortality rates, and risk-adjusted readmission rates for any reason and for complications or infections. PHC4 employs a sophisticated risk-adjustment model that incorporates not only patient-specific clinical information (collected in part from the medical record) but also geographic risk factors such as the area's poverty rate or incidence of cancer. The state

Case Study 8. Hospital-Specific Reporting of Cardiology Outcomes

Virginia maintains a site intended to provide health care consumers with access to hospital-specific volume and risk-adjusted mortality for three categories of cardiac services (Virginia Health Information, 2004). Users can easily create customized reports for the hospitals and cardiac service categories of their choosing. An example of a customized report that focuses on medical cardiology in five hospitals chosen from different areas of the state is shown in Figure 2.2. For ease of interpretation, additional information about each column is available by clicking on the heading text, and the mortality ratio column uses a series of symbols to indicate whether the hospital's actual mortality rate is less than, the same as, or greater than its expected (risk-adjusted) mortality rate. To facilitate comparisons of hospitals performing similar volumes of the services in question, the rows are color coded according to four different volume ranges. Additionally, hospitals were given the opportunity to comment on their results, and users can access the letters from the facilities by clicking on the envelope next to the mortality ratio column. Finally, this site contains links to a variety of other web sites that may provide additional helpful information related to cardiology issues.

also maintains a query system specific to coronary artery bypass graft (CABG) surgery, which can be used to obtain similar performance data for individual hospitals or surgeons (Pennsylvania Health Care Cost Containment Council, 2004).

- The California Hospital Outcomes Program reports quality of care, measured as 30-day mortality rates, for community-acquired pneumonia. On-line access to hospital-specific pneumonia mortality rates is available; data have been risk-adjusted to account for differences in demographic and clinical characteristics (California Office of Statewide Health Planning and Development, 2004).

Many private-sector examples of quality-based consumer decision tools are also available.

- The Alliance for Quality Health Care and the Niagara Health Quality Coalition have developed a web-based query system that uses discharge data from New York state to compare performance on the AHRQ inpatient Quality Indicators (Alliance for Quality Health Care and Niagara Health Quality Coalition, 2004). Reported measures include volume for 7 conditions for which a volume-performance relationship has been demonstrated, risk-adjusted mortality rates for 7 procedures and 6 conditions, and utilization rates for 5 procedures. In addition to these measures, an "honor roll" lists hospitals whose risk-adjusted mortality is substantially lower than the state average.

- The Employer Health Care Alliance, which represents 1,500 companies in

Figure 2.2 Sample Comparison Report on Medical Cardiology Outcomes from the Virginia Health Information Web Site

Cardiology - Medical

Facility Name	Teaching Status	2003 Volume Used	2003 Expected Mortality	2003 Mortality Ratio		2002 Volume Used	2002 Expected Mortality	2002 Mortality Ratio	
Bon Secours-Maryview Medical Center	ACGME	1693	3.64%	◒		1834	2.96%	◒	✉
VCU Health System	COTH	1607	3.89%	○		1914	3.68%	◒	✉
Chesapeake General Hospital	NONE	1290	4.56%	◒		1349	4.07%	◒	
Rappahannock General Hospital	NONE	275	4.33%	●		321	4.35%	◒	
Stonewall Jackson Hospital	NONE	303	3.22%	●	✉	268	2.72%	●	

KEY

Discharge Volume

	Medical	Invasive	Open Heart
	1500+	1000+	1000+
	800 - 1499	250 - 999	500 - 999
	250 - 799	100 - 249	100 - 499
	1 - 249	1 - 99	1 - 99
N/A	0 Discharges	0 Discharges	0 Discharges

Mortality Ratio
- ● - Greater than Expected
- ◒ - As Expected
- ○ - Less than Expected
- ◔ - Too Few to Calculate

✉ - Letter from Facility

Click on underlined column headers for definitions

South-Central Wisconsin, has used the state's inpatient data to rate the safety of hospitals in that region of the state (Consumer Information for Better Health Care, 2000). Each hospital is rated in terms of whether it had more than, fewer than or the expected number of mistakes, complications, and deaths for surgical procedures, non-surgical procedures, hip and knee replacement, cardiac care, and maternity care. The expected performance is based on the performance of hospitals in 12 other states for similar patients.

Quality Assessment and Performance Improvement

When the measures being reported relate to quality and outcomes, many of the applications just discussed in the context of comparative reporting and informed purchasing might also be categorized as initiatives to assess and improve hospital quality. Distinctions can be made, however. Whereas comparative reporting for informed purchasing requires that hospital-specific data be publicly reported for multiple hospitals, similar information on quality measures may be used internally by individual hospitals without public reporting and (less ideally) even without comparison to other facilities. While many hospitals are undoubtedly using the data for this purpose, few accounts are presented in the literature due to the proprietary nature of the work. One exception is an example from the Dayton, Ohio area Hospital Performance Reports Project, which received the 2002 Codman award for achievements in quality improvement. Additional details on this initiative are presented in Case Study 9.

There is also evidence that the public reporting of comparative quality measures derived from the discharge data may serve as a catalyst for quality improvement and as a gauge to assess the impact of quality improvement interventions. For example:

- Bentley and Nash (1998) found that hospitals changed their policies and clinical practices following the release of the Pennsylvania Consumer Guide to Coronary Artery Bypass Graft (CABG) Surgery, a comparative performance report.

- The California Hospital Outcomes Project Report, which compares hospitals on the basis of heart attack outcomes, spurred hospital quality improvement activities that included the development of clinical pathways and improved use of thrombolytic therapy (Rainwater et al., 1998).

Quality assessments and performance improvement initiatives may also be conducted for entire health systems as well as for individual hospitals. A health system performance assessment is conducted to determine how well the interrelated components of the health care infrastructure perform in terms of quality

Case Study 9. Reductions in Mortality as a Result of a Community-Wide Quality Improvement Initiative

Five hospitals in the Dayton, Ohio area, working in collaboration with local physicians and business leaders, pioneered an initiative to improve the quality of the inpatient care provided in the area. In contrast to initiatives based on public reporting of quality data, with their implicit expectation that individuals will be able to make informed decisions when selecting a provider and that these choices will indirectly drive providers to make quality improvements, this project relied on on-going physician peer review of the quality data within a protected environment and direct modifications to provider behavior in response to the evidence.

Key to the success of this project was a robust risk adjustment methodology that was not only transparent to the participating physicians but accepted by them as providing comparable results across hospitals. The large number of diagnosis and procedure fields available in the Ohio Hospital Association's inpatient file supported the development of the necessary model, and physicians had the opportunity to participate in the development of the methodology. Inpatient data were then used to compute hospital-specific risk-adjusted mortality rates (among other variables) for a number of conditions, and these results were shared across hospitals for review by a committee of physicians.

Early review of the quality measures identified specific Dayton hospitals with acute myocardial infarction (AMI) mortality rates that were significantly higher than those achieved by other hospitals in the state treating similar patients. Careful review of the underlying patient data – including additional data elements that had been collected for a separate pilot study on the process of care – identified a direct correlation between the percent of patients with ST segment elevated myocardial infarction (STEMI) who did not receive reperfusion and the hospital's AMI mortality rate. Armed with this information, the project began collecting AMI process of care data from all participating hospitals, and hospitals began modifying their treatment of STEMI patients. Some three years after the project began, the Dayton area hospitals had reduced their risk-adjusted AMI mortality rates by 36 percent, and had moved from being an area of the state with higher-than-expected mortality to an area with mortality rates below those that would be predicted based on their patient mix (Snow et al., 2003).

Plans around public release of the hospital-level data are moving forward. Project leaders are encouraged by the results achieved through this non-punitive peer-review process, and have been pleased with the business community's involvement and support. Correspondingly, they are finalizing the release of aggregate results to the consumer community through printed and web-based venues. This public disclosure will highlight the collaborative process and demonstrate how, through working together, quality can be improved – benefiting all participants in the health care delivery continuum (personal communication with Greg Sample, Greater Dayton Area Hospital Association, January 20, 2005).

and efficiency. One set of measures that is gaining in use for this purpose are rates of hospitalizations for ambulatory care sensitive conditions or ACSCs (e.g., hypertension, diabetes). Estimated with discharge data, ACSC hospitalizations are suggestive of hospitalizations that might have been averted if access to appropriate and timely ambulatory care had been received.

- One example of how ACSC hospitalization rates have been used to monitor health system performance comes from The Safety Net Monitoring Initiative headed by AHRQ and the Health Resources and Services Administration. This work used the 1999 HCUP data to compute preventable hospitalization rates by age for selected metropolitan areas, counties and states, then compared the actual rates with the rate that would have been expected based on the area's income, racial/ethnic composition, and physician practice style. Areas where the actual rate exceeds the predicted rate may be areas of concern regarding inadequate access to ambulatory care. Results were presented in two data books (Billings and Weinick, 2003a and 2003b), as well as via an on-line query tool and a downloadable electronic database.

Several states assess health system performance for selected conditions and procedures using other outcome measures derived from hospital discharge data. For instance:

- Florida reports diabetes outcomes for the state population, including rates of admissions for diabetes with complications (e.g., kidney disease, nerve damage), rates of amputation and discharges to post-acute providers (Florida Department of Health, 2002).

- Rhode Island has compared trends in inpatient mortality following gall bladder removal and surgical complication rates in the state to that of the nation (Muri et al., 2001).

- Since 1997, Vermont has used its hospital discharge data and national discharge statistics derived from the NIS to compare state performance to national benchmarks. Available statistics include trends in hospitalization rates for selected high-volume surgical procedures, and analyses of age-adjusted hospitalization rates by hospital service area to identify areas with utilization rates that are significantly above or below the state average. The state also uses these data to monitor progress in achieving its *Healthy Vermonters 2010* goals, and is planning future analyses related to hospital-acquired infections and the AHRQ Patient Safety Indicators (Vermont Program for Quality in Health Care, Inc., 2004).

Health Services and Health Policy Research Applications

As previously noted, it is difficult to group data applications into a typology because of the extensive overlap across applications. For no category is this truer than for "research applications."

Many of the applications mentioned in this report are based on applied research, where discharge data are used to influence consumer or provider behavior, influence or measure change in a program, and enhance the health and well-being of a population. However, hospital discharge data also are used extensively in basic research, where the goal is to establish a foundation of knowledge in health services or health policy.

Countless studies have used discharge data to examine how systems for organizing, financing and delivering health services affect hospital utilization, costs and outcomes.

- Zwanziger et al. (2000) used California hospital discharge data to examine the effect of market competition on hospital cost growth.

- Angus et al. (1996) used Massachusetts hospital discharge data to study the effect of insurance status and, specifically, enrollment in a managed care plan, on resource consumption in intensive care units (ICUs).

- In one of several studies that examined the relationship between volume and outcomes, researchers at the University of Michigan used NIS data to study the effect of provider volume on outcomes after intra-cranial tumor resection (Cowan et al., 2003).

- Aiken et al. (2003) linked hospital discharge data to data from a nursing survey to assess the relationship between nurses' educational level and surgical outcomes.

An issue that has received increased attention in health services research is health disparities. Typically, disparities studies aim to better understand the relationship between racial or ethnic status and health care utilization and outcomes.

- California hospital discharge data, linked to user data from the Indian Health Services, provided information on hospitalization rates and potentially avoidable hospitalization rates for American Indians and Alaska Natives (Korenbrot et al., 2003).

- Discharge data have also served as the source of information for studies that examined interracial variation in treatments (procedure type); these include treatment of colorectal cancer (Ball and Elixhauser, 1996), cardiac procedures (Hannan et al., 1991; Philbin et al., 2001), and cesarean deliveries (Brooks et al., 2000).

Among the objectives of health policy research is to understand how state and federal policies influence the health care delivery system. In the course of con-

ducting the literature review, we found several examples of how hospital discharge data have been used in health policy research.

- Raube and Merrell (1999) used Illinois state hospital discharge data to study the cost implications of maternal minimum stay legislation, while a 2002 study (Madden et al., 2002) examined the effect of minimum stay laws on utilization and outcomes for newborns.

- A 2002 Florida study conducted by Marquis and Long (2002), linked records from the state hospital discharge database to birth records, Medicaid eligibility and claims files, and health department records to determine how the expansion of a public insurance program would affect access to prenatal care and birth outcomes.

- In their seminal study, Robinson and Luft (1988) evaluated the relative effectiveness of state cost-control policies using discharge data from states that had implemented all-payer rate regulation programs and states that relied on market-based approaches to reduce cost inflation.

In more clinically-oriented research, hospital discharge data have been utilized independently or in combination with other data to investigate a diverse set of issues, including the effect of specific procedures/interventions and the provider practices that produce the best clinical and economic outcomes.

- One example of the use of data in this capacity is a study by Provonost et al. (1999), which examined how ICU processes affect outcomes and resource use. Linking Maryland discharge data to data from a survey of ICU medical directors, these researchers found that in hospitals where the ICU physician did not make daily rounds, rates of mortality and the incidence of cardiac arrest, renal failure, and septicemia were higher than in hospitals where the ICU physician did make daily rounds. Failure to extubate patients in the operating room (information available from the survey) was further found to be associated with higher resource consumption.

The discharge data also offer clinicians insight on the incidence of selected medical conditions and the characteristics of patients with these conditions, as well as patient characteristics that are most predictive of a favorable outcome. Applications illustrating this type of use include studies of:

- cancer incidence among American Indians and Alaska Natives (Nutting et al., 1993);

- the incidence and demographics of patients with cat scratch fever (Jackson et al., 1993);

- differences in toxic mushroom poisoning by age and race (Jacobs et al., 1996); and

- the epidemiological characteristics of children with Kawasaki syndrome in Hawaii and Connecticut (Holman et al., 2000).

Hospital discharge data are an established tool in health services and health policy research and the examples cited above represent only a small number of the studies and types of studies for which discharge data have proven useful.

Private-Sector and Commercial Applications

Private-sector and commercial uses of discharge data add economic and market value to statewide discharge data. These applications range from hospital strategic planning to the development of proprietary tools that supply information for purchasers, providers, and consumers. In some cases, the statewide data organization produces analyses specifically for use by the hospital community, while in other instances the data are purchased by private consulting firms, health care providers, or health information management vendors. When these commercial users purchase the public data sets, it generates product sales revenue that can benefit the statewide data organization. Furthermore, because the industry relies on state data, these commercial users are often an important political constituency for publicly-funded data systems.

One of the most common commercial uses of inpatient discharge data is to generate market share and patient origin reports that can be used for hospital strategic planning. Market competition has always driven the financing, organization, and provision of health services, and competitive bidding and enrollment has become an increasingly integral part of the organization and delivery of care. The market share and patient origin studies provide critical information needed to respond in this environment, and these studies rely almost solely on hospital discharge data. For example:

- The California Office of Statewide Health Planning and Development (2004) makes patient origin and market share data available electronically through two pivot profiles. The Patient Origin pivot profile identifies the zip codes from which patients are drawn for each California hospital. The Market Share pivot profile identifies the hospitals serving patients from a selected zip code or county. In each pivot profile, the user can also select a specific Diagnosis Related Group (DRG), age group, and/or payer category. These Pivot Profiles are currently available for 2000 to 2003.

- The Massachusetts Health Data Consortium (2004) uses its inpatient data to generate a series of three reports that describe: a) patients who remain in their own geographic area for inpatient care; b) patients who migrate out

Case Study 10. Market Share and Patient Origin Reports for Hospital Strategic Planning

The New Hampshire Hospital Association produces an annual market share and patient origin report. The market share table shows data for each town from which any patients in the state's inpatient database have been drawn (including towns in other states) and shows which New Hampshire hospitals treated these patients. The number of days and number of discharges are shown for each hospital serving the town, and the relative importance of the hospital in providing care to the town is computed (e.g., days provided by the hospital divided by the total days of care provided to town residents). Similar information is presented for the prior year, and an annual percent change is also computed. The patient origin portion of the report contains similar information, but is organized by hospital and shows the number of days and discharges provided to residents of each town contributing patients to the hospital. The towns are arrayed in decreasing order of their importance to the hospital's market share, making it easy to determine the markets from which the hospital draws most of its patients (New Hampshire Hospital Association and Foundation for Healthy Communities, 2004).

of their area of residence for hospital care; and c) non-residents who migrate into Massachusetts for care. These reports are available for six health service areas and 23 subareas, and statistics are presented for pediatrics, medical/surgical, obstetrics/maternity, and psychiatric cases separately, as well as by age group.

Other hospital strategic planning applications move beyond the patient origin and market share analyses to a comparison of utilization and outcomes data for the hospital with similar data from peer hospitals or from the state, region, or nation.

- For example, Intermountain Health Care (IHC), a non-profit integrated health system located in Salt Lake City, routinely uses Utah's hospital discharge data along with data from its own system for planning and quality improvement. The statewide data permit IHC to compare its own charges, length of stay, and severity-adjusted outcomes with those measures statewide and in defined market areas. This quality benchmarking assists IHC in evaluating its performance and competing more effectively in its target markets.

Consulting firms, database vendors, and health information companies also make heavy use of the state discharge databases (see Case Study 11). Frequently, these users rely on discharge data from all states that make their data publicly available. For example, CareScience, a Pennsylvania consulting company, uses discharge data to:

- develop liability reduction plans for hospitals, targeting quality problems that result in avoidable claims;

Case Study 11. Use of Discharge Data by Consulting Firms

Consulting and health information management vendors often utilize statewide discharge data to develop analytic tools and products that support client decision making. Milliman, one of the largest independent actuarial consulting firms in the United States, for example, uses hospital discharge data to estimate the Hospital Efficiency Index (HEI), a tool used by hospitals for strategic planning. Derived using statistical/actuarial methodologies, the HEI was designed to allow hospitals to compare their own inpatient data to common benchmarks (i.e., case-mix and severity-adjusted length of stay for the most "efficient" providers) estimated from state or national hospital discharge data. The HEI provides hospitals with insight on potentially avoidable admissions and days.

Providers use the indices for risk or capitation evaluation, long-term strategic planning, profitability analysis, acquisition decisions, identification of most efficient practice facilities, and determination of reasons for avoidable hospitalizations. Purchasers may use the HEI to select or integrate networks, determine hospital efficiency, establish reimbursement strategies, and identify the most efficient facilities (personal communication with Richard Kipp, Milliman, September 23, 2004).

- develop a Patient Risk Assessment Tool that combines discharge with Census data;
- assess the impact of complications and morbidity; and
- identify top-performing hospitals nationally for purposes of contracting.

Commercial users emphasized that access to all-payer, comprehensive discharge data strengthens the market and improves market decisions. Without statewide data, many of the commercial users could not do what they now do. The closest alternative to hospital discharge data is the Medicare claims database, but these data do not include populations of interest to most commercial purchasers and market analysts.

In states where discharge data are publicly available and widely used in the private market, there were demonstrated benefits, including stronger price competition in the market area, community-wide and hospital-specific quality improvement initiatives, and more aggressive purchaser negotiations. A few respondents also cited the hospital errors avoided as a result of hospital benchmarking and quality improvement programs, which rely on state hospital databases.

Informing Policy Deliberations and Legislation

In theory, the hospital discharge data hold the potential to be of great value for informing policy decisions and legislation, and evidence of this value would seem to be particularly compelling in arguments to state legislatures when state data organizations face their periodic reauthorizations. Indeed, as we collected

leads during the initial stages of the project, we heard of many potential examples where the hospital data had supported legislation. These examples included legislation around issues such as primary enforcement of seat belt use and child restraints, mandatory motorcycle helmet use, Medicaid presumptive eligibility, specialty (or "niche") hospitals, no-fault vs. tort auto insurance, minimum hospital stays for childbirth, and mandatory coverage for specific types of services (e.g., diabetic supplies) or specific types of patients (e.g., uninsured).

As we began to follow up on these leads, however, and contact potential key informants, we were often unable to attribute legislative debate or action to the information available from the inpatient discharge data. In some instances, the difficulty in making this link was a matter of poor timing. Most state laws about seat belt use or minimum maternity stays, in particular, were passed many years ago. While we believe the hospital discharge data were probably informative for these issues, no contacts with direct knowledge of the situation were available for interviews. In other instances, however, the inability to attribute legislative successes to the availability of hospital discharge data was due to a combination of other factors:

- our sources were mistaken regarding the use of discharge data (for example, the analyses used hospital cost reports or Medicaid claims, not discharge data);
- the discharge data were used for analyses that might have informed the debate, but the results were not as expected and the information was never put forward for consideration (this situation arose most often when state hospital associations were using the data to advocate for or protect the interests of their members);
- the discharge data were used, but the key informant had only conducted the analyses and was unable to comment on if or how the findings were used by legislators (this situation arose most often when state employees were responding to legislative requests for information);
- the discharge data were used, but were only a tangential part of the evidence used in the deliberations or were not well-suited to the task at hand; or
- information derived from the discharge database was submitted for consideration in the debate and could have been helpful, but was largely ignored – due either to political realities or to failure to present the information in a way that could be easily assimilated by legislators.

Despite the difficulty in directly linking inpatient discharge data to legislation, we did find several examples of how discharge data might be used for legislative and policy decisions that merit discussion here.

Case Study 12. Using Hospital Data to Inform Legislation

Over the past few years, some Connecticut hospitals had been turning away transfers of NICU patients. Although the hospitals claimed that this was occurring because they had no NICU beds available, there were concerns that these decisions were being made because the infants were on Medicaid or were uninsured. The state legislature began considering legislation to require hospitals to accept NICU transfers regardless of insurance status, and the state's Office of Health Care Access (OHCA) was asked to provide data to inform these deliberations. OHCA used discharge data from Connecticut and New York, along with information on the number of NICU beds in each state, to examine the prevalence of births with complications and low-weight births and to compute NICU occupancy rates for each type of birth. Information on payer was used to determine the percent of these cases that were covered by Medicaid. New York data were used for comparison purposes because that state already had a law similar to the one being considered in Connecticut. Results of the analysis showed that although birth rates and rates of complications were similar in the two states, Connecticut had a higher proportion of low-weight births. NICU occupancy rates were much higher in Connecticut than in New York, even exceeding 100 percent. Furthermore, the proportion of complicated and low-weight births covered by Medicaid was three times higher in Connecticut than in New York. Thus, Connecticut hospitals seemed to be turning away NICU patients because of capacity constraints rather than due to Medicaid status. Based on this information, the state legislature withdrew its proposal to require acceptance of all NICU transfers (personal communication with Olga Armah, Connecticut Office of Health Care Access, October 15, 2004).

- As described further in Case Study 12, Connecticut combined its own state discharge database with similar information from New York to demonstrate to its state legislature that a bill that would have mandated acceptance of all NICU transfers was unnecessary.

- Hawaii maintains a web-based mapping system that allows users to map hospitalization rates for a number of important conditions by the state's House and Senate districts (Hawaii Health Information Corporation, 2004).

- In a project in California, the state's discharge data are one of many sources of information being used to quantify a diverse set of environmental indicators, including asthma hospitalization rates, for a neighborhood in Oakland. The intent of this novel project is to provide local residents with the solid evidence they need to advocate for improvements to their neighborhood, and a key part of the project is to provide training and support to community activists in how to use the facts derived from these various databases to affect change in their neighborhood. The project has already succeeded in forcing the closure of a local factory that was responsible for large amounts of toxic emissions (Costa et al., 2002),

and it is possible that the evidence will be used to advocate for the re-routing of diesel trucks away from the neighborhood (personal communication with Michael Kassis, California Office of Statewide Health Planning and Development, April 27, 2004).

- Coben et al. (2004) used HCUP data to examine hospitalizations for motorcycle accident injuries, and to document the higher incidence and associated costs of head injuries in states without motorcycle helmet laws. This research recently led West Virginia legislators to drop a bill that would have rescinded the state's helmet law.

More traditional health services research studies can also speak to policy issues, as already described above. In many cases, these studies have used discharge data to evaluate the impact of policy decisions that have already been made (e.g., Raube and Merrell, 1999; Madden, 2002; Long and Marquis, 1998; Marquis and Long 2002; Volpp et al., 2003) or to determine whether the legislation was necessary (Edmonson et al., 1997). Others, however, have tried to anticipate policy decisions, or have considered whether a law passed by one state should be adopted on a wider basis.

- In the midst of Oregon's debate over health care rationing, Fisher et al. (1992) used the discharge data to document geographic variation in rates of use for discretionary medical admissions and to propose an alternative rationing method based on setting ceiling use rates for each hospital service area.

- In reaction to a California law mandating minimum nurse staffing ratios, Aiken et al. (2002) linked hospital discharge data from Pennsylvania with data from a large survey of nurses to examine the relationship between nurse staffing ratios and patient outcomes and nurse retention.

3. Lessons Learned Regarding the Uses of Hospital Discharge Data

Our review of the literature and interviews with key informants provided us with insight as to why hospital discharge data may be better suited for many applications than other data sources, as well as with insight into the limitations of these data. This chapter draws upon findings from this study to describe both the strengths and limitations of hospital discharge data.

Strengths of Hospital Discharge Data

As described in Chapter 2, hospital discharge data are incorporated into a wide range of applications. Discharge databases are not, however, the only source of data that can be used to obtain the information required in these diverse applications. Claims data derived from payers, survey data, medical record abstraction, and other databases developed using primary data collection techniques may provide information that parallels that contained in most discharge databases. In fact, several of our key informants indicated that the specific application for which discharge data were used could still have been accomplished with other data. However, the availability of hospital discharge data did greatly facilitate the process.

Costs of Discharge Data

Several of the data users interviewed indicated that if they did not have access to hospital discharge data, they would have been required to undertake primary data collection to address the specific issue in which they were interested. In one interview, an injury epidemiologist stated that in the absence of discharge data the public health department would have monitored injuries by requesting that hospitals submit the names and contact information for all individuals who suffered a specific type of injury. To obtain additional epidemiological information, the public health department would then select a sample of this population for further medical record abstraction. In fact, the information necessary to conduct injury and disease surveillance (as well as other applications) is available and may be compiled through alternative means, including medical record abstraction, physician reports (passive surveillance), death records, and surveys. However, since data are computerized and already collected for other purposes (e.g., billing), discharge databases offer an important cost advantage for monitoring conditions in which hospitalizations are a typical occurrence and death infrequently occurs. The costs of data collection are a particularly important consideration in monitoring trends, since annual data collection is time-consuming and costs may be prohibitive.

Accuracy and Completeness of Data

In some applications, data in hospital discharge databases have been found to be more reliable than data identified from other sources. As an example, Koobatian et al. (1991) found that in monitor-

ing Guillain-Barré syndrome, a rare neurological condition, incidence rates determined from computerized discharge data were more accurate than rates determined from physician reports (i.e., passive reporting). In another study, Windau et al. (1991) concluded that hospital discharge data often capture cases that are missed by employment-based reporting systems and could therefore be used effectively for surveillance of well-recognized occupational conditions.

For many applications, discharge data may be more accurate and reliable than survey data. Information on diagnoses and procedures, for instance, are obtained directly from providers. As such, these data elements are typically unaffected by recall bias and may therefore be of higher quality than comparable data obtained from household self-reported survey data (Machlin et al., 2000). Compared to the National Hospital Discharge Survey or other survey-based discharge datasets the populations included in hospital discharge datasets are large. For this reason, analyses of rare populations or conditions and for small areas are likely to be more accurate than analyses conducted with survey data.

Representativeness and Inclusiveness

Whereas the validity and generalizability of survey results are dependent on whether the sample is representative of the population, most discharge datasets record hospitalizations for the entire population. Concerns about whether the sample is representative of the population as a whole or the validity of results are therefore mitigated.

On a related note, some health plans use hospital discharge data to develop quality reports, which are distributed to members as a tool to assist them in selecting hospitals. Although health plans routinely collect and analyze plan members' inpatient experiences using claims, discharge data may be a preferable source of information for quality reporting since claims often contain records only for plan members and contracted hospitals. State discharge data systems offer plans an opportunity to gauge hospitals' performance in treating all patients, and allow the organization an opportunity to compare performance of contracted and non-contracted providers.

Range of Data Elements and Data Linkages

State discharge datasets typically contain information on patient demographics (age, sex, zip code), clinical characteristics (diagnoses, procedures, source of admission, discharge status), utilization (length of stay), financial characteristics (primary and secondary payers, charges) and facility identifiers. The impressive range of applications described in Chapter 2 is feasible because even when data elements in discharge databases are insufficient to permit users to carry out an application, discharge data can often be linked to other datasets that do contain the needed information. For instance, to obtain information on characteristics of the community in which patients reside,

data users often employ geographic codes (e.g., county and ZIP Codes) to link discharge data to county-level files such as the Area Resource File (maintained by the Health Resources and Services Administration, HRSA) or ZIP Code data from the Bureau of the Census. As another example, state discharge datasets that use Medicare provider numbers and/ or American Hospital Association (AHA) numbers to identify hospitals may be linked to data from the AHA Annual Survey to create a file containing elements related to both the inpatient admission and characteristics of the admitting hospital (e.g., ownership, profit status, size, and services offered). To the extent that common patient identifiers are employed and these data sets are available, it is also possible to link outpatient, ambulatory surgical center or emergency department data to discharge data in order to develop a more comprehensive profile of patients' health care experiences or to examine episodes of care.

Limitations of Hospital Discharge Data

Hospital discharge databases are not without problems that may limit their usefulness for certain applications. These limitations may be classified as problems with (a) data quality; (b) excluded populations; and (c) missing data elements.

Data Quality Problems

Inconsistencies in the collection of data and quality problems may hinder the use of hospital discharge data for specific applications. In multi-state comparisons, analyses can be greatly limited by standards and coding practices that are incompatible across states (Coffey et al., 1997; Berthelsen, 2000). One example is the coding of the expected payer field. There is presently no national standard for identifying and reporting payer data, and states have different approaches for grouping payer categories, with categories that may be neither comprehensive nor mutually exclusive (Public Health Data Standards Consortium, 2005). These data reporting problems make it particularly difficult to conduct meaningful cross-state comparisons of payer performance.

Even in analyses that are focused on one state, the validity of analyses may be affected by inconsistency across providers in the way certain fields are reported. Among the most common data quality problems cited by key informants were the inaccuracies that may occur for diagnosis and procedure codes. These problems may be due to errors in providers' understanding of diagnostic coding/ groupings (e.g., ICD-9-CM, DRG), which lead to misclassification, or due to purposeful attempts to alter coding in order to maximize reimbursement. Similarly, there is evidence that co-morbidities (reported as secondary diagnosis codes)

may be underreported, particularly for some conditions (Kieszak et al., 1999; Malenka et al., 1994). This underreporting may occur for many reasons. Particularly if these data are not used for reimbursement, hospitals may not collect or report this information. In other instances, data collection agencies differ in the number of diagnostic fields that they import into the statewide database, and co-morbidity data may therefore be truncated.

Another type of data quality problem that was frequently cited by key informants was hospital-specific errors in coding certain fields. One respondent that we spoke to had attempted to use hospital discharge data to develop an asthma surveillance system for the state. In analyzing the state data, he discovered that at least one hospital was erroneously reporting the facility's own ZIP Code rather than the patient's ZIP Code of residence. Before proceeding with the development of the surveillance system, he intends to conduct additional investigation into the quality of the hospital discharge data and ways to improve it.

Excluded Populations

Exclusion of Selected Facilities. The types of facilities and populations represented in data systems may limit the use of hospital discharge data in national and state applications. At present, 38 states require hospitals to submit discharge data. Two states do not collect discharge data and, in the remaining states hospitals are encouraged, but not required, to submit data to the statewide data organization (Consumer-Purchaser Disclosure Project, 2004). Clearly, in the states that do not mandate data submission, coverage of hospitals may be less than complete. Even in those states that mandate hospital participation, certain types of hospitals, such as Veterans' Administration and Indian Health System facilities, are typically exempt. Incomplete data can hinder efforts to use discharge data in many of the applications described in Chapter 2.

Exclusion of Selected Populations. Obviously, discharge data capture only those events that occur in a hospital. Many procedures are now performed in both inpatient and outpatient settings. For these types of procedures, one would have an incomplete picture of the full patient population unless data from outpatient settings are also included. A similar limitation arises in injury surveillance efforts when injuries are so serious that the patient dies before being admitted to the hospital or when the injury is not serious enough to result in a hospital stay. For example, one of our key informants was using discharge data to monitor suicide attempts and fatalities in a state. Because the discharge data contain records only for those persons who were hospitalized following an attempt or who died while an inpatient, all fatalities were not represented in these data. Lacking individual patient identifiers, the informant has

not yet been able to link discharge data to death records in order to estimate the burden of suicide in the state.

An additional consideration is that, unless states have data sharing agreements and use common patient identifiers (which appear to be relatively uncommon), patients who are hospitalized outside the state are not captured by their home state's data system. Conversely, unless ZIP Code or state identifiers are available, it is not possible to identify hospitalizations by out-of-state patients. Data collection organizations' ability to obtain patient-specific geographic identifiers may be more difficult now that the HIPAA privacy rule has been implemented. Under HIPAA, data on geographic subdivisions smaller than a state are considered protected health information (PHI). In states in which participation in a discharge data system or the provision of residence data is not mandatory, it is possible that more hospitals will choose either to not submit data or to de-identify data (i.e., by removing PHI) in order to comply with patient privacy regulations.[4] To the extent that geographic identifiers are unavailable, it will be more difficult to conduct population-based applications.

Missing Data Elements

E-codes. Submission of discharge data is voluntary in some states, and submission of certain data elements may be voluntary even in states that mandate hospital participation. As an example, public health practitioners often use external cause of injury codes or "E-codes" contained in hospital discharge data to estimate the incidence of specific types of injuries and to build injury surveillance systems. However, only 23 states mandate that hospitals report E-codes (Wadman et al., 2003). Results from the HCUP E-code Evaluation Project indicate that while the overall completeness of E-codes in injury records is quite good, in almost one-fifth of 33 HCUP states the completeness of E-codes was less than 75 percent. Not surprisingly, rates of completeness were higher in states that mandate E-code reporting (Coben, 2004).[5] As noted by Sorock et al. (1993) in an evaluation of the usefulness of New Jersey discharge data for injury surveillance (conducted prior to the state-mandated reporting of E-codes) hospital discharge data are valuable for estimating the number of injuries that occurred, but the absence of E-codes makes it difficult to understand why these injuries occurred. Key informants for this study as well as many organizations interested in advancing the effectiveness of injury surveillance systems (Institute of Medicine, 1999; STIPDA, 2003) have indicated sup-

[4] A covered entity may provide access to certain PHI that includes geographic location, under certain conditions, such as when a signed data use agreement is obtained and only the minimum necessary information is released.

[5] Rates of completeness were also higher for conditions not related to patient safety or medical errors.

port for the mandatory reporting of E-codes and other policies that promote uniformity in hospital coding of external cause of injury. Examples of these other policies that could be employed even without mandatory reporting include educating medical records coders, monitoring the completeness of coding, and providing feedback to hospitals on the quality of their coding. In Colorado, for example, these actions have consistently made the state a leader in terms of completeness of E-coding (personal communication with Michael Boyson, Colorado Health Institute, March 9, 2005).

Race and Ethnicity. Several interview respondents indicated that they were unable to adequately risk-adjust data or were unable to examine disparities in health status using hospital discharge data because information on race and ethnicity were either missing or unreliably reported. Indeed, in an analysis of the 2000 Nationwide Inpatient Sample, Romano et al. (2003) noted that 20 percent of hospital discharge records were missing race/ethnicity data. One reason for missing data is that hospitals may not be required and may choose not to report this information. Nationwide, only 22 states mandate hospital collection of information on race and ethnicity. Even in those states with such a requirement, however, providers may be unaware of the mandate and may fail to collect this information.

As noted by key informants, even when race/ethnicity data are available, the quality of this information is, at times, questionable. Several factors account for the poor quality of race/ethnicity data. To begin with, there is no consistent approach for collecting this information;[6] race/ethnicity is not included in the UB-92 core billing standards. Even though many states collect data on race/ethnicity as one of the state-specific fields, how the race/ethnicity variable is defined and, indeed, even whether it is defined in terms of one or two variables,[7] varies across states (Geppert et al., 2004). Blustein (1994) further notes that admitting clerks often assign race/ethnicity based on their observations; they may not directly ask patients to self-identify. This may result in misclassification, a problem that Blustein found to be worse for non-Black and non-White categories. The quality of race/ethnicity data may also be problematic due to the reluctance of patients to provide this information.

Costs vs. Charges. Hospital discharge data systems collect data on billed charges as opposed to costs. Typically, an external data source containing financial data and, specifically, hospitals' cost-to-charge ratios (e.g., Medicare Cost Reports) are

[6] For an extensive discussion of this and other issues concerning the collection of race and ethnicity data refer to the 2004 National Research Council Report: "Eliminating Health Disparities: Measurement and Data Needs."

[7] Some states define race and ethnicity as two separate variables—one for race and one for ethnicity (Hispanic or not). Other states combine race and ethnicity categories (such as in the categories: White, not of Hispanic origin; Black, not of Hispanic origin; Hispanic).

necessary to estimate costs from the reported charges. The accuracy of this approach for estimating inpatient costs is not always clear, however, since charges may not entirely reflect the resources that the provider used and, hence, what it actually costs to provide a service.

Another concern is that charges are not uniformly reported by hospitals or across states. Billed total charges may include professional fees and patient convenience items; these professional services or items may differ across hospitals and states. Where a payer requires bundled billing, emergency room charges may also be included. Detailed charges are also not uniformly reported. For example, although many states collect detailed charge data using the revenue center codes identified in the UB-92, states may collapse revenue center codes and redefine ranges of services. Acknowledging these limitations and caveats, many states and data users have nonetheless succeeded in conducting studies of inpatient costs and cost-effectiveness with hospital discharge data.

Data Elements for Risk Adjustment. Although the data users we interviewed for this study indicated that hospital discharge data are a valuable resource for assessing the quality of hospital care, there are some concerns about the adequacy of these data for risk adjustment. As described earlier, the diagnosis and procedure codes may face a number of quality issues, ranging from provider inconsistencies in coding to data truncation in reporting. In addition, other clinical data that could be valuable for risk adjustment – including laboratory values, test results, functional status, severity of illness, and behavioral risk factors – are typically not present. For instance, Jonkman et al. (2001) noted that ICD-9-CM diagnoses and procedure codes contained in typical discharge datasets lack the clinical detail needed to determine disease stage. Their work on early-stage breast cancer showed that discharge data have a high degree of sensitivity (i.e., they identify most early-stage breast cancer patients identified through other means) but a low degree of specificity (i.e., they identify many patients who are not early-stage breast cancer patients). As such, the use of discharge data to examine patterns of cares for early-stage breast cancer patients may be misleading due to inclusion of (later-stage) patients who are not candidates for breast conserving surgery.

In addition to the fact that detailed clinical information is unavailable, the diagnostic information recorded on a discharge record often does not indicate whether the condition was present on admission or whether it was acquired during the hospital stay. For purposes of quality assessment it is critical to distinguish between the two situations. On the one hand, conditions that are present at the time of admission are likely to be comorbidities; adjustments to account for differences in risk associated with the

presence or absence of the condition are often necessary. On the other hand, conditions acquired during the hospital stay may reflect the product or outcome of care. The occurrence of complications (e.g., pressure ulcers, urinary tract infections) may suggest poor quality of care.

Several of our informants echoed the recommendation of The Workgroup on Quality of the National Center for Vital and Health Statistics (2004) to include an indicator of whether a secondary diagnosis was present on admission into discharge databases; the proposed UB-04 incorporates such a "present-on-admission" indicator. California, New York, and Wisconsin currently collect this information in their discharge databases, but there are some state differences in how this variable is recorded.

Another data element that interviewees indicated was important when using discharge data to compare hospital mortality rates is an indicator of whether a patient has a do-not-resuscitate (DNR) order. In theory, hospitals with greater proportions of patients with DNR orders will tend to have higher mortality rates; higher mortality rates would reflect patients' wishes as opposed to poor hospital care. Without a DNR indicator, quality comparisons based on mortality rates are biased against hospitals with more DNR patients.

The inclusion of present-on-admission and DNR indicators will advance the use of discharge data for quality measurement. Nonetheless, standard definitions of these data elements and detailed instructions for reporting are necessary in order to ensure comparable data collection and promote comparisons across providers and states.

Unique Patient Identifiers. Although many discharge datasets contain this information, some interviewees indicated that the inclusion of unique patient identifiers would be one of the most useful database enhancements. Providers and state database developers may be reluctant to incorporate patient identifiers because of concerns about patient confidentiality and the requirements imposed by regulations such as HIPAA. When available, these data are usually encrypted; encryption methods are likely to differ across states and across organizations in a state. In the absence of unique patient identifiers or standard encryption methods, it is much more difficult to link the discharge records with other files, construct episodes of care, or ensure that a single episode is not being counted multiple times (such as when a patient is re-admitted or transferred between hospitals (Westfall and McGloin, 2001)).

Importantly, several of the applications that we identified require that discharge data be linked to other person-level event data. For instance, Polednak and Shevchenko (1998) linked data from the Connecticut hospital discharge database and the state Tumor Registry to estimate

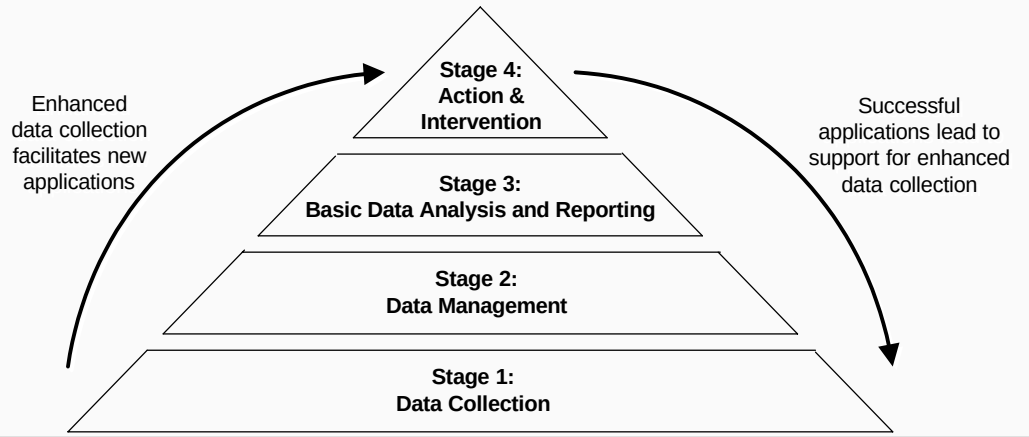
inpatient cancer-related charges during the last year of life. The Crash Outcomes Date Evaluation System (CODES), funded by the National Highway Traffic Safety Administration, links motor vehicle crash data to hospital inpatient and emergency room data and other data sources to monitor motor vehicle accidents and examine the cost-effectiveness of safety measures. Although the lack of individual identifiers often hampers the ability to link data from hospital discharge datasets with other datasets, a variety of approaches – including probabilistic or deterministic matching techniques – may enable cross data linkage.

4. A Look to the Future

The demand for health information has risen sharply over the past decade. At the same time, state health data programs continue to face fiscal, political, and technical challenges to meet these evolving information needs. As described in this report, statewide data organizations, in particular, are among the leading innovators in the use of hospital discharge data. These accomplishments have been achieved by states that are facing budget and other constraints as well as by states that are commonly perceived as the "industry leaders" in health care data.

Statewide health data organizations vary in the roles and responsibilities that they assume. As illustrated in Figure 4.1, these roles may be conceptualized as developmental stages, with each subsequent stage building upon the accomplishments of prior stages. Organizations at the first stage are engaged almost exclusively in data collection. These organizations may not have the necessary resources available to move beyond this role, or because of political realities, their primary mission may be limited to data collection. At the second developmental stage, organizations also function as data processors or managers. Some organizations at this stage may go so far as to perform limited analyses in house, but most analytic work and dissemination of findings is left to others. Again, the decision to limit the amount of in-house analysis may reflect a lack of resources within the organization, or concerns about taking a role that is too visible and potentially controversial to state policymakers and/or database funders.

Figure 4.1 Developmental Stages of Statewide Health Data Organizations



Once a statewide organization has firmly established itself as a valued data collector and database manager, it may then be able to attract the resources and political support needed to branch out into more extensive data use. Organizations at stage 3 are performing their own analyses with the data that they collect, and preparing and disseminating basic reports.

While all data organizations achieve the first two stages (data collection and processing) and most reach stage 3 by producing standard utilization reports or profiles, very few organizations progress to the fourth stage. Organizations at stage 4 are the industry leaders. These organizations have successfully managed to move beyond basic data collection and analysis to increasingly sophisticated analyses that result in actionable information or in programs with market or policy relevance. The very tangible value arising from these applications then provides a new impetus and support for continued and enhanced data collection, which in turn facilitates new applications. Organizations reaching this stage have effectively closed the loop that links data collection and highly useful applications.

Data organizations that succeed in developing sound discharge data systems are more likely to progress to the more difficult task of translating the data into information. An organization that succeeds in applying methods and tools to produce relevant reports (either through in-house analysis or through arrangements with outside organizations) is likely to increase demand for more sophisticated reports and data enhancements for these reports.

While maturity may be a key factor in determining an organization's stage of development, maturity alone does not assure progression from one stage to the next. Some mature data organizations do not operate at the fourth level, while some newer organizations may progress through the developmental stages rapidly. Additionally, it is important to recognize that statewide health data organizations may differ in their mission, and that not all organizations will strive to advance to the final stage.

Working together, there is much that private, state and federal health data organizations can do, both to improve the utility of state hospital data and to facilitate progress through these developmental stages for those organizations wishing to improve or expand their role. Below, we describe a multi-faceted strategy to achieve these dual goals. Key features of this strategy include: (1) improving the inpatient discharge databases themselves; (2) strengthening inpatient data by building more comprehensive data systems; and (3) providing technical assistance to enhance the analytic and reporting capacity of statewide data organizations.

(1) Improve Inpatient Discharge Databases

Additional Data Elements. From the key informant interviews and the literature review, we identified a number of additional data elements that could be quite helpful for future applications.[8] These include:

- **unique patient identifiers** – for linking records, identifying readmissions, and constructing episodes of care;
- **expanded clinical information** – for risk adjustment, identification of at-risk populations, and quality reporting;
- **E-codes** – for improved understanding of causes of injury;
- **race and ethnicity** – for better analyses of disparities in care and identification of subpopulations;
- **condition present on admission** – for better outcomes/quality studies;
- **presence of " do not resuscitate" (DNR) order** – for improved risk-adjustment of mortality outcomes;
- **unique identifiers for all physicians involved in the episode** – for analyses of the impact of physician characteristics and process of care; and
- **date and time of procedures** – for an improved understanding of the process of care.

While a few of these data elements are collected by some states, there is presently significant variation across states in the availability and reliability of this information, and it is unlikely that any state collects the full complement of desired data elements. One important reason that most of these data elements have not been widely collected to date is that the UB-92 from which discharge data have been drawn was created for the purpose of making payments, not for conducting research. As long as the data were not used for payment, providers had little incentive to collect the information.

Even though reporting of data using the UB form is required only if mandated by the state, it is important to note that the proposed UB-04 will be designated for both payment and reporting. As such, many of the desired data elements will be defined and supported. For example, the proposed UB-04 includes a DNR indi-

[8] Data experts with whom we spoke were supportive of the inclusion of these data elements; however, some informants cautioned that their inclusion could have budget implications for both states and hospitals. It was suggested that in determining which data elements to pursue, statewide data organizations and data standard setting organizations assess the financial impact on hospitals in order to strike a balance between hospital costs and the value that is gained by this information.

cator, and supports collection of data on whether a condition is present on admission, clinical data elements (e.g., lab values and test results), and health status and functioning information. Furthermore, with the advent of "pay - for - performance" initiatives, many of these desired variables will become relevant for the calculation of provider payments, enhancing the likelihood that they will be collected through the uniform bill.

In addition to the promise held by the advent of the UB-04, a number of other efforts are already underway to help improve the quality of healthcare administrative data, as part of AHRQ's Healthcare Cost and Utilization Project. For example, one project is currently investigating problems in the reporting of race/ethnicity and what can be done to improve it. Another project is examining the status of reporting external cause of injury codes (E-codes) across the states in order to provide information on how E-code reliability can be enhanced. AHRQ is also supporting a study to identify the most efficient set of clinical data elements that can be added to administrative data in order to improve the reliability of public quality reporting. Full reports on these projects will be available in the future through the HCUP-User Support web site (http://www.hcup-us.ahrq.gov).

Coding Errors and Standardization. To address the most pervasive concerns about data quality – namely, coding errors and inconsistencies across providers and across states – one of our informants suggested that a data auditing system be established. Another informant recommended that as states develop plans to promote cross-state sharing of data, these plans must include standardization of data definitions and data collection approaches. Indeed, several organizations, including Health Level 7 (HL7) and the National Uniform Billing Committee (NUBC), have been actively working toward the development of standardized terminology and data structures that could greatly facilitate analyses and benchmarking within and across states.

National standards may not be sufficient, however, to ensure that the quality of discharge data is adequate to undertake all of the applications described in Chapter 2. Several of the individuals with whom we spoke emphasized the importance of training hospitals' frontline workers on collecting these data and applying these standards. One informant further cautioned that the UB form is a template and without an explicit state reporting mandate, discharge data may continue to suffer from quality problems.

(2) Build More Comprehensive Data Systems

From any number of the sample data uses we uncovered, it was clear that the utility of inpatient data is greatly enhanced when supplemented with data from other health care sectors. Commu-

nity needs assessments and health planning studies were more comprehensive when they could include data on outpatient and emergency department use. Additional data from laboratories and pharmacies, as well as from physician offices, ambulatory surgery centers, and ambulance runs, can only add to the ability to perform risk adjustment and conduct more in-depth studies of a broad range of issues.

Indeed, all but the most intensive therapies continue to move out of the inpatient setting, so inpatient data alone provide an increasingly limited view of health care overall. Consider, for example, the area of quality assessment. With data on ambulatory surgery activity, analyzing a much broader range of procedure-related quality indicators would be feasible. These would include volume, utilization, and complication or readmission indicators for cardiac catheterization and a range of arthroscopic and gynecologic procedures. With data on ED activity, it would be possible to construct more complete and accurate indicators for quality of care for serious conditions that are sometimes managed on an outpatient basis. Emergency department data would also support the construction of more complete quality indicators related to ambulatory care sensitive conditions.

As of May 2004, at least 29 states were collecting ambulatory surgery data and 26 were collecting ED data (Consumer-Purchaser Disclosure Project, 2004), and AHRQ now compiles data from both of these sectors as part of the family of HCUP databases. As more states begin to collect these data and they begin to be used more widely, we can expect improvements in the types and depth of analyses that are possible. This analytic capability will be much stronger to the extent that unique patient identifiers are available and consistently defined across settings.

The past year, in particular, has seen a coordinated federal interest in promoting health information technology, with the goal of having electronic health records (EHRs) for every American within a decade. In their best incarnation, EHRs will contain a patient's full medical history, using standardized nomenclature that can be consistently accessed and interpreted by all providers from which the patient receives care. Since this information would include electronic recording of test results and pharmacy use, for example, the availability of EHRs could facilitate the collection of the clinical data that many wish to see added to the discharge records and, importantly, the incorporation of data from a wide range of health care sectors. Although EHRs have yet to evolve, it is not too early to identify a key set of clinical data elements that could be readily abstracted from electronic medical record systems or to examine how the shift toward EHRs could impact state hospital discharge data systems.

In a small number of geographic areas, Regional Health Information Organiza-

tions (RHIOs) currently provide a means for integrating and exchanging health data. With the recent federal push to encourage the development of RHIOs as a means to advancing the National Health Information Network, we expect the number of geographic areas engaging in data exchange activities to grow. Success in the development of these RHIOs should further the goal of building more comprehensive health data systems.

In the course of our interviews, we asked informants to describe their vision for the next generation of discharge data. Key informants generally agreed that the value of discharge data extends well beyond health-related applications and that evolving information needs can be met through integrated data systems that link inpatient data not only with data from other health care sectors, but also with data from the human services sector. One model of such an integrated data system, which shares data across a multitude of state agencies, has been developed by the state of South Carolina (Case Study 13). The range of topics that can be addressed and the large number of constituents who can be served with such an integrated data system can greatly increase the utility and base of support for the data collection activities.

Case Study 13. Integrated Data Systems: A Model Program

South Carolina has devoted extensive resources to the development of a state integrated data system that combines data from government programs and the private sector. In addition to hospital discharge and other health-related data, this state system includes administrative data from the social services, criminal justice, education, housing and other government sectors (Bailey, 2004).

The success of this data system hinges on the ability to link person-level records across the different private and state program databases. Linking across databases is accomplished with a unique, randomly selected tracking number that is obtained upon entering the health and human services system and remains with an individual throughout all encounters.

Examples of the applications that may be supported by the South Carolina integrated data system include:

- estimating the prevalence of special needs children;
- identifying geographic areas with large numbers of uninsured patients to focus Medicaid and State Children's Health Insurance Program enrollment efforts;
- recruiting and targeting interventions under the Healthy Start program;
- evaluating the performance of mental health centers and counselors;
- estimating the costs of not having seat belt legislation; and
- examining the quality of foster homes.

(3) Provide Technical Assistance to Enhance Analytic and Reporting Capacity

In addition to improvements to the databases themselves, much could be gained by providing the statewide data organizations with technical assistance so that they can do more with the data that are presently available to them. A broad range of TA topics can be envisioned, such as:

- helping to improve the data submission and editing processes in order to improve timeliness and reduce data errors;
- developing and sharing analytic tools and reporting templates;
- producing primers on key health policy issues and ways data organizations can play a role in the policy process; and
- developing tips on effective dissemination strategies to reach a range of audiences.

Some states may need assistance regarding implementation of data standards, and many could benefit from guidance in how to apply risk adjustment methods to their data, especially as discharge data sets evolve to incorporate clinical and other data elements. Other states may require assistance in linking discharge data to other health and non-health databases, particularly when unique identifiers are missing. And even states with a well-developed technical capacity may have difficulty communicating the findings to the intended audience and translating analysis into policy or actionable information.

Statewide data organizations may obtain technical assistance in many ways. However, we believe that a collaborative model, in which private, state and federal health data organizations partner to develop a nationwide network for improving state data, may be among the most effective means for ensuring that health data organizations obtain the technical assistance that they need. As demonstrated by AHRQ's HCUP Partners group, networking is an effective means for transferring knowledge, technology, and expertise between health data organizations. Furthermore, to the extent that standards-setting organizations also participate in such a partnership, health data organizations may have greater input into the development of standardized terminology and data structures, and could also work collaboratively to foster improvements in data quality and reporting.

Through this network, partners could provide technical assistance to one another – with organizations that have reached more advanced developmental stages providing training and mentoring to personnel in other organizations that are striving to make similar gains. To constrain costs, in-person and remote training tools could be used to teach

participants to analyze and present data in a manner that fosters uptake and use. Several states could work together to develop reporting templates appropriate to their common needs, and computer code could be shared across agencies wishing to conduct similar analyses. Training in the use of available national tools, such as the AHRQ Quality Indicators, could also be provided to statewide data organizations wishing to apply these tools to their data. Finally, dissemination of existing research accomplishments through this network could help to strengthen analytical and reporting capacity of the participating partners.

Closing Comments

The results of this study clearly demonstrate that states and other users have developed a wide range of innovative and meaningful applications for hospital discharge data. With the advent of the electronic health record it might be easy to assume that these discharge databases will no longer be necessary given the depth of clinical information that will be available electronically. But there are two reasons that discharge databases, or something like them, will continue to be important. First, from a purely pragmatic viewpoint, a universal EHR will not be available for a decade or more. In the interim period, we will need to continue to rely upon discharge data and other administrative databases to meet current needs for information. As described elsewhere in this report, efforts are underway in some states and at the national level to enhance these databases by improving the quality of existing data elements and adding new data elements, and by building more comprehensive data systems. Of course, more remains to be accomplished in all areas.

Second, once the universal health record becomes available, it may not be amenable to filling the same needs if we do not plan and design databases aimed at specific applications such as those described here. The EHR will be richly detailed for real-time clinical decision-making, but what is needed for most of the applications identified in this report are population-based databases that aggregate administrative and clinical information. For example, these databases need to be designed so they provide area-wide insight into patterns of disease and treatment, can be used in the context of population denominators to create rates, can be linked with outside data sources such as motor vehicle records and hospital-level or community-level data, and continue to be readily available to researchers who have driven the use of administrative data and have encouraged their development. Without planning for such applications, we risk losing a critical data source. This planning requires not only sketches of how the databases will be structured and what data elements they will include, but also arrangements for access to the databases by researchers, organizations, and agencies outside the setting of health care delivery.

It, thus, seems clear that inpatient discharge and other administrative data-

bases will continue to be important even as EHRs begin to be developed and become more widespread, and that additional efforts will be needed not only to enhance the utility of these databases but also to facilitate statewide data organizations' progress from basic data collection to advanced analysis and reporting of findings. It is important to realize that progress on these fronts may require resources that could strain the already tight budgets of some statewide data organizations. For example, states may need additional funding to provide onsite training for their staff or to enable their staff to travel to technical assistance and training activities organized more centrally. Some states may need to hire staff to provide statistical or analytical expertise. Even if technical expertise is available, training and development will require staff time that will be taken away from other activities.

As with the provision of technical assistance, a combination of federal, state and private contributions and efforts may be necessary to secure the resources likely to be needed for these activities. The returns to these new investments are many and include:

- availability of national methods and tools that may be applied in a standard and timely manner;
- ability to benchmark state or regional performance;
- access to information to develop effective interventions and support local (as well as state and national) decisions; and
- improvements to state analytic capacity.

Each statewide data organization will need to determine its desired place in the developmental hierarchy and identify its priorities and means for building upon its existing strengths to advance to that stage. Although some organizations will assume leadership positions and others will not, we suggest that staying "under the radar screen" may not be the best strategy in this era of increasing reliance on health data to drive evidence-based initiatives. Organizations that do little more than collect data, without seeing that the data are translated into helpful and relevant information, are likely to face significant challenges as they strive to demonstrate their value to stakeholders. State health data programs that are able to use their data in sophisticated and meaningful ways can expect to be better positioned to deal with the fiscal and political realities in their state.

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Appendix B. State-by-State Summary of Web Site Searches

Alabama	Through its website the Alabama Health Planning and Development Agency makes several hospital reports available for sale to the public; these include reports on patient days, average LOS, charges. The source of these data is not clear from the information on the website.
Alaska	No information found.
Arizona	Arizona collects data, but does not appear to do analysis (beyond a few tables on charges, discharges, LOS, etc.). Although data submission is mandatory, the quality of data submitted by some hospitals is too poor to permit their inclusion in the database.
Arkansas	The Arkansas Dept of Health (ADH) has collected hospital discharge data since 1997. These data have been used by the Office of Injury Prevention to prepare a report on injury morbidity in the state. Additionally, ADH produces strategic planning and marketing reports for each hospital, and has used the data to assess preventable hospitalizations, evaluate the impact of repealing the motorcycle helmet law, identify regional market areas in the state, provide data to the Traumatic Brain Injury Registry, and studied issues related to specific diseases and injuries. No reports on these applications appear to be publicly available, however.
California	The California Office of Statewide Health Planning and Development (OSHPD) provides public access to numerous reports that use hospital discharge data. OSHPD produces a state and county-specific "Perspectives in Healthcare" report that summarizes data on inpatient hospitalization characteristics (e.g., utilization and patient characteristics) for all discharges and discharges corresponding to selected diagnoses or procedures. Additionally, OSHPD has prepared reports that use hospital discharge data to examine racial and ethnic disparities in health care services (e.g., preventable hospitalizations) and heart attack and CABG outcomes for the state overall, for specific counties, and for individual physicians and hospitals. California provides access to pivot files that allow the user to profile and prepare custom reports with summary data on the characteristics of California inpatient discharges. Online access to data from the EPICenter also allows users to create data tables to address questions about nonfatal injury hospitalizations in the state.
Colorado	The Colorado Health and Hospital Association (CHA) collects discharge data from its member hospitals, and produces a series of regular reports back to members allowing them to track their utilization, charges, market share, etc., and compare themselves with peers. CHA will also produce

	ad hoc reports, and sells the entire database. They use the data to report birth defects and traumas directly to the state registries, saving the participating hospitals the cost of separate reporting to these systems. They have produced a number of briefs on selected topics (e.g., teen pregnancy), and publish an annual report showing the average charge and LOS by hospital for the 45 most common reasons for admission. The discharge data are also part of the Colorado Health Information Dataset, where they provide information on injury hospitalizations.
Connecticut	Connecticut Office of Health Care Access (OHCA) maintains a data warehouse of hospital discharge data for the state. Submission of data is mandatory. OHCA has produced a small number of reports analyzing trends in use, charges, payer mix, as well as a report on preventable hospitalizations. It appears OHCA also makes the data available to others (perhaps only in aggregate form). Through the ChimeData Program, the Connecticut Hospital Association maintains a proprietary system of discharge data that are voluntarily submitted by members. Members have access to comparative reports through a web based tool, and ChimeData can produce customized reports. They annually produce a Patient Census Report Trend Summary, showing utilization trends.
Delaware	Delaware requires all hospitals to submit hospital discharge data. These data are collected by the Delaware Health Statistics Center. The Department of Health and Social Services has used these data to develop a report on childhood injuries as well as report of racial/ethnic disparities in health status.
District of Columbia	No information found.
Florida	Florida's Agency for Health Care Administration, State Center for Health Statistics is responsible for collecting and disseminating hospital discharge data. They have produced a number of reports examining health care trends and outcomes for selected conditions (The Health Outcomes Series), and have a web-based system (The Florida Hospital Services Guide 2003) that shows hospital volume for selected procedures, which is intended to help people select a hospital. The hospital discharge data are also used in two web-based query systems. FloridaHealthStat enables users to access 'canned' reports on specific conditions and procedures (QuickStat), as well as to develop customized tables (HealthStat). CHARTS provides tables and maps showing hospitalization rates for some chronic diseases as part of a much larger query system. The data are also used for birth defects and cancer registries, and for injury surveillance/prevention.

Georgia	The Georgia Hospital Association (GHA) produces a Fact Book that is available to its members, and provides members access to software that permits them to compare themselves to other hospitals. The Georgia Department of Human Resources, Division of Public Health, has produced numerous reports on hospitalizations for selected conditions.
Hawaii	The Hawaii Health Information Corporation produces a series of online reports that present graphs and charts at a very aggregate level for selected conditions. They also maintain an online mapping capability that permits users to map hospitalization rates for a short list of conditions by hospital district and by state house/senate district. In conjunction with HMSA Foundation, they maintain an online version of the "Health Trends in Hawaii" annual report. Users can access aggregate charts and graphs, and underlying data tables, on a variety of topics. Discharge data are one of many sources used for this report.
Idaho	No information found. May be located in "members only" section.
Illinois	The Illinois Health Care Cost Containment Council maintains a web-query system for accessing the discharge data, produces numerous consumer guides showing charges and utilization data to help patients select hospitals in certain areas and for certain conditions, and publishes numerous reports on hospitalization statistics for certain conditions.
Indiana	The Indiana State Department of Health publishes a consumer guide that uses hospital discharge data to estimate discharge rates by demographic characteristics, and for selected conditions and procedures.
Iowa	The Iowa Hospital Association has been collecting hospital discharge data since 1988, and makes it available via a series of customized reports for its members; the reports examine market share, patient origin, top DRGs, diagnoses, charges, etc. The data are also available for purchase. The web site contains no reports for other audiences.
Kansas	The Kansas Hospital Association (KHA) collects hospital discharge data, but their web site does not discuss how the data are used, nor how to obtain them. They publish an annual book with hospital and other health care statistics (KHA STAT Book), but this does not seem to rely on the inpatient discharge data. The Kansas Information for Communities division of the Kansas Department of Health and Environment has a web-based query system (like HCUPnet) that permits the user to generate summary tables and county-by-county maps from the hospital discharge data.
Kentucky	The Health Policy Development Branch of the Kentucky Department of Public Health is responsible for collecting inpatient discharge data from

	all hospitals in the state. They produce an annual report on hospital utilization.
Louisiana	Hospital data are collected by the State Health Care Data Clearinghouse, State Center for Health Statistics. The data have been used to generate estimates of hospitalization rates for a report on cardiovascular disease that was published by the American Heart Association, and to produce portions of a state health report card.
Maine	The Maine Health Data Organization helps to support HealthWeb of Maine, which provides interactive access to a number of state health databases, including the inpatient discharge records. Users can examine number of discharges, charges, LOS, and discharge status by procedure, DRG/MDC, hospital, payer, year, patient age, sex, region, hospital service area and hospital peer group.
Maryland	Maryland collects inpatient claims data as part of its all payer database, collected from the major insurers operating in the state. The Maryland Health Care Commission has used the data to project the utilization of inpatient resources associated with obstetric services. They also have a web-based query system (The Maryland Hospital Performance Evaluation Guide) that enables users to generate comparisons of volume, risk-adjusted LOS, risk-adjusted readmission rates among hospitals for a variety of conditions and procedures.
Massachusetts	The Massachusetts Division of Health Care Finance and Policy collects inpatient discharge data, makes it available for outside uses (some downloadable files, some for purchase), and produces a series of reports. Their "Datapoint" series provides quarterly and full year comparisons of volume, charges, and LOS by payor and by top DRGs. They also have an "Analysis in Brief" series that treats special topics of interest; several of these have used hospital discharge data. In their "Hospital Procedure Volume Reports" they compute each hospital's volume for the Leapfrog procedures and provide comparisons with the Leapfrog volume standards. They also have four tables presenting 1998 and 1999 data on preventable hospitalizations by age group by small geographic areas within the state. The state's Injury Surveillance Program also uses the inpatient discharge data as part of the injury surveillance system. The Massachusetts Health Data Consortium enhances the state's discharge database by capturing care for state residents treated out of state and at VA hospitals, offers the enhanced database for sale, and produces a series of standardized reports. These reports include a variety of patient origin and market share analyses, and analyses of charges and LOS by DRG, service category, health service area, etc., for individual hospitals, or groups of hospitals. Area population data are added to the file to produce utilization rates.

Michigan	The Michigan Health and Hospital Association (MHA) collects inpatient discharge data on a voluntary basis from the state's hospitals. MHA has an on-line query system (The Michigan Hospital Report) that can be used to display each hospital's actual LOS and mortality experience against the performance that would be expected based on its patients' severity of illness and its number of patients. This information can be obtained for selected procedures and groups of procedures, with hospitals arranged by region of the state. The Michigan Department of Community Health (MDCH) presents a detailed set of tables on preventable hospitalizations by local community, age, gender, and diagnosis. MDCH has also prepared a series of reports on hospitalizations for asthma.
Minnesota	The Minnesota Hospital Association collects inpatient discharge data on a voluntary basis, and estimates having about 90 percent of the discharges captured. The MHA web site does not appear to have been updated since 1998/1999, but lists a series of "Community Health Reports" that have been developed from the discharge data. These are available on-line for the entire state or by substate region, and include tables showing discharges and population-based utilization rates for selected conditions, number of cases, days, and charges for leading causes of hospitalization by age, and hospitalization rates by type of condition and age. As of 1998, they had also released 2 data tables on hospitalizations for injuries in the St. Paul-Minneapolis area. MHA does not release the raw data, but will prepare customized non-identifiable reports for a fee.
Mississippi	No information found.
Missouri	The Missouri Department of Health and Senior Services uses the inpatient discharge data to produce an annual consumer's guide that shows the volume of surgeries performed by each hospital for selected procedures (10 in 2002), and compares these rates with volume thresholds suggested by the literature as the level associated with better outcomes. This department also produces "Community Data Profiles" for a range of indicators, including hospitalizations for chronic diseases, and inpatient hospital utilization by condition. The profiles can be produced for each county, and show the age adjusted rates for the county and the state, significance of any difference, and the quintile ranking of the county. There are also graphing capabilities. This department also maintains a site called the "Missouri Information for Community Assessment" that lets users generate tables on inpatient

	hospital use, charges, days, preventable hospitalizations, by age, race, sex, county, and/or district. The Hospital Industry Data Institute, part of the Missouri Hospital Association, collects inpatient discharge data, and produces several reports for each participating hospital (e.g., utilization patterns, patient characteristics, patient origin).
Montana	The Montana Association of Health Care Providers uses data that hospitals submit to the COMPdata program to generate estimates of length of stay and charges for common inpatient diagnoses. This database includes about 90 percent of Montana inpatient discharges. The Association uses these data for advocacy, and hospitals use them for benchmarking.
Nebraska	The Nebraska Hospital Association restricts access to information about the inpatient discharge database to its members.
Nevada	The Center for Health Data and Research, of the Nevada Bureau of Health Planning and Statistics, is building a warehouse of 35-40 databases that can be linked to support research and policy analysis. This warehouse includes the inpatient discharge data. They maintain a web-based query system for a number of these databases, including the discharge data. Users can produce tables on LOS, charges, and volume by a wide range of other variables (e.g., age, gender, payor, hospital/patient county, DRG, procedure, diagnoses, and year/quarter (1991-onward). There are additional 'drill down' capabilities enabling the user to obtain added detail. The Center for Health Information Analysis at the University of Nevada works with the state to make the hospital data available for purchase and through a series of 6 standardized reports that examine volume, charges, LOS, and patient age by hospital, payer, DRG, and patient county of origin. Customized reports and analyses are also available. They also produce an annual report called "Personal Health Choices" that presents discharge statistics for 39 common DRGs.
New Hampshire	Discharge data are reported to the New Hampshire (NH) Bureau of Health Statistics and Data Management. The hospital data are submitted electronically to the NH Hospital Association, which is under contract with the Department of Health and Human Services (DHHS) to collect the data. Data are used for health planning, as well as health and program evaluation. Among the reports identified on the DHHS website that used these data is an analysis of primary care access that includes hospitalization rates for ambulatory care sensitive conditions. Hospital discharge data have also been used in a report of injuries. The state hospital association website also includes inpatient utilization and

	market share trend reports that were compiled with these data.
New Jersey	The New Jersey (NJ) Department of Health and Senior Services has inpatient discharge data from 1976 onward. Anyone may purchase the non-confidential data, and approved researchers may purchase the confidential data. The state also makes a series of standardized report (data tables) available on the web. These reports show the volume, LOS, and charges, by DRG, payer and year; the inpatient case counts by hospital and payer; and principal diagnosis, and E-code by county of residence. The Department has also produced a series of 'consumer reports' showing risk-adjusted mortality rates for CABG by hospital and for individual surgeons. The Center for Health Statistics within the NJ Department of Health and Senior Services produces a "Topics in Health Statistics" series; one of these has used the inpatient discharge data to present a profile of inpatient hospitalizations in the state.
New Mexico	Submission of discharge data is required by NM and is maintained by the Health Policy Commission. The HPC issues an annual report that contains data on utilization, patient days and length of stay by condition, top diagnoses and procedures, charges and rates of hospitalization for ACSCs. The inpatient discharge data are also used for a short series of standard tables showing utilization statistics for specific conditions, and for the annual Quick Facts publication describing various aspects of the health care system in the state. NM has also published a consumer guide designed to help patients compare hospitals' performance in treating pneumonia and performing gall bladder surgery; this guide provides hospital-specific data on volume, and risk adjusted LOS and readmission rates.
New York	The New York State Department of Health has been collecting inpatient discharge data since 1979 as part of the Statewide Planning and Research Cooperative System (SPARCS). They produce an annual report with 19 standardized tables presenting discharges, LOS by age, sex, payer, service category, discharge status, hospital/patient county, principal diagnosis, procedure categories, etc. The data have also been used for a series of data tables on asthma hospitalizations, and for annual reporting of risk-adjusted outcomes by hospital and by physician for CABG.
North Carolina	All hospitals in North Carolina (NC) must submit discharge data; the NC Hospital Association contracts with Solucient to collect and process the data, and Solucient is required to provide copies of the annual file to the Division of Facility Services (without patient identifiers) and to the State Center for Health Statistics (SCHS), of the Division of Public Health in the NC Department of Health and Human Services (with patient identifiers). SCHS is responsible for maintaining the files, and for

	performing analyses for other DHHS agencies, as requested. The data files may be purchased from Solucient, and accessed through HCUPnet. SCHS has produced a number of "Special Studies" and "Statistical Briefs" on various topics using the discharge data. SCHS also produces a "County Health Data Book" which consists of detailed Excel data tables that can be downloaded from the web. This book uses data from many sources, but does include several tables based on the discharge data.
North Dakota	No information found.
Ohio	The Ohio Hospital Association uses a web-based tool "DECIDE" to collect inpatient data from member hospitals; participation appears to be voluntary. DECIDE is marketed as a decision support system, useful for strategic planning, quality improvement, etc. Types of information available from the system include patient origin, payer mix, utilization patterns. Reports or applications of this system were not identified.
Oklahoma	The Oklahoma (OK) Health Care Information System collects discharge data for use in "ongoing analysis, comparison and evaluation of trends in the quality and delivery of health care services…for purpose of effective health care planning by public and private entities and cost containment." The HCI reports on inpatient demographics, length of stay and costs, and leading discharge diagnoses for the state as a whole and demographic subgroups. Mapping software also appears to be used to derive rates of hospitalization by 3-digit zip code.
Oregon	The Oregon Association of Hospitals and Health Systems posts hospital-specific utilization measures on their website. However, it appears that these are derived from monthly utilization and financial summaries that hospitals submit through the DataBank System. The Oregon Department of Human Services draws upon the inpatient discharge data as part of its asthma surveillance system.
Pennsylvania	The Pennsylvania Health Care Cost Containment Council provides access to an interactive database and several reports that build upon the state's hospital discharge database. The "Hospital Performance Report" provides region-specific data on hospitals' volume of cases, mortality rate, LOS, charges and readmissions. The state's guide to CABG surgery uses hospital discharge data to report on CABG volume, mortality, and readmission rates for hospitals and surgeons practicing in these hospitals. Other reports include a study of drug-related inpatient hospitalizations by the Bureau of Narcotics, a report on hospital admissions for firearm related injuries, and a report on C-section deliveries. An interactive database provides access to county-level

	information on hospital utilization and performance.
Rhode Island	Rhode Island (RI) has required hospitals to submit data as a condition for licensing since 1989. RI has prepared a series of briefs "Health by Numbers" that focus on key health care topics, many of which use data from their inpatient system. In recent years, topics have included utilization of surgical procedures, hospitalization for mental health and substance abuse, hospitalizations for atrial fibrillation, gastric bypass surgery, structure fires injuries, trauma care, uninsured, anesthesia complications, asthma trends, cholecystectomies, and spinal cord injuries. The RI Office of Minority Health has also used the discharge data to report on access to care (e.g., percent of hospitalizations without health insurance) among minorities in the state, and to examine trends in hospital quality indictors. RI participates in the CODES system.
South Carolina	South Carolina maintains a query system that provides data on inpatient charges and average length of stay by selected characteristics and combination of characteristics that include: diagnosis, age, race, gender, and county. The system also provides data on the top 25 reasons for hospitalization by county, age, race and gender. Summary statistics may be generated for individual hospitals. Hospital discharge data has been used by the Office of Research and Statistics to obtain information on preventable hospitalizations and utilization of health services for a report on rural health. SC participates in the CODES project.
South Dakota	No information on data collection efforts was found.
Tennessee	The Tennessee (TN) Hospital Discharge Data System includes data on most of the elements in the UB92. Both inpatient and outpatient records are reported. TN maintains a web-based query system for hospital data, however it appears that this information is derived from hospital surveys rather than the discharge data. TN participates in CODES. The state has prepared a report that includes data on the hospitalization costs associated with automobile accidents by race, sex, and seat belt use.
Texas	The Texas Health Care Information Council has used discharge data to develop reports on preventable hospitalizations, characteristics of hospitalizations (e.g., top diagnoses, charges), and the costs of cancer in the state. The state also has several hospital-specific reports that contain data on volume indicators, mortality indicators for selected inpatient procedures, mortality indicators for selected inpatient conditions, and utilization indicators. These reports are designed to assist consumers compare and select hospitals. Data on rates of utilization of selected procedures are also available by hospital referral region.
Utah	Utah makes non-identifiable public-use datasets widely available, and also releases a restricted, identifiable database to approved researchers. They maintain several web-based query systems that can generate

	information on the number of discharges, LOS, and charges; crude and age-sex adjusted rates by county for selected conditions; and LOS and charges for various types of injuries. They currently produce an annual report profiling utilization and charges by hospital, and in prior years produced periodic reports on hospital utilization rates for conditions believed to be preventable or related to behavior/lifestyle choices, and on clinical and demographic profiles for the top 50 DRGs. They also produce a consumer guide to maternity care that shows charges by hospital for childbirth admissions. Additionally, the web site lists a small number of one-time reports on specialized topics.
Vermont	Vermont hospitals submit data to the Missouri Hospital Industry Data Institute (an independent data processor). The Vermont Explor system makes these data available (by request) to the public through a variety of standardized reports – patient origin reports, DRG reports, reimbursement reports, MDC reports. Hospital specific reports are also available, but they are only released to the hospital who submitted the data. The Vermont Program for Quality in Health Care draws upon the hospital discharge data as part of its larger report on quality of care in the state.
Virginia	Virginia Health Information (VHI) maintains patient-level data going back to 1993. VHI sells customized reports, and are planning to market patient origin reports soon. They maintain a web-based query system that uses discharge data to rate hospitals based on their performance for three types of cardiac care, showing the volume of cases treated by the hospital and hospitals' actual mortality relative to expected mortality.
Washington	Washington uses the CHARS (Comprehensive Hospital Abstract Reporting System) to compile hospital discharge data. The Department of Health (DOH) uses CHARS to analyze health trends in hospitalization, establish DRG weights, create case mix indices, and examine uses related to access, quality and cost containment. CHARS standard reports available through the WA DOH website include hospital census and charges by payer and DRG as well as patient origin census and charges. The state has published several consumer guides showing average hospital charges for common procedures, including childbirth. The Department of Health also makes a standardized tool for performing community-level health assessments (VistaPHw) available for downloading; the hospital discharge data are one of the databases that can be accessed through this tool.
West Virginia	The West Virginia (WV) Health Care Authority has collected discharge data since 1985. Data are limited to information in the UB and certain data elements, such as race, are not collected. The WV Authority indicates that "although …these data are useful in analyses of inpatient utilization and charges, they are not adequate to support in-depth quality

	of care analyses. A dataset to support such analyses would need to include such information as severity of illness, and outcome measures." WV data are available through HCUPnet and a link to that site is provided on the WV website. Additionally, WV has a web-based query system that allows users to obtain inpatient discharges, charges, inpatient days and LOS by DRG, ICD-9, sex and age groups, county, payer and other variables.
Wisconsin	Beginning January 2004 the Wisconsin (WI) Dept of Health and Family Services (Bureau of Health Information) transferred the collection of hospital inpatient data to the WI Hospital Association. Among the reports available on the WI website is a report on hospital safety, which was designed to assist consumers in selecting a provider. To further assist consumers in selecting hospitals WI provides data on average charges for selected inpatient diagnoses; these data are also available by county. An inpatient quality indicator report is designed for hospitals to use in benchmarking and for quality improvement efforts as well as a educational /general resource for payers and consumers. Two web-based query systems are maintained on the WI site. The first system WISH (Wisconsin Interactive Statistics on Health) provides information about health indicators, including injury-related hospitalizations. Data may be abstracted by cause of injury, geographic area, and characteristics of the population. The other system WITHIN (WI Inquiry Tool for Healthcare Information) provides information on number of hospitalizations, average charges, LOS by several variables that include sex, age, county, year, payer and discharge status. A "data specialist" version of the system that allows persons familiar with DRGs and ICD 9 coding to conduct a more refined search.
Wyoming	No information on Wyoming discharge data collection efforts was found. This information may be maintained in the "member's only" section.

Appendix C. List of Key Informants

Olga Armah
Associate Research Analyst
Connecticut Office of Health Care Access

Ihsan Azzam
Program Manager and Epidemiologist
Nevada Environmental Tracking System
Nevada State Health Division
Bureau of Community Health

Bruce Boisennault
Director
Niagara Health Quality Coalition

Shannon Callaway
Vice President
Subimo

Susan Cole
Director of Certificate of Need
Connecticut Office of Health Care Access

Mona Doshani
Epidemiologist
Louisiana Department of Health and Hospitals
Office of Public Health

Gary Davis
Vice President, Governmental Affairs
Colorado Health and Hospital Association

David Engler
Vice President, Data Services
Ohio Hospital Association

Susan Forbes
President and CEO
Hawaii Health Information Corporation

Norbert Goldfield
Medical Director
3M

Catherine Karr
Director
Pediatric Environmental Health Specialty Unit
University of Washington

Carla King
Principal
Carla King and Associates, Inc.

Richard Kipp
Consulting Actuary
Milliman USA

Arthur Levin
Director
Center for Medical Consumers

Sarah Loughran
Executive Vice President Information Technology
HealthGrades

Ranyan Lu
Medicare Informatics
Pacificare Health Systems

Michael Lundberg
Executive Director
Virginia Health Information

Mary Mort
Vice President DataBay Resources
Amerinet Central

Patricia L. (Penny) Nagler
Deputy Attorney General
Anti-Trust Section
California Office of the Attorney General

Matthew Neidell
Assistant Professor
Department of Health Policy and Management
Mailman School of Public Health
Columbia University

Greg Poulsen
Senior Vice President of Strategy
Intermountain Health Care

Mary Tyrell
Director of Data and Research
Department of Health and Demographics
South Carolina Office of Research and Statistics

Kristen Vincent
Executive Director
Brain and Spinal Injury Trust Fund Commission

Appendix D. Generic Protocol for Key Informant Interviews

Prior to the interview, we will have communicated with the informant to explain the purpose of the call and identify the application(s) we wish to discuss, and/or any broader-ranging questions we want to address. We will also have learned as much as possible about the application(s) through written materials available to us.

1. Perhaps you could begin by providing a little historical context for the application. What was the motivation for undertaking this work? What problem or issue was it designed to address? What did you hope to accomplish with the work?

2. How were the inpatient discharge data used? What specific data elements did you use? Were there any data elements from this file that were not available to you (e.g., due to confidentiality issues) but that would have helped your analysis? Was there any additional information not available in discharge data that would have helped?

3. Were there any problems with the data that you did use? (Prompt, if necessary: These might be quality concerns related to specific data items, non-reporting by certain types of hospitals, inability to capture out-of-state use, changes in definitions of variables over time, inability to identify and account for readmissions, etc.)

4. Did you incorporate data from any other source? Did this involve actually linking the discharge records with other databases? If so, what issues arose in the linking process?

5. If the discharge data had not been available, would you have been able to carry out this work? What other data would you have used in place of the discharge data? What analytic compromises would have been necessary?

6. How were the results of this work disseminated? Who were the intended end users?

7. Do you have any evidence that these results have been valuable to the end users? Are the intended users accessing the results? How are they using them? What concrete actions have been taken as a result of this work (e.g., law passed, quality improvement program initiated, outreach to special populations)? Can you quantify any benefits (e.g., cost savings, lives saved, errors avoided)?

8. Are you aware of others who are using hospital discharge data for similar purposes?

9. Is there anyone else you think I should speak with about this application and the related issues we've been discussing?

10. Thinking more generally now, not just about the use we've been discussing, what types of improvements would you recommend to hospital discharge dis charge databases?

11. What types of data systems do you think it would be helpful to build around hospital discharge data?

12. How do you think hospital discharge databases will fit into a future where everyone has an electronic health record?

Appendix E. Sample Entries from Electronic Citation Database

Entries from the Published Literature
(with comments fields (User 1 – User 5) for articles that were reviewed comprehensively)

Ref ID:	241
Ref Type:	Journal
Authors:	Derrow,A.E.; Seeger,J.M.; Dame,D.A.; Carter,R.L.; Ozaki,C.K.; Flynn,T.C.; Huber,T.S.
Title:	The outcome in the United States after thoracoabdominal aortic aneurysm repair, renal artery bypass, and mesenteric revascularization
Periodical, Full:	Journal of vascular surgery : official publication, the Society for Vascular Surgery [and] International Society for Cardiovascular Surgery, North American Chapter
Periodical, Abbrev:	J.Vasc.Surg.
Pub Year:	2001
Pub Date Free Form:	07//
Volume:	34
Issue:	1
Start Page:	54
Other Pages:	61
Descriptors:	Aged; Aged,80 and over; analysis; Aortic Aneurysm,Abdominal; Aortic Aneurysm,Thoracic; Arteries; classification; complications; Disease; Female; Florida; Hospital Charges; Hospitals; Human; International Classification of Diseases; Ischemia; Length of Stay; Male; Mesenteric Vascular Occlusion; methods; Middle Aged; mortality; Patients; Retrospective Studies; surgery; Survival Analysis; Treatment Outcome; United States
Abstract:	OBJECTIVES: The purpose of this study was to determine outcome and identify predictors of death after thoracoabdominal aortic aneurysm (TAA) repair, renal artery bypass (RAB), and revascularization for chronic mesenteric ischemia (CMI).Patients and Methods: In this retrospective analysis, data were obtained from the Nationwide Inpatient Sample, a 20% all-payer stratified sample of hospitals in the United States during 1993 to 1997. Patients were identified by the presence of a diagnostic or procedure code from the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM). The main outcomes we examined were death, ICD-9-CM -based complications, length of stay, hospital charges, and disposition. A multivariate model was constructed to predict death. RESULTS: A total of 2934 patients were identified (TAA, 540; RAB, 2058; CMI, 336) in the database. The mean age was comparable (TAA, 69 +/- 9 years; RAB, 66 +/- 12 years; CMI, 66 +/- 11 years), but the breakdown between the sexes varied by procedure (male: TAA, 53%; RAB, 55%; CMI, 24%). The mortality rate (TAA, 20.3%; RAB, 7.1%; CMI, 14.7%), complication rate (TAA, 62.2%; RAB, 37.4%; CMI, 44.6%), and the percentage of patients discharged to another institution (TAA, 21.2%; RAB, 9.3%; CMI, 12.0%) were clinically significant for all procedures. The mortality rate for RAB was greater when performed concomitant with an aortic reconstruction (4.4% vs 8.3%). All three procedures were resource intensive as reflected by the median length of stay (TAA, 14 days; RAB, 9 days; CMI, 14 days) and median hospital charges (TAA, $64,493; RAB, $36,830; CMI, $47,390). The multivariate model identified several variables for each procedure that had an impact on the predicted mortality rate (TAA, 14%-76%; RAB, < 1%-46%; CMI, < 2%-87%). CONCLUSIONS: The operative mortality rates across the United States for patients undergoing TAA repair and RAB are greater than commonly reported in the literature and mandate reexamining the treatment strategies for these complex vascular problems
Notes:	ID: 842; DA - 20010703 IS - 0741-5214 LA - eng PT - Journal Article SB - IM; RP: NOT IN FILE
Author Address/Affiliation:	Department of Surgery, University of Florida College of Medicine, Gainesville, USA
Links:	PM:11436075; 2
User 1:	DATABASE NAME: 1993-1997 Nationwide Inpatient Sample
User 2:	STATE/NATIONAL: 19 states
User 3:	DEPENDENT VARIABLES: In-hospital mortality, post-operative complications, LOS, charges, and discharge disposition
User 4:	TYPE OF APPLICATION: Outcomes of care.
User 5:	COMMENTS: Race data were not available for all states. The database contains only a limited amount of clinical information, which may be insufficient for risk adjustment or precise identification of procedures and conditions. Accuracy of data coding is unknown. Can examine only in-hospital mortality. Cannot track patients longitudinally; therefore do not know where patients who are discharged to another facility ultimately end up. The 3 procedures examined are relatively rare, so the volume of cases available for analysis is small, even using several years of this large database.
Created:	7/28/2004 8:54:44 AM
Last Modified:	11/15/2004 12:41:27 PM

Ref ID:	57
Ref Type:	Journal
Authors:	Dillingham,T.R.; Pezzin,L.E.; MacKenzie,E.J.
Title:	Discharge destination after dysvascular lower-limb amputations
Periodical, Full:	Archives of Physical Medicine and Rehabilitation
Periodical, Abbrev:	Arch.Phys.Med.Rehabil.
Pub Year:	2003
Pub Date Free Form:	11//
Volume:	84
Issue:	11
Start Page:	1662
Other Pages:	1668
Descriptors:	Aged; Amputation; Amputees; Artificial Limbs; congenital; Disease; Female; Health; Health Services; Hospitals; Human; Insurance,Health; Leg; Male; Maryland; Middle Aged; nursing; Patient Discharge; Patients; Peripheral Vascular Diseases; Prospective Studies; rehabilitation; Rehabilitation Centers; statistics & numerical data; Support,U.S.Gov't,P.H.S.; surgery; trends; utilization; Wisconsin
Abstract:	OBJECTIVE: To examine postacute care rehabilitation services use after dysvascular amputation. DESIGN: State-maintained hospital discharge data from the Maryland Health Services Cost Review Commission were analyzed. SETTING: Maryland statewide hospital discharge database. PARTICIPANTS: Persons discharged from nonfederal acute care hospitals from 1986 to 1997 with a procedure code for lower-limb amputation (ICD-9-CM code 84.12-.19), excluding toe amputations. Those persons with amputations due to trauma, bone malignancy, or congenital anomalies were excluded. INTERVENTIONS: Not applicable. MAIN OUTCOME MEASURES: Postacute care service utilization. RESULTS: There were 16,759 discharges with an amputation procedure over this period. The average age was 69.3+/-14.3 years, and 51.9% were men. Black persons comprised 42.4% of the sample. Diabetes was present in 42.0%, and peripheral vascular disease was noted for 66.1% of amputees. Amputations were at the foot (19.4%), transtibial (38.1%), and transfemoral (42.4%) levels. The largest proportion (40.6%) of patients was discharged directly home after acute care, 37.4% went to a nursing home, 9.2% went home with home care, and 9.6% were discharged to an inpatient rehabilitation unit. From 1986 to 1997, there were downward trends in the rate of discharges directly home and corresponding upward trends in nursing home and inpatient rehabilitation dispositions. CONCLUSIONS: Inpatient rehabilitation use is infrequent after dysvascular amputation. Prospective studies are necessary to examine outcomes for persons receiving rehabilitation services in different care settings to define the optimal rehabilitation venue for functional restoration
Notes:	ID: 4654; DA - 20031125 IS - 0003-9993 LA - eng PT - Journal Article SB - AIM SB - IM; RP: NOT IN FILE
Author Address/Affiliation:	Department of Physical Medicine and Rehabilitation, Medical College of Wisconsin, Milwaukee, 53226, USA. tdilling@mcw.edu
Links:	PM:14639567; 2
User 1:	DATABASE NAME: 1986-1997 Maryland Health Services Cost Review Commission discharge data
User 2:	STATE/NATIONAL: Maryland
User 3:	DEPENDENT VARIABLES: Discharge to selected post-acute care settings
User 4:	TYPE OF APPLICATION: Health services and clinical research.
User 5:	COMMENTS: Unique patient identifiers were not available. Patients may have been counted more than once, leading to false inflation of the incidence rate. ICD-9-CM codes specific to amputation as a result of vascular disease are not available. A sample selection strategy that excluded persons with traumatic cause of amputation was used. This approach may have resulted in inaccuracy in classifying cases.
Created:	5/17/2004 1:13:22 PM
Last Modified:	5/17/2004 1:49:24 PM

Ref ID:	1239
Ref Type:	Journal
Authors:	Aiken,L.H.; Clarke,S.P.; Sloane,D.M.; Sochalski,J.; Silber,J.H.
Title:	Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction
Periodical, Full:	JAMA : the journal of the American Medical Association
Periodical, Abbrev:	JAMA
Pub Year:	2002
Pub Date Free Form:	10/23/
Volume:	288
Issue:	16
Start Page:	1987
Other Pages:	1993
Descriptors:	Adult; Affect; Aged; Burnout,Professional; California; complications; Cross-Sectional Studies; Death; epidemiology; Evaluation Studies; Female; Health; Health Services Research; Hospital Bed Capacity,100 to 299; Hospital Mortality; Hospitals; Hospitals,General; Human; Job Satisfaction; Legislation; Male; manpower; Middle Aged; mortality; Nurses; nursing; Nursing Research; Nursing Service,Hospital; Nursing Staff,Hospital; Odds Ratio; Outcome and Process Assessment (Health Care); Patients; Pennsylvania; Personnel Staffing and Scheduling; Philadelphia; psychology; Research; standards; supply & distribution; Support,U.S.Gov't,P.H.S; surgery; Surgical Procedures,Operative; Teaching; United States; Universities; Workload
Abstract:	CONTEXT: The worsening hospital nurse shortage and recent California legislation mandating minimum hospital patient-to-nurse ratios demand an understanding of how nurse staffing levels affect patient outcomes and nurse retention in hospital practice. OBJECTIVE: To determine the association between the patient-to-nurse ratio and patient mortality, failure-to-rescue (deaths following complications) among surgical patients, and factors related to nurse retention. DESIGN, SETTING, AND PARTICIPANTS: Cross-sectional analyses of linked data from 10 184 staff nurses surveyed, 232 342 general, orthopedic, and vascular surgery patients discharged from the hospital between April 1, 1998, and November 30, 1999, and administrative data from 168 nonfederal adult general hospitals in Pennsylvania. MAIN OUTCOME MEASURES: Risk-adjusted patient mortality and failure-to-rescue within 30 days of admission, and nurse-reported job dissatisfaction and job-related burnout. RESULTS: After adjusting for patient and hospital characteristics (size, teaching status, and technology), each additional patient per nurse was associated with a 7% (odds ratio [OR], 1.07; 95% confidence interval [CI], 1.03-1.12) increase in the likelihood of dying within 30 days of admission and a 7% (OR, 1.07; 95% CI, 1.02-1.11) increase in the odds of failure-to-rescue. After adjusting for nurse and hospital characteristics, each additional patient per nurse was associated with a 23% (OR, 1.23; 95% CI, 1.13-1.34) increase in the odds of burnout and a 15% (OR, 1.15; 95% CI, 1.07-1.25) increase in the odds of job dissatisfaction. CONCLUSIONS: In hospitals with high patient-to-nurse ratios, surgical patients experience higher risk-adjusted 30-day mortality and failure-to-rescue rates, and nurses are more likely to experience burnout and job dissatisfaction
Notes:	ID: 5736; DA - 20021021 IS - 0098-7484 LA - eng PT - Evaluation Studies PT - Journal Article SB - AIM SB - IM; RP: NOT IN FILE
Author Address/Affiliation:	Center for Health Outcomes and Policy Research, School of Nursing, University of Pennsylvania, 420 Guardian Dr, Philadelphia, PA 19104-6096, USA. laiken@nursing.upenn.edu
Links:	PM:12387650; 2
Created:	10/21/2004 6:07:57 AM
Last Modified:	10/21/2004 6:07:58 AM

Entries from the Unpublished Literature

Ref ID:	1172
Ref Type:	Abstract
Authors:	Asthma Initiative of Michigan and the Michigan Department of Community Health
Title:	Epidemiology of Asthma in Michigan: 2004 Surveillance Report
Pub Year:	June 2004
Abstract:	The Michigan Inpatient Database for the years 1990 to 2001 was one source of data used in this report on the extent and burden of asthma in the state. Age-adjusted asthma hospitalization rates are presented by sex, race, income, month of admission, year, and county of residence. Rates are age-adjusted so that valid comparisons can be made between populations of different age distributions. Estimates of the cost of asthma hospitalizations in Michigan are derived from state data accessed through HCUPnet.
Links:	http://www.michigan.gov/documents/MIAsthmaSurveillance_2004_96083_7.pdf
User 1:	STATE: Michigan
Created:	8/18/2004 12:22:38 PM
Last Modified:	8/20/2004 6:54:24 AM

Ref ID:	174
Ref Type:	Abstract
Authors:	Health & Demographics Section, Office of Research & Statistics, South Carolina State Budget & Control Board
Title:	Inpatient Hospital Discharge Database Query
Pub Year:	Updated 2002
Abstract:	South Carolina's Office of Research and Statistics maintains several web-based query systems that permit the user to construct customized tables derived from data in the hospital discharge database. Available queries include: (1) analysis of charges and/or length of stay by diagnosis, age, race, sex, payer, and/or county, health district, or health service area, (2) top 25 reasons for inpatient hospitalization by county of residence, age, race, and/or gender; (3) number and rate of hospital discharges by county, diagnosis, age, race, and/or sex; (4) hospital-specific reports showing the county of origin of its patients and its market share for each county; (5) hospital-specific reports showing length of stay, average daily census, use rates, and market population; and (6) county-level reports showing the county of service for all residents discharged from a hospital outside their home county. Multiple years of data may be accessed through these queries.
Links:	http://www.ors2.state.sc.us/inpatient.asp
User 1:	STATEl|: South Carolina
Created:	7/9/2004 2:20:43 PM
Last Modified:	8/6/2004 1:42:24 PM

Ref ID:	1190
Ref Type:	Abstract
Authors:	Vermont Program for Quality in Health Care, Inc.
Title:	The Vermont Health Care Quality Report, 2003
Pub Year:	Updated 2003
Abstract:	The Vermont Hospital Discharge Data Set (VHDDS) is one of many sources of data used for this series of annual reports on quality of care in the state. Similar reports have been produced since 1997. These reports are patterned after the National Quality Report of the National Academy of Science. The 2003 report presents within-state geographic variation in age-adjusted hospitalization rates for specific procedures, and comparisons between state and national data on LOS and hospitalization rates by age and type of admission, for 1997 to 2001. The state database captures hospitalizations for Vermont residents, including those treated at the state's VA hospital and those discharged from hospitals in the neighboring states of New Hampshire, New York, and Massachusetts. The national comparison statistics are drawn from the National Inpatient Sample.
Links:	http://www.vpqhc.org/QualityReports/index.htm; http://www.vpqhc.org/QualityReports/qr2003/QR2003.PDF
User 1:	STATE: Vermont
Created:	8/24/2004 8:56:17 AM
Last Modified:	10/7/2004 12:08:31 PM