

# Severity of illness and evaluation of hospital performance

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**Starting by the clarification of the importance of hospital performance evaluation, this article focus on the measurement of the «case-mix» that a hospital treats and why that is crucial for the evaluation of quality of care and use of resources.**

**After describing Disease Staging, the authors provide examples of its possible applications, such as timing of hospitalization, case-mix classification and quality of care assessment.**

**Since etiology and stage of disease are directly related to the use of resources and mortality, there is a need for clinical specificity when comparing outcomes and resource use, whether the focus is at the level of an individual physician, a hospital product line, or an entire institution.**

**The evaluation of care given in a hospital should document the health status of the patient before and during medical intervention, at the time of discharge and, depending on the nature of the problem, after the patient leaves the hospital. The authors conclude that medical care evaluation studies that fail to consider the health care status of the patient when first seen by the physician, will lead to inappropriate**

**analyses of care received by the patient. Without clear definitions, hospitals, physicians, payers and society will be unable to establish priorities, squandering time and money as a result.**

**Keywords: hospital performance evaluation; hospitals; severity; quality assessment.**

Hospitals are complex and costly institutions. The evaluation of hospital performance is important to those paying for health care, the community served by the hospital, the physicians and other professionals providing care in the hospital, the management of the hospital, and to the patients and their families treated in the hospital. This article will focus on the measurement of the «case-mix» that a hospital treats and why that is crucial for evaluation of quality of care and the use of resources.

Measurement of severity of illness is required to evaluate diagnostic efficiency of physicians, assess quality of care, understand utilization of health services, design clinical trials, and reimburse hospitals on the basis of output. «Disease Staging» is a method for measuring severity of specific, well-defined diseases. Staging defines discrete points in the course of individual diseases that are clinically detectable, reflect severity in terms of risk of death or residual impairment, and possess clinical significance for prognosis and choice of therapeutic modality. Medical staging criteria have been developed for 400 diagnoses and converted into «coded» criteria for the

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major diagnostic coding systems. These criteria can be efficiently applied to computerized hospital discharge abstracts to derive a comprehensive case-mix classification system. After describing the Disease Staging system, we provide examples of its use in evaluation of hospital performance.

## 1. Disease Staging

Where? Why? How serious? These are the basic questions that a clinician must attempt to answer when a patient presents with a medical problem. The same questions must be answered to make appropriate comparisons in studies of outcomes, quality, or costs of care. The «where» is the specific organ or system of the body; the «why» is the etiology of the problem; and the «how serious» is the pathophysiologic changes that have occurred and the ranking of the disease's complications.

Physicians use information from a patient's history, physical examination, laboratory findings, and other diagnostic tests to answer these questions in order to diagnose a disease, to estimate the patient's prognosis, and to prescribe appropriate treatment. Ideally, answers should be available before therapeutic intervention. Even in those cases when definitive answers may not be available and treatment must be given, it should be based on the presumptive answers to these questions.

Disease Staging is a classification system that uses diagnostic findings to identify clusters of patients who require similar treatment and have similar expected outcomes. It can serve as the basis for clustering of clinically homogeneous patients to assess quality of care, analyze clinical outcomes, review utilization of resources, assess efficacy of alternative treatments, and assign credentials for hospital privileges.

Ideally, a diagnostic label should have explicit data about the location of the health problem, the cause of the problem, and the severity of the problem. The majority of diagnostic labels identify the site of the disease (e. g., appendicitis, cholecystitis, diverticulitis, and peptic ulcer). Some provide information about the system involved and cause of the problem (e. g., pneumococcal pneumonia and urinary tract infection caused by *E. coli*). Other diagnostic labels are manifestations of problems (e. g., hypertension and anemia). A few, because of the body system involved, also convey a degree of severity (e. g., myocardial infarction or bacterial meningitis). And some may even be distinguished by the time of onset (e. g., congenital toxoplasmosis).

Only in the discipline of cancer has the medical profession developed a diagnostic classification that in-

cludes severity based on the understanding of the need to measure the efficacy of various treatments for similar clusters of patients. Now that society is challenging the medical profession to document quality of care in a more objective manner, similar measurement instruments are needed for all medical problems.

## 2. Disease Staging criteria

The Disease Staging criteria define levels of biological severity for specific medical diseases, where severity is defined as the risk of organ failure or death (Gonnella *et al.*, 2003; Gonnella, Hornbrook and Louis, 1984). The classification is based on the severity of the pathophysiologic manifestations of the disease:

- Stage 1: a disease with no complications;
- Stage 2: the disease has local complications;
- Stage 3: the disease involves multiple sites, or has systemic complications;
- Stage 4: death.

Subdivisions of these stage levels have been defined to allow more precise classification. The challenge is to include enough detail to allow for a rich description of each disease and yet not be so overwhelmingly complete that the staging is cumbersome.

In the definition of the staging criteria, most of the diseases begin at stage 1 and continue through stage 4. There are several exceptions to this rule. Some self-limiting diseases, such as cataracts, do not include a stage 3 or 4. Other criteria begin at either stage 2 or 3 since they are often complications of other diseases (e. g., bacterial meningitis, which can be a complication of sinusitis, otitis media, or bacterial pneumonia). Stage 0 has also been included in the classification of diseases for patients with a history of a significant predisposing risk factor for the disease, but for whom there is currently no pathology (e. g., history of carcinoma or a newborn baby born to a mother suspected of having an infection at the time of delivery).

The stage levels are ordinal in nature for each medical problem. Stage 1 of one disease may have different implications for resource use, treatment, and prognosis than a similar stage of another disease. For example, hyperglycemia (stage 1 diabetes mellitus) is different than positive serological evidence of AIDS (stage 1). Even when major pathophysiologic damage exists such as coma, which in all diseases is a stage 3 complication, the prognosis may be different for each disease since for some there is treatment

which may reverse the complication. Treatment, whether medical or surgical, has not, however, been introduced into the staging classification; staging is driven by the natural history of the disease. Nor has quality of life been taken into consideration in Disease Staging. Controlling for other factors (e. g., choice of treatment, age, and presence of co-morbid disease), risk of death is a function of etiology and stage of disease. While this risk generally increases with each higher stage level, it may vary dramatically by stage from one disease to another.

It is important to distinguish the etiology of a disease whenever possible. For example, «pneumonia» does not specify etiology. Designating that the pneumonia was bacterial in origin would be an improvement, (e. g., «bacterial pneumonia»), but optimally a physician should document the specific bacteria causing the pneumonia (e. g., pneumococcal pneumonia).

Health problems, such as congestive heart failure, and laboratory findings, such as anemia, that may result from a variety of causes, are not diagnoses. When such problems are recorded is the only evidence and stated as the patient's «diagnosis», the implication is that the physician did not know, or did not document, the disease process that produced the problem. Unfortunately, many users of medical information fail to distinguish between non-specific health problems (e. g., symptoms and laboratory findings) and diagnoses of specific diseases (Louis *et al.*, 2004). As a result, patients may be inappropriately classified for the purposes of reimbursement, for the analysis of resource utilization, and for the assessment of quality of care.

Examples of the Disease Staging classification for appendicitis and bacterial pneumonia are shown in *Tables I and II*.

**Table I**  
Disease Staging criteria — appendicitis

Stage	
1.01	Appendicitis
2.01	with localized peritonitis abscess
2.02	and intestinal obstruction
2.03	with perforation and generalized peritonitis
2.04	with pylephlebitis or liver abscess
3.01	with sepsis
3.02	with shock

**Source:** GONNELLA, J. S., *et al.*, eds. — Clinical criteria for Disease Staging, 5th edition. Ann Arbor, Mich : Thomson-MEDSTAT, 2003.

**Table II**  
Disease Staging criteria — bacterial pneumonia (specify etiology)

Stage	
1.01	Pneumonia in one lobe
2.01	with bacteremia
2.02	with epiglottitis
2.03	with empyema
2.04	with lung abscess or bronchopleural fistula or bronchopleural cutaneous fistula
2.05	with diffuse involvement of multiple lobes
2.06	with septic arthritis
2.07	with osteomyelitis
2.08	with peritonitis or subphrenic abscess
2.09	with pericarditis
3.01	with endocarditis
3.02	with meningitis
3.03	with congestive heart failure
3.04	with sepsis
3.05	with respiratory failure
3.06	with shock

**Source:** GONNELLA, J. S., *et al.*, eds. — Clinical criteria for disease Staging, 5th edition. Ann Arbor, Mich : Thomson-MEDSTAT, 2003.

### 3. Applications of Disease Staging

Disease Staging is a valuable tool in many clinical, research, management, and educational studies. Examples of how Disease Staging has been used to classify patients for a number of applications are highlighted below.

#### 3.1. Timing of hospitalization

Disease Staging may be used to document potential quality of care problems in ambulatory settings by providing data relating to patients' severity of illness at the time of hospitalization (Gonnella and Louis, 1988a). Patients admitted to the hospital with advanced stages of illness represent possible failures of outpatient care. For example, an admission for cellulitis secondary to diabetes mellitus might have been preventable if the disease progression could have been averted with appropriate outpatient care (Gonnella *et al.*, 1990; Louis, Gonnella and Zeleznik, 1988).

For some diseases, such as appendicitis, hospitalization is clearly appropriate at the earliest stage of the disease. Other diseases, such as essential hypertension, rarely require hospitalization at the early stages; hospitalization is only required if the disease progresses to more advanced stages.

Because admitting patients to an acute care hospital involves incurring significant cost and potential risk, patients should be admitted to the hospital only if the expected benefits outweigh the costs and risks of the admission. Questions to address include: is inpatient diagnostic testing required? Do the symptoms suggest a serious illness which, if confirmed, may require immediate treatment? Does the patient require treatment that is most appropriately provided as an inpatient? Does the patient require the types of monitoring and nursing care available only in an acute care hospital?

Classification of severity of illness at the time of hospitalization is important for analysis of both inpatient and outpatient care. Comparisons of inpatient care outcomes can be accomplished only if one adjusts for patient risk at time of admission.

For patients admitted at earlier stages of illness, one may question whether an acceptable level of care could have been provided in an outpatient setting. A number of factors could make such an earlier stage admission appropriate. For example, a patient with acute symptoms (e. g., chest pain), but without a confirmed diagnosis, may be appropriately admitted to the hospital until a diagnosis and a decision can be made as to whether further inpatient care is neces-

sary. A patient may have other co-morbid conditions (for example, poorly controlled diabetes mellitus) that make the admission advisable, or a patient may choose to undergo an elective surgical procedure that must be performed as an inpatient. A patient with osteoarthritis of the hip who decides to have a total hip replacement would clearly require hospitalization.

For patients hospitalized at more advanced stages, the issue is whether the patient has complications that could have been preventable with earlier inpatient care. For example, a patient admitted with acute cholecystitis and gangrene of the gallbladder has a serious complication that may have been prevented with earlier hospitalization and treatment.

Timeliness of admission is, in part, a function of whether hospitalization is the first or subsequent admission for a particular complication of episode of care. For example, a first admission at advanced-stage cancer should raise questions about whether earlier detection was feasible. Subsequent scheduled admissions for the same patient to undergo chemotherapy would not, of course, raise the same question.

It is important to differentiate the concept of a timely admission from a preventable admission. For example, an admission at stage 1 appendicitis is timely and, given current medical knowledge, not preventable. Such an admission does not raise issues of appropriateness of care. On the other hand, while an admission for stage 2.5 diabetes mellitus and cellulitis is also timely, it may have been a preventable admission if the disease progression could have been averted with appropriate outpatient care.

#### 3.2. Case-mix classification for analysis of resource utilization and reimbursement (Conklin *et al.*, 1984)

Disease Staging should be an integral part of systems designed to analyze resource utilization. Differences in length of stay and cost may result from differences in patient populations treated, as well as from differences in efficiency. Etiology and stage of disease are directly related to the use of resources and must be considered in these types of analyses, whether the focus is at the level of an individual physician, a hospital product line, or an entire institution.

In addition to the stage of the principal disease, other variables to be included in analysis of utilization include: presence of co-morbid, or co-existing, medical problems (e. g., presence of diabetes mellitus in a patient hospitalized for appendicitis — both the diabetes mellitus and appendicitis should be staged);

reason for admission (e. g., for diagnostic purposes, therapeutic purposes, both diagnosis and therapy, chemotherapy, or observation); and the use of surgical procedures or special units (e. g., ICU, CCU), if such use is justified by the needs of the patient.

Use of resources depends on the clinical status of the patient, the reason for admission, and whether the latter is the first or one of many re-admissions. For instance, a woman with stage 3 cancer of the breast will consume more resources during the first hospitalization, when more diagnostic and therapeutic interventions will be used, than on her third hospitalization, when for the same problem she may likely receive only chemotherapy or radiation therapy. In addition, the social support needs of the patient should be considered, although this variable would have a greater impact on timing of hospitalization and length of stay than on the diagnostic or therapeutic intervention.

By using Disease Staging, variations in resource use resulting from patient differences can be controlled, thereby allowing the manager or researcher to appropriately focus on the analysis of differences resulting from variation in physician and institutional practices (Louis *et al.*, 1996). For similar reasons, reimbursement systems should be modified to account for differences in severity of illness (McKee and Petticrew, 1993).

### **3.3. Quality of care assessment (Gonnella and Louis, 1988b; Gonnella and Louis, 1992)**

Whether the goal is assessment and improvement of the process of care or evaluation of clinical outcomes, there is a need for clinical specificity. The centers for medicare and medicaid services (CMS) and several statewide data organizations publish institution-specific, and in some cases physician-specific, information on outcome measures such as mortality. Without appropriate ways to account for differences in the severity of the patient mix treated, the relevance of these types of analyses is questionable. For example, analysis of data from the National Hospital Discharge Survey demonstrated a 5.6% mortality rate for patients hospitalized with stage 1 bacterial pneumonia, 9.5% for those with stage 2, and a 33.1% mortality rate for stage 3. These estimates were further refined by considering the specific etiology (organism) of the pneumonia (Gonnella and Louis, 1995).

As a part of a quality improvement program, these types of advanced-stage admissions should be reviewed to evaluate whether they resulted from physician-related problems (e. g., delayed or incorrect

diagnosis or treatment), patient-related problems (e. g., failure to seek timely care or comply with prescribed treatment), system problems (e. g., lack of access to care), or were not preventable (e. g., resulting from rapid disease progression in a particular patient) (Louis *et al.*, 1999; Taroni *et al.*, 1997).

Disease Staging can also be used as a direct measure of patient outcomes by studying changes in disease stage over time. For instance, severity at hospital admission can be compared with severity at discharge. Patient-based longitudinal data can be used in conjunction with Disease Staging to assess changes in severity of illness or define populations and specific episodes of care.

Another valuable use of Disease Staging is the evaluation of processes as well as outcomes of medical care. A great deal of activity is currently being devoted to the development of clinical guidelines designed to reduce uncertainty and help guide the process of care. One of the difficulties faced in guidelines development is that the appropriateness of a specific diagnostic test or prescribed treatment varies by stage of disease. By defining stage-specific criteria, it is possible to improve the specificity of clinical guidelines and process review criteria and to make them more useful and acceptable to clinicians.

### **3.4. Professional staffing and facility planning in health care institutions**

Severity of illness, as documented by Disease Staging, may be used to evaluate the appropriateness of current or planned staffing levels within hospitals or managed care institutions in relationship to patients' health care needs. Staging can provide severity-level data for specific patient groups that may justify establishing or expanding special care units or securing special diagnostic equipment or other facilities.

### **3.5. Specialty board certification and clinical privileges**

A major responsibility of medical specialty boards is the development and administration of procedures and examinations for board certification and re-certification. Disease Staging has been used to classify the content of test items from the board certification/re-certification examinations administered by the American Board of Family Practice and to analyze medical licensing examinations in Japan. Each item on the examination is classified by organ system, etiology, and stage of illness, along with other dimensions such as the age group affected and whether

the item focuses on diagnosis or management (Pisicano *et al.*, 1989; Kaga and Gonnella, 1990). Use of this type of classification enables the specialty board to assess the current mix of items and begin to develop a «blueprint» to guide development of future examinations. For example, by using Disease Staging, one can refine the assessment of the physician's knowledge of diabetes mellitus management to assure that there is an appropriate mixture of items relevant to the early stages, as well as prevention and management of specific advanced-stage complications.

Disease Staging can be used in the assignment of hospital clinical privileges (Nash, Louis and Gonnella, 1990). Currently, the delineation of clinical privileges is primarily procedure-oriented, even in the medically-oriented specialties. For example, a general internist may be «credentialed» to perform procedures such as arterial puncture, thoracentesis, and lumbar puncture. However, the skills necessary to successfully perform an arterial puncture say very little about the physician's ability to diagnose or manage the complex patient with advanced-stage medical problems.

Disease Staging can be used to delineate disease-specific privileges that more appropriately reflect the clinical challenges of patient management. For example, a board certified general internist may have the appropriate education and experience to manage early stage diabetes mellitus, but not to manage a patient admitted for hyperosmolar coma. Potentially, the volume and outcomes of stage-specific experience could also be monitored, as is increasingly done for surgical volume and outcomes, to reassess the privileges assignment.

### 3.6. Medical education

A significant part of both undergraduate and graduate medical education involves increasing levels of patient care responsibility as the experience of the student/physician increases. Disease Staging can be used as part of systems designed to document these clinical experiences (Rattner *et al.*, 2001; Markham *et al.*, 2002). For example, what is the mix of severity of illness of patients with diabetes mellitus seen by medical students? Does the student have adequate experience managing a patient with this disease to avoid, as well as in treating complications which may occur? Does this vary depending on the site where the students perform their clerkship? Is there significant variation from student to student?

Similarly, Disease Staging concepts can be used to evaluate the content of the curriculum. To what extent

does the medical curriculum address stage 1 illness and to what extent does it address stage 3 illness? To what extent is attention devoted to problems associated with particular body organ systems or to problems of a particular etiological nature?

Use of Disease Staging can also help the student and resident become more effective diagnosticians. By understanding the evolution of a disease, the physician will use the laboratory more effectively and avoid delay in arriving at an accurate diagnosis (Gonnella *et al.*, 1993).

## 4. Conclusion

The determination of what is beneficial and affordable in medicine has always been a challenge. Given the increasing cost of medical care, this challenge is receiving attention from physicians, health services researchers, economists, government officials, and the public. Hospital specific data on costs (charges) and outcomes of care are now available to the public. Unfortunately, these data are being released without their limitations being fully understood. While mortality results, hospital costs (charges), and patients' satisfaction are all clues that require additional analyses to understand their cause, the data are often global and too superficial to be interpreted. They may unfairly suggest, for example, that the hospitals of physicians with the highest mortality provide marginal or poor care, but they fail to adequately consider the severity of the problems being treated.

This article has focused on the need for clinical specificity when comparing outcomes and resource use. Without clear definitions, hospitals, physicians, payers, and society will be unable to establish priorities. As a result, time and money will be squandered. The long-run savings in resources is important to bear in mind because outcome studies will be costly. New personnel need to be trained to collect data and analyze information using sophisticated techniques. Also, once the data are collected, who will receive them? We may very well overwhelm the public with information that has little clinical relevance, and which is difficult to understand and use appropriately.

Utilization of medical services and quality of care are affected by many variables, including the competence of the physician and other health professionals, the environment of the institution in which the physician practices, the contribution of the patient, and the patient's social environment and support systems. Medical care evaluation studies that fail to consider the health care status of the patient when first seen by the physician will lead to inappropriate analyses and

ineffective recommendations (e. g., inappropriate educational programs or unjustified restriction of a physician's medical privileges) which will not solve the identified problems.

Evaluation of care given in a hospital should document the health status of the patient before and during medical intervention, at the time of discharge, and, depending on the nature of the problem, data may need to be collected after the patient leaves the hospital. The change before and after medical intervention is a reflection of the care received by the patient, although factors beyond the physician's or hospital's control may also be responsible for the change.

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## □ Resumo

### SEVERIDADE DA DOENÇA E AVALIAÇÃO DA PERFORMANCE DO HOSPITAL

Começando pela clarificação da importância da avaliação da performance do hospital, este artigo centra-se na aferição do *case-mix* do hospital e na questão da sua importância crucial para a avaliação da qualidade dos cuidados e da utilização dos recursos de saúde.

Após uma descrição do Disease Staging, os autores dão exemplos das suas possíveis aplicações: a adequação da admissão, a classificação em *case-mix* e a qualidade da avaliação dos cuidados.

Uma vez que a etiologia e a severidade da doença estão directamente relacionadas com a utilização dos recursos e com a mortalidade, existe a necessidade de uma especificação clínica quando se compara a utilização de resultados e de recursos, quer a tónica se centre ao nível do médico, de uma linha de produção do hospital ou da instituição hospitalar como um todo.

A avaliação dos cuidados prestados num hospital deve incluir elementos sobre o estado de saúde do doente antes e durante a

intervenção médica, na altura da alta e, dependendo da natureza do problema, depois de o doente ter deixado o hospital.

Os autores concluem que os estudos de avaliação dos cuidados médicos que não considerem o estado de saúde do doente quando é visto pela primeira vez pelo médico conduzirão a interpretações erradas sobre os cuidados recebidos por esse doente.

Sem definições claras, os hospitais, os médicos, os utentes e a sociedade não serão capazes de estabelecer prioridades, desperdiçando, assim, tempo e dinheiro.

Palavras-chave: avaliação do desempenho de hospitais; hospitais; severidade; avaliação da qualidade.