Letter To the Editor.

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LETTERS TO THE EDITOR

To the Editor:

In a recent editorial (*J Trauma* 31:1049, 1991), Dr. Howard Champion commented on an article that we co-authored entitled, "Defining the Major Trauma Patient and Trauma Severity," (*J Trauma* 31:1125, 1991). In the article itself, we presented criteria for defining the major trauma patient which can be used in retrospective analyses with any discharge abstract data base. These criteria are based on patient management categories (PMCs), a computerized and clinically specific classification of injuries and other comorbid and complicating conditions. Patient management categories, the only major alternative to diagnosis related groups (DRGs) for classifying trauma and non-trauma patients in large data bases, were shown to facilitate the identification of patients with multiple as well as single injuries who *require* tertiary level care.

Injury PMCs actually identified major trauma patients more accurately and more specifically than other frequently used measures of severity which are only available in trauma registry data (i.e., AIS and ISS). In addition, unlike these other measures, PMC tertiary criteria can be applied readily to data routinely collected at both trauma centers and non-trauma centers, thus facilitating evaluation of trauma systems and patient outcome assessment.

In Dr. Champion's editorial about this article, there were certain statements that seem to represent a misunderstanding of the conceptual and clinical underpinnings of the PMC system.

One major issue that is of concern to Dr. Champion, and to many other physicians as well, is the use of the *International Classification of Disease* (ICD) codes as the basis of patient category definitions. This seems to be a problem for physicians because most are aware of the serious clinical deficiencies of ICD-based DRGs and because most have never seen ICD codes used effectively to define clinical conditions. Just because DRGs are inadequate, however, does not mean that the ICD diagnosis codes cannot be put together in clinically meaningful ways.

Think for a moment that the ICD codes are an alphabet. That alphabet can be put together to form words (PMCs) or gibberish (DRGs). Certainly, it is clear that DRGs do not offer meaningful clinical categorizations, but it is not because of their basis in ICD codes per se. Rather, it is the way in which ICD codes are aggregated by the DRG algorithm (e.g., being driven by the principal diagnosis code and allowing only one DRG per patient) that makes their results so unintelligible.

By contrast, the way ICD diagnosis codes are aggregated by the PMC algorithm is significantly different from the way they are used in any other classification. For example, all available diagnosis codes (in many cases, up to 20) are used in defining PMCs, the sequence in which codes are listed on the patient's record is disregarded, and more than one PMC can be assigned to each patient depending on the injuries sustained, comorbid conditions, and complicating factors.

ICD codes, in spite of certain clinical limitations, are recorded by hospitals nationwide (as well as internationally). Thus, they provide the most comprehensive and available data source to analyze the epidemiology of injuries and the effectiveness and costs of trauma care. An example will help illustrate how the PMC system overcomes the limitations of certain codes and coding practices to identify clinically specific patient types.

Since there is no single ICD code for pelvic ring fracture,* such patients could not, in the past, be differentiated in computerized registry, hospital, or regional data bases. Obviously, severity indices (scalar values such as TRISS or AIS) cannot be used to select injury types; nor can DRGs be used to identify these patients. The fact is that pelvic ring fractures must be identified using combinations of ICD diagnosis codes before any physiologic values, treatments, or outcomes can be assessed. The PMC algorithm searches for these multiple diagnosis codes that are necessary to define a pelvic ring fracture, thus actually identifying certain types of patients that heretofore were not possible to extract from large, computerized data bases.

Dr. Champion correctly states that it is not possible to go to a DRG data base and pull out a complete set of data for injured patients by DRG code. Unfortunately, in his editorial, he does not then go on to acknowledge that you can do precisely that with PMCs. In fact, in a recent article published in the *Journal of Trauma* (Young J, Macioce D, Young W: Identifying injuries and trauma severity in large databases. 30:1220, 1990), PMCs were shown to have greater sensitivity and overall accuracy in identifying trauma patients and defining trauma severity than trauma registry selection criteria.

Unlike other injury classification and severity systems, PMCs offer a way of organizing the numerous ICD diagnosis codes that are routinely recorded by *all* hospitals—not just trauma centers—on *all* patient discharges. To disregard the potential trauma applications of this data base that are possible using PMCs would be a serious strategic error in addressing regionalization and trauma reimbursement issues.

The other major concern that Dr. Champion has relates to his misconception that disease categories are defined using therapies. The fact is that the injury PMCs, as described in the original article, are primarily defined based on combinations of diagnosis codes—NOT on treatment or therapies. In some cases, these disease or injury categories are subdivided by the presence of specific operative procedures (e.g., pelvic ring fracture with or without ORIF), but these categories can easily be aggregated, or put back together, to reflect only the fracture or injury (without reference to the operative procedure). Services and therapies included on patient management paths (which were also described in the article) have been used to calculate an intensity score and expected costs for each category or PMC; but therapies (PATHS) are not used to *define* the CATEGORY or the disease of the patient, nor to assign PMCs to the patient's record.

Thus—and this is important—contrary to Dr. Champion's statement, disease and severity distinctions made in the PMC classification are, in fact, independent of treatment (as Dr. Champion thinks they should be). That is, the presence of procedure data does NOT affect the clinical or disease basis of the PMC classification itself. On the contrary, the collection and analysis of operative procedure data are critical for making distinctions among patients for payment, for assessing differences in the intensity and costs of resources required for

* Although ICD-9 provides codes for multiple pelvic fractures (808.43 or 808.53), coding guidelines restrict their use to circumstances in which there is insufficient detail in the medical record to identify the individual fracture sites involved or when reporting forms limit the number of codes. In all other cases, the multiple, individual ICD-9 codes that reflect the fracture sites must be used.

treatment, and for assessing outcomes associated with alternative therapies. Analyses are in fact extremely limited without operative procedure data, as has been shown by many trauma registry data bases that do not have it.

Patient management categories are a disease-based patient classification, designed so that each category includes patients who, because of their clinical similarity, are expected to have similar resource requirements for their diagnosis and treatment. Note that patients in each category do not necessarily use the same services nor are these services used in the PMC assignment process. Using the PMC classification methodology permits each disease and injury (represented by combinations of diagnosis codes recorded on the patient's record) to be identified specifically. Each patient can be assigned one or more PMCs to reflect the unique mix of injuries and comorbid conditions being managed in a particular hospitalization.

To use such a diagnosis-based classification effectively for comparative analyses and to adjust for expected differences among patient types, it is important to derive a composite measure, reflecting one or more of a number of dimensions, such as severity, intensity of resource use or need, duration of days required for treatment, and actual or expected costs. Such a relative value scale can then be used to project the resources (days, services, or costs) required to manage each patient type or to predict an expected outcome for patients in each category.

The basis of that relative value scale, however, should be related to the purpose intended for the measure. An admission severity measure, or a severity measurement taken at the time of injury, may be useful in triage, but is less likely to be useful, by itself, in trauma systems evaluation, patient outcome assessment, or in assessing morbidity, costs, or resource allocation. Similarly, a measure designed to predict mortality will not necessarily be useful in predicting length of stay or costs. For example, an acute myocardial infarction (AMI) patient with cardiogenic shock is one of the most severe PMCs (with an expected death rate of 83%), but this case type is not expected to have the most costly management. Other AMI patients who are more likely to require operative procedures are expected to be more costly while having higher probabilities of survival. (In this case, it actually costs more to live than to die.)

In the PMC system, each patient is assigned a PMC relative intensity score (PMC-RIS) that reflects the relative intensity of expected resource requirements for the effective management of that patient's unique combination of disease conditions (represented by PMCs). It is important to re-emphasize here that this score is independent of the categories and based on the complexity and intensity of the *expected* clinical management strategy, not actual services received by the patients in that category.

Our original article was intended to present the results of our work so that this system could be reviewed and used by others to improve our collective ability to identify the major trauma patient and measure trauma severity effectively in regional data bases—not just in trauma centers. In fact, working with physicians, we have already effectively used the PMC system for multiple applications—in payment, trauma systems evaluation, and patient outcome assessment. Because PMCs can accurately identify hospitalized injuries by severity level using large existing data bases, they have the potential to increase substantially the amount of information we have about the epidemiology of injuries and to evaluate outcomes of trauma care with comparative data.

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To the Editor:

In the article by Choban and colleagues: Obesity and increased mortality in blunt trauma,[1] there are problems with the body mass index as a concept and with some of the details of its presentation. The formula shown in the abstract "$(\text{weight(kg)}/(\text{height(m)})^{2}$" has four parentheses facing the right but only three facing the left and it is therefore incomplete. Further, the squaring of the whole expression, as indicated by placing the "2" outside the rightmost parentheses is meaningless. Probably the correct formula is "kg/m^2" but that does not resolve the fundamental dimensional flaw.

The concept of weight is a function also of space, specifically a three-dimensional euclidean space. By contrast, length is unequivocally associated with a one-dimensional conceptual abstraction. While we assign *numbers* to measurements of both length and weight, this assigning of numbers still does not allow us to operate on such *numbers* as we would operate on ordinary numbers. Thus "3 + 2 = 5" but "3 kg + 2 m = 3 kg + 2 m". Within this context the formula "kg/m^2" or for that matter "kg/m" are both dimensionally incorrect because they presuppose operations on elements that are dimensionally not equivalent.

One way to avoid this impasse and achieve a satisfactory index would be to introduce such modifications to the terms so as to make them dimensionally equivalent. Thus, we could consider either "kg/m^3" or "$\sqrt[3]{\text{kg}}/\text{m}$" (the cubic root of a cube is a length and reciprocally the cube of a length is a volume).

This is not entirely new, since the reciprocal of the second formula, namely "$\text{m}/\sqrt[3]{\text{kg}}$", also labeled the *Ponderal Index*, has been recognized as a valid index and studies have confirmed an association between a falling index and rising health risks.[2]

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Authors' Reply:

We appreciate Dr. Boba's close attention to our article "Obesity and Increased Mortality in Blunt Trauma." If he will check again, he will see in the text that there are four parentheses and one bracket pointing left and the same number pointing right, corresponding to units of kg/m^2.

Although there is no ideal variable to accurately reflect the degree of obesity associated with a given height and weight, we selected body mass index (BMI) for several reasons. It is simple to calculate. It is directly applicable to the National Center for Health Statistics Anthropometric Reference Data and Prevalence of Overweight.[1] BMI has been documented to have a correlation with increasing mortality.[2,3] BMI was suggested most recently as the desirable means to define overweight at the March, 1991 NIH Consensus Development conference.[4] Additionally, we have found being able to compare populations in many other studies of obese and nonobese patients with our population an advantage of using BMI.

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