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Page the Critical Care Epidemiologist, STAT!

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Introductory courses and textbooks of epidemiology seek to inculcate students in the distinction between assessing the proportion of individuals dying from a certain disease as a percentage of the number of people with the disease (case fatality rate) versus the percentage of the population as a whole (mortality).¹ As physicians, we think in terms of the case fatality rate: what percentage of our patients will die from their disease despite our best efforts? As epidemiologists, we must also think of the burden of morbidity and mortality of a disease in relation to everyone at risk. The case fatality rate is typically easier to assess—count the number of patients with a particular condition who present to your hospital or intensive care unit and divide deaths by total number of ICU patients with that condition. Population-based epidemiology is more difficult, either because the population of any given area may move or seek care elsewhere, or because assessing larger areas or the United States as a whole entails great enormity and complexity of data. Crucial steps in critical care epidemiology were made with the development of techniques to measure the population-based incidence and mortality rate of acute lung injury² (using data from King County, Washington State) and sepsis (linking hospital and Census data from 7 states).³

These studies made us aware of how many Americans would require care in the ICU, and how age impacts the risk of developing acute lung injury or sepsis. Diseases with high case fatality rates get our attention (e.g. *capnocytophaga canimorsus* sepsis,⁴ with a case fatality rate of 30% but an incidence too low to accurately estimate) and propel our desire to recognize them and better treat them at the bedside. For our improvement of care at the systemic level, however, population-based epidemiology provides us the knowledge necessary for the recognition of common diseases with significant morbidity, mortality, and

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financial burden (e.g. sepsis as a whole, whose incidence is 3.0 cases per 1,000 population and increasing by 1.5% per annum³). Understanding the extent of the challenge helps us to marshal the organizational skills and resources necessary to effectively battle it.

In this context, we read the study by Bice et al⁵ in this issue of *Critical Care Medicine*. Olmstead County, Minnesota provides a unique opportunity to assess critical illness using a population-based denominator. Geographically isolated, its sole providers of critical care are the two hospitals of the Mayo Clinic. This has provided a unique opportunity to study the epidemiology of acute lung injury. Their study is the first estimate of the incidence of recurrent acute lung injury.

From 1998 to 2008, the investigators screened all ICUs daily for patients with ALI, and assessed an incidence based on census data for the county. Of the 917 patients with ALI, 19 of them were hospitalized a second time, an incidence of recurrent ALI of 2.02 cases per 100,000 person years. The median time to a second case was less than 9 months, with a case fatality rate of 47%. Because the number of patients with a recurrent ALI was small, case-control methods were used to evaluate characteristics associated with recurrence. In this analysis, gastroesophageal reflux (GERD) was significant.

Several caveats should be acknowledged, from both the population-based and case-controlled methodologies. The authors discuss some of these: small sample size, lack of a standard definition of aspiration, and bias in assessing exposure variables. Others are inevitable with case-control methods (the larger the number of variables matched, the more limited the analysis of variables of interest) and population-based studies (patients dying of ALI before reaching the hospital would not be counted, as would be the case for residents developing ALI while traveling outside the county).

While its limitations are significant, the study makes two important epidemiologic conclusions. The first is that recurrent ALI is real and its incidence can be calculated. While the conclusion may seem obvious, our ability to quantify this will grow in importance as the population ages and the incidence of ALI increases, and as mortality decreases and the number of patients at-risk for recurrent ALI also increases. The second is that GERD may play a significant role in the risk for recurrent ALI. In children with developmental disability, GERD has also been linked to ALI.⁶ GERD plays an important role in other lung diseases, including asthma,⁷ chronic obstructive pulmonary disease,⁸ idiopathic pulmonary fibrosis,⁹ and chronic lung transplant rejection.¹⁰ This research is a modest but valuable first step in parsing the full extent of this newly quantified entity of recurrent ALI.

Identifying and quantifying at-risk populations, with population-based methods such as this study and expanding our understanding of these populations with genetic data is essential as we face the growing challenges of critical care to a population that grows older and sicker in the 21st century. Despite the enormous resources expended in the care of critically ill patients,¹¹ our epidemiologic capabilities have lagged behind other fields of medicine. For example, in 1973, the National Cancer Institute began collecting data for its Surveillance, Epidemiology, and End Results (SEER) Program. This population-based registry covers 26% of the US's population and provides detailed data on cancer incidence and mortality; identifies temporal changes in incidence, disease extent, staging and survival; and facilitates quality assurance.¹² Imagine the effects of this knowledge, to facilitate a nation-wide research agenda, improve regional ICU organization, and insure consistent and effective delivery of critical care.

Is anyone calling out for a critical care epidemiologist in the midst of a code? Maybe not, but he or she plays a vital role in the ICU nonetheless.¹³ As we confront these challenges,

we must start thinking not only of our own patients in the unit but of all our potential and actual patients nationwide.

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