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How objective is the observed mortality following critical care?

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Hospital mortality is frequently quoted as an outcome measure in intensive care medicine. It is valued by patients, families, health workers, policy makers and all of society, although long-term survival is probably the most important outcome for the patient and family. Hospital mortality per se is not an accurate reflection of ICU performance because ICUs admit heterogeneous groups of patients in terms of age, co-morbidities and acute health status, but it is one of the most readily available parameters. The development of mortality prediction models that can account for most of the previously mentioned confounders has led to the introduction of the standardised mortality ratio (SMR), which is the ratio between observed and predicted deaths of ICU admitted patients in a given period of time [1]. Not surprisingly, the report as well as analysis of SMR is one of the indicators identified by the Task Force on Safety and Quality of the

European Society of Intensive Care Medicine [2]. The use of SMR requires on one hand an appropriately calibrated severity of illness score to predict deaths and on the other the in-hospital mortality to calculate the actual deaths. It may improve intensive care quality and allow the comparison of a given ICU against others in a benchmarking project. Thus, ICU SMR and benchmarking are increasingly reported in PubMed articles as shown in Fig. 1.

In this issue of *Intensive Care Medicine* Brinkman et al. [3] raise the problem of the mortality-related factors that influence SMR and, consequently, ICU ranking. The authors linked the data from the NICE registry to a national administrative database of health insurance companies and selected 77,616 patients admitted to 44 mixed Dutch ICUs in a 42-month period. Four customised models based on APACHE IV to predict in-hospital mortality and mortality at fixed time points (1, 3 and 6 months) after ICU admission were developed. As expected, the best performance was shown by the customised model for in-hospital mortality, but there was only a slight and clinically negligible decline in performance for the mortalities at fixed time points. Regarding the SMR, the authors found that if the endpoint for mortality changes from in-hospital to 1 month, for example, it is possible to rank the same ICU in a very different way. Indeed, in comparison with the ICU rank based on the in-hospital endpoint, the SMR for mortality at 1, 3 and 6 months significantly changed the ICU rank of 23, 36 and 30 % of the included ICUs, respectively. These differences were mainly explained by the discharges from ICU to other medical facilities outside the hospital or home.

Indeed, the reliability of hospital mortality information can be biased by either patients transferred to other acute hospitals without a known vital status at the final hospital discharge or by patients that will die soon after being hospital discharged. In contrast, when fixed time endpoints are chosen, the mortality rate can be biased by either loss to follow-up or the number of patients staying in the hospital

Fig. 1 Number of articles mentioned in PubMed (1993–2012) according to a search conducted using the following words: “(intensive care unit OR critical care unit) AND standardised mortality ratio”; “(intensive care unit OR critical care unit) AND benchmarking”. *SMR* standardised mortality ratio

longer than the endpoint. Brinkman et al. [3] suggest using SMR based on the mortality at a fixed time point. The ideal time to avoid biased information is 3 months after ICU admission, which would solve the problem of patients with hospital stays of 1 month or longer and avoid including mortality not related to the acute phase of illness responsible for ICU admission [4]. Unfortunately, collecting the final hospital discharge data in case of transferred patients or fixed time endpoints is resource consuming, and some hospitals may have difficulties obtaining them, especially where information technology is not widespread.

This study [3] has many strengths. The wide sample of the NICE patients allowed excluding patients admitted from another ICU and readmissions, who have higher mortality rates [5, 6]. The non-linked patients are only 4 % of the suitable cases. In comparison with the linked ones, they are younger and more frequently male, and they have lower severity of illness and shorter ICU and hospital stays, being mainly cardiac surgery patients with low mortality rates. Another strength of the study is the formal validation of the second level customisation of

APACHE IV performed by the authors, which guarantees the reliability of the predictive models developed for the study. Indeed, the timely recalibration and repeated validation of prognostic models over time are pivotal for SMR, as recently shown [7].

The major weakness of the study is that the authors were not able to know the discharge destination of all patients. The discharge destination to another medical facility outside the hospital or directly to home is recorded in the NICE database only for the ICU discharges. Therefore, the final destination of patients discharged from the ICU to wards of the same hospital is unknown. We can reasonably hypothesise that the hospital discharge policies of the wards where the ICU patients were transferred to also affect the hospital mortality, SMR and, consequently, ICU ranking. Moreover, the presence or the introduction of any other facility to treat low-acuity patients in the hospital, not mentioned in the study of Brinkman et al. [3], may also strongly influence the mortality of ICU patients [8, 9].

The finding that the SMR and SMR rank position of ICUs is significantly influenced by the chosen endpoint of follow-up is crucial for the ICU management because of the great value placed on SMR by administrators [10]. Regardless of the healthcare system, we live in a difficult economic situation, where scarce resources will probably be further reduced. The key point is and will be the resource allocation, especially as demand has been increasing. Therefore, administrators will need to take difficult decisions based on reliable data concerning the effectiveness of intensive care delivery. The intensivists need to know the reliability of the parameters used and their pitfalls perfectly, while looking for better approaches to quantify ICU performance [11, 12] to offer better care. Although SMR has some limitations [13], the well-performed study of Brinkman et al. [3] contributes to a next step in the benchmarking and ICU performance fields.

Conflicts of interest The authors declare that they have no competing interests.

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