

How to predict ICU bed occupancy and manage it effectively

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The critical care doctor Julio Barado-Hualde (Villava, Navarre, 1965) has developed a mathematical simulation model that enables the occupancy of beds in an ICU (Intensive Care Unit) to be predicted so that they can be managed more effectively. This research, which focusses on the Hospital Complex of Navarre, is part of his PhD thesis read at the NUP/UPNA-Public University of Navarre.

Patients in a more serious condition or who have a greater need of support for various organic systems affected are admitted to ICUs. "Contrary to what one might think, the patients admitted to them do not do so 'to die', as one of the determining factors for admitting them is that there should exist a reasonable expectation of recovery with a good quality of life. Despite that, the mortality rate in these units is high; in the case of this study, 19.8%," explained Julio Barado, a Critical Care specialist of the Intensive Care Service at the Hospital Complex of Navarre.

ICUs are costly due to their technological and healthcare staffing requirements. "In Navarre the daily cost of an ICU bed is reckoned to be about 1,431 euros," pointed out Julio Barado. "The recovery options for those patients needing to be admitted to an ICU are reduced, but they cannot recover unless there is a bed available for them".

So according to Julio Barado, there are two sides to the problem about the choice of the number of beds in an ICU: firstly, "a high number of beds entails excessive expenditure," and secondly, "an insufficient

number could cause a healthcare problem".

Study of patients treated over a nine-year period

In order to find the fairest solution to this problem, Julio Barado has developed a [mathematical simulation](#) model to predict bed occupancy in the ICU-A section of the Hospital Complex of Navarre, based on admittance and length of stay data of patients treated over a nine-year period and who totalled 6,300.

"Unlike the classical methods previously used for this purpose, this method is capable of providing for variability in terms of admissions and length of stays, so its predictive capacity is higher," said the new NUP/UPNA PhD holder. When building this model, problems remaining in others of this type were resolved, such as the adjusting of prolonged stays and, above all, the incorporation of medical decisions geared towards modifying the length of stay of certain patients."

These decisions are manifested in the reduction of the stay of some patients in the ICU when they have reached a level of recovery allowing them to continue their process in a conventional hospital ward, because their beds are needed by other patients in a more serious state; when occupancy is lower, the discharging of these patients would be delayed for a certain time.

"In this respect, the doctor acts simultaneously as a doctor and as the manager of a common resource which, on occasions, is in short supply," said Julio Barado. "Incorporating this behaviour into a mathematical simulation model has been an unprecedented fact that has allowed the occupancy of ICI-A section beds at the Hospital Complex of Navarre to be correctly represented".

Predicting bed requirements

According to Julio Barado, the mathematical model built is going to make it possible to predict "what the bed requirements are going to be or how many patients are not going to be able to be admitted owing to lack of beds when faced with a range of assumptions. That way," he went on, "we can know precisely what the future bed requirements will be if there is a continuation in the increase in the admissions of elderly patients, which has been seen in recent years; or the requirements in acute situations which could emerge following a pandemic along the lines of the A/H1N1 flu outbreak; or the repercussions in occupancy caused by changes of functioning: for example, changes in the surgery programming of patients needing to spend an initial postoperative period in an ICU; the creation of Intermediate Care Units to alleviate occupancy in ICUs, etc. All these analyses will help in the quest for better management of ICU beds."

In actual fact, the methodology followed in this PhD thesis entitled "Methodological proposal for drawing up simulation models of bed occupancy in an Intensive Care Unit" (Propuesta metodológica para la elaboración de modelos de simulación de la ocupación de las camas de una Unidad de Cuidados Intensivos), can be adapted to other ICUs to make bed occupancy prognoses.

More information: "Optimal control of ICU patient discharge: from theory to implementation." *Health Care Manag Sci.* 2015 Mar 13.

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Provided by Elhuyar Fundazioa

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