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Ivey Business School
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London Health Sciences Centre

Identifying 'step-down' bed needs to improve ICU capacity and costs

London Health Sciences Centre and Ivey Business School utilized SIMUL8 simulation software to ***evaluate the implementation*** of 'step-down' or 'level 2' beds, ***identifying positive impacts*** on ICU patient throughput, length of stay and costs.

About the project

In congested hospitals it can be common for patients to overstay at Intensive Care Units (ICU) due to blockages and imbalances in capacity.

There are various reasons why an unnecessary stay in the ICU can be costly for hospitals:

- **Clinically** - patients occupy a service they no longer need
- **Operationally** - it disrupts flow from upstream units
- **Financially** - ICU beds are more expensive than ward beds

To meet this challenge, ***step-down beds*** (also known as level 2 beds) are an increasingly popular and less expensive alternative to ICU beds.

*"With many complex processes and parameters involved, **we needed simulation** to be able to test the implementation of step-down beds to meet our objectives of maximizing patient throughput, while minimizing the length of stay in the ICU and cost to the hospital."*

Felipe Rodrigues, Ivey International Centre for Health Innovation

About the project cont.

London Health Sciences Centre (LHSC), one of Canada's largest acute-care teaching hospitals, together with the team at ***Ivey Business School for Health Innovation***, utilized simulation to identify the impact of using step-down beds in the University Hospital's Medical Surgical Intensive Care Unit (MSICU).

Analyzing historic data, it was identified that of patients treated in the ICU in 2014, 660 out of 864 were recorded with a NEM score (a measure of nursing workload requirements) that would have enabled those patients to eventually step down into a level 2 ward - saving valuable potential resources.

The key goal of LHSC's research was to evaluate if additional ICU bed capacity could be released through the use of level 2 beds and how many beds would be needed to deliver efficiency and cost savings.

The team also wanted to assess whether NEM scoring could be used to identify when a patient could be stepped-down and help estimate level 2 bed needs.

Using SIMUL8 simulation software, the team could consider a wide range of parameters to ***fully assess the impact on patient flow***, ***length of stay***, ***utilization and costs*** - all within a safe, risk-free environment.

Taking every factor into consideration using simulation

When looking at bed needs, every process and decision within a hospital can impact capacity and patient flow. With a huge range of parameters to consider, planning any changes to the process cannot be achieved in silo. How can you be confident that changes won't have ramifications elsewhere?

This is a key reason why LHSC utilized simulation software over other analytical methods. Using SIMUL8, the team could take a diverse range of factors into consideration to ensure accurate results, including:

- **Arrival rates** – these vary throughout the hour of the day, day of the week, as well as seasonally.
- **Bounce backs** – patient flow isn't always linear - a patients' journey can take them through various departments, such as the ICU and operating rooms.
- **Patient's health and death probability change over time** – for example, the odds of a patient's survival increase as they spend more time in the ICU.
- **Off-service patients and length of stay** – the misplacement of patients into wards that they are not originally supposed to go can lead to an increase in length of stay and costs.
- **NEM scoring process** – the level of nursing care where a patient could be considered for the step-down and how this score changes over time.

Key project steps

1

Utilizing existing data to create step-down rules

The team were able to utilize existing data from LHSC's patient management system, containing patient arrival times and characteristics, as well as precise patient transfer files.

This provided a view of the individual beds where the patients came to and from in each hospital unit. Additionally, as nursing workloads are recorded at upon arrival and once daily, as well as when the patient leaves the unit, the team had access to data on the NEM scoring process for every patient that went into the MSICU.

Distributions could then be created, along with a patient flow matrix and step-down rules to power the simulation.

2

Planning the simulation

To take into account the various entry points and congestion that occurs in the hospital, and assess how these complexities could potentially impact the use of level 2 beds, the team made the decision to simulate the entirety of the hospital patient flow.

The simulation also included stochastic attributes, such as the probability of death, to give a fully accurate representation of what really happens in the ICU.

*"If we had just simulated the ICU and the level 2 units, we would not be able to capture blockage and congestion and off-service. So, even though it took longer, it was the wider decision to make as **we had a wealth of data that we could analyze and make decisions on**."*

3

Validation and testing step-down bed scenarios

After validating the accuracy of the base simulation against the current system performance, the team could run different scenarios to identify the best approach to the implementation of level 2 beds:

Scenario one
Adding up to 20 beds in a new level 2/step-down unit, with no changes to existing MSICU beds.

Scenario two
Re-allocation of existing capacity by converting some of the 25 MSICU beds into level 2 beds.

Scenario three
Adding 5 extra beds to bring total MSICU capacity to 30 beds, allocating these between the MSICU and a new level 2 unit.

*"When I first approached this research I had the idea that patient flow would be quite linear and flow downstream. What we found is that actually patients go to and from a wide range of sources. **Using simulation enabled us to address this to a very high level of detail**."*

Felipe Rodrigues, Ivey International Centre for Health Innovation

Project results

Using SIMUL8, LHSC could quickly run each of the scenarios and get detailed results around the key metrics of cost, length of stay and utilization of the MSICU and level 2 beds.

Across all scenarios, it was found that simulating level 2 beds into the current patient flow generally provided a positive impact - reducing occupancy, decreasing length of stay of MSICU patients, as well as saving and costs.

Comparing the three different scenarios to the baseline results, ***it was found that converting existing capacity from the MSICU would provide an optimal balance on return***, rather than adding new, additional capacity.

*"The results from the simulation were very helpful and provided additional evidence to **reinforce our decision-making**. It has been a very useful project to be involved with on a very relevant question."*

***Dr. Claudio Martin**, London Health Sciences Centre*

Adding the NEM scoring process and the stochastic death probability process into the simulation proved to also be very useful, helping identify the point where patients could be stepped down from an ICU bed to a level 2 bed.

With the project delivering many valuable insights, LHSC are now looking at using simulation in their sister hospital, Victoria Hospital, as well as creating simulations to look at the impact of having dedicated long-stay beds.

For full analysis and in-depth results of LHSC's simulation project, please watch the webinar.

$10 million of potential cost savings

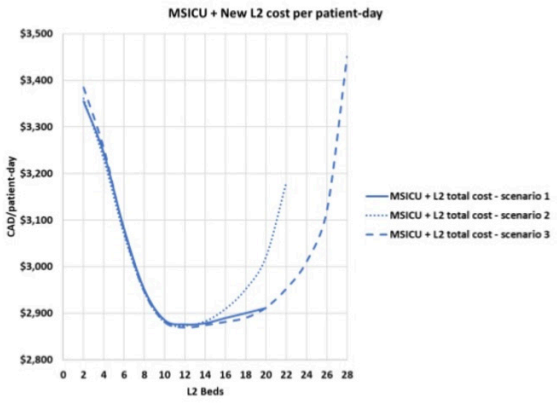
A key driver for the project was to evaluate potential cost savings of using level 2 beds. Using the simulation results, the estimated short-term and long-term costs of each scenario could be compared.

The simulation results showed that as more level 2 beds were added, costs start to drop dramatically to as much as $600 per patient/day - reaching a minimum cost at around 12 beds across all scenarios due to economies of scale.

When more than 12 beds are added, there is an increase in idle capacity and costs start to increase as the MSICU is further reduced in size. This showed that the optimum threshold would be between 10 to 14 level 2 beds.

As the simulation could run years into the future, LHSC could see the longer-term cost savings of implementing each of the scenarios – ***with potential savings of almost $10 million dollars over the span of eight years***, compared to the baseline simulation.

*"We found that there is room to reduce the current operational cost of that structure by **many millions of dollars**, and this is something that only a very precise and detailed simulation could provide results for."*



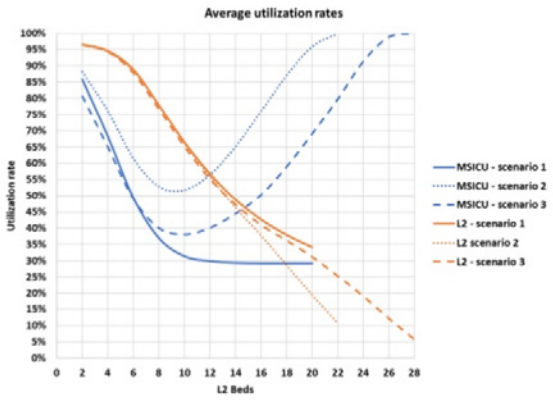
Total costs per patient-day across each scenario

Utilization rates for each scenario

Although empty beds are essential to have in an ICU for surges in patient arrivals, ***they must be balanced against having excess idle capacity*** that wastes resource and costs.

The simulation results showed that in scenario one, where a completely new unit is added, level 2 bed utilization rates drop dramatically and keeps falling up to 30%, meaning there would be too many beds not in use for this to be a viable option.

Scenario two proved to strike an ideal balance, using between 8 to 10 level 2 beds from existing capacity provided better utilization, with the ability to accommodate surges in patients throughout the year.



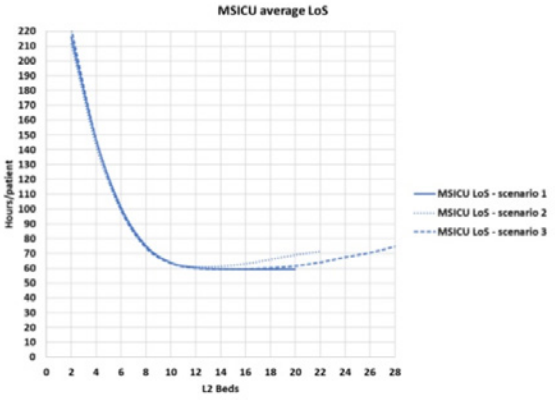
Average utilization rates across each scenario

Reducing MSICU length of stay

The simulation showed that as the number of level 2 beds increased, patient length of stay could also drop dramatically.

From the baseline of 160 hours per patient, in the beginning there is a sharp increase. As patient flow into the level 2 unit improves, there would be a sharp drop – eventually reaching a threshold of roughly 60 hours. In the scenarios where beds are reallocated from existing capacity, the level 2 unit would eventually become bottlenecked by the MSICU, with length of stay starting to increase again from this point.

Reducing patient length of stay by ***up to 100 hours per patient*** would provide substantial extra capacity as ICU beds are released to receive new patients that emerge from the operating room.



MSICU average length of stay

Make fast, confident decisions with simulation

Simulation enables healthcare systems and processes to be tested in a safe, virtual environment without risk to patients and staff – supporting organizations to make better decisions, improve systems of care and maximize resources.

To find out more about how simulation could help your organization and to see SIMUL8 in action, visit ***www.SIMUL8Healthcare.com/case-studies***