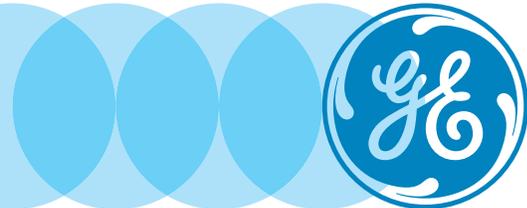




# Care Redesign and Strategic Simulation:

A New Approach to Optimizing Health Care



## INTRODUCTION

One of the most significant obstacles to effective delivery of health care is the shortage of professionals, including some of the most crucial members of the health team: nurses.<sup>1</sup> Although the reasons differ from one country to the next, the nursing shortage is a global phenomenon. The World Health Organization (WHO) has warned that the need for health providers, including nurses, will continue to grow in all countries. In wealthy countries, increasingly aging populations will suffer from chronic conditions and degenerative illnesses that demand higher levels of care. Increased demand in these countries may draw health providers from poorer nations, potentially exacerbating already-existing shortages in those regions.<sup>1,2</sup>

For hospitals and other health care institutions facing this looming shortage, an approach known as care redesign offers the opportunity to map out and analyze the current care model, identify challenges and suggest possible improvements. This paper will describe the care redesign process as well as innovations that allow organizations to test and optimize operational parameters using simulation modeling. This approach is designed to help health care organizations review and redesign care models to deliver care that meets patients' needs while addressing issues such as labour shortages.

## A GLOBAL SHORTAGE OF NURSES

As early as 2005, the Organisation for Economic Co-operation and Development (OECD) reported that all but a few member countries were experiencing nursing shortages; this problem is expected to continue and perhaps worsen.<sup>3</sup>

Other research appears to support this prediction. In Canada, the OECD documented a shortage of 16,000 nurses in 2002. In 2011, a Canadian news report estimated a national shortage of more than 20,000 nurses.<sup>4</sup> Similarly, the OECD-reported nursing shortage for the United States as of 2002 was 110,700 – a number expected to increase to a staggering 800,000 by the year 2020.<sup>5</sup> With so many other countries having also reported nursing shortages, the problem has been described as a “global challenge.”<sup>6</sup>

## NURSING: STAFFING LEVELS AND IMPACT

Nurses have been described as “the main professional component of the front line staff” providing health care.<sup>1</sup> The importance of nurses is demonstrated by research that directly links nurse staffing levels to quality of care. Decreased levels are associated with higher rates of negative outcomes such as mortality<sup>1,8,9</sup> post-surgical adverse events<sup>1,10</sup> and infection,<sup>1,10</sup> while increased staffing levels are linked to decreased patient mortality and lower rates of medical complications.<sup>1,9-11</sup>

A nursing shortage has the potential to impact not only patient-related outcomes but an organization's entire model of care. Other providers become responsible for tasks that would usually be carried out by nurses. If these tasks are not suited to their training and experience, it is possible that these providers will perform sub-optimally through no fault of their own. Moreover, the additional workload may affect providers' ability to perform their designated responsibilities.

A high performing model of care requires adequate resources in order to deliver the best possible patient outcomes. In an era where nurses are increasingly in short supply, how can health care organizations ensure their care models are designed to best utilize these crucial resources to ensure patient well-being?

## CARE REDESIGN AND SIMULATION MODELING

Care redesign is an approach that allows health care organizations to assess current models of care and adapt those models to meet patients' needs while taking into account limitations such as a shortage of health care providers.

A recent innovation in care redesign, workforce simulation planning, allows organizations to test different operational models in a virtual environment. This approach allows planners to assess multiple scenarios, including staffing models that vary by mix, FTEs and role assignment..

## Goals

The overarching goal of care redesign is to develop a sustainable model of care that makes optimal use of available resources. Specific goals may include the following:

- Optimizing the work of licensed health care providers and ensuring this work is consistent with each provider group's scope of practice;
- Creating a structure that fosters communication and collaboration between different provider groups and makes this communication and collaboration part of common practice;
- Providing patient-centered care that involves patients and their families in decision-making;
- Delivering care that meets the needs of the patient population as well as the individual needs of each patient; and
- Creating a collaborative work environment that makes the best use of each provider group's knowledge, skills, ability and expertise.

## Role of simulation

A key component of care redesign is the use of simulation scenario planning. As a first step, a model based on the current practices of the organization (the “current care model”) is built and validated using well-established software. The current care model becomes the basis for collaborative scenario planning or the process of defining a model of possible future practices (“future state model”) that includes types of staff, staffing levels and activities staff complete based on local scope of practice requirements.

The organization's priorities help to define alternative scenarios that are tested in the future state model – a low-risk approach to defining staffing patterns, unit layouts, timing of patient activities and many other metrics to support the organization's priorities.

## THE PROCESS: OVERVIEW

The care redesign process consists of five stages: current-state assessment, current-state model development, analysis, consultation and finally experimental design, testing and review of results.

**Table 1. Percent reduction in rates of outcomes among medical patients in hospitals with high nurse staffing (75th percentile) compared to the rates in hospitals with low nurse staffing (25th percentile)**

Outcome in medical patients	Amount by which rates are lower for:	
	High RN staffing	High staffing, all levels (RNs, LPNs, aides)
Urinary tract infection	4-12%	4-25%
Upper gastrointestinal bleeding	5-7%	3-17%
Hospital-acquired pneumonia	6-8%	6-17%
Shock or cardiac arrest	6-10%	7-13%

**Note:** Difference is expressed as a range of values (e.g., 4-12 percent) because several statistical models were used in evaluating the relationship between nurse staffing levels and each adverse event.

**Source:** Needleman J, Buerhaus P, Mattke S, et al. Nurse-staffing levels and patient outcomes in hospitals. Final report for Health Resources and Services Administration. Contract No. 230-99-0021. 2001. Harvard School of Public Health, Boston, MA.

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### Stage 1: Current-state assessment

Current-state assessment begins with an initial assessment which involves gathering primary and secondary data needed to create the current care model. Primary data is collected which documents the work of providers as they carry out patient care activities, maps the physical layout of the organizations' service units (e.g., hospital ward or surgical facility) and collects other necessary details such as the schedules, frequency and duration of diagnostic and other activities.

Secondary data may be obtained by reviewing care plans for different patient groups or analyzing historical ADT data (admission, discharge and transfer data) in order to better understand patterns of patient inflow and outflow and diagnostic categories. In many cases, interviews with front-line care providers, hospital leadership, physicians, patients and patients' families may supplement quantitative data with qualitative insights.

### Stage 2: Current-state model development

Data from the initial assessment is used to create a detailed model of how care is delivered within the organization. This model is brought to life in a three-dimensional animated simulation that provides a detailed representation of patient care delivery.

### Stage 3: Analysis

In-depth analysis of patient care activities and other duties, as well as patient load, licensure and certification requirements for each group of care providers, is used to identify similarities and differences between provider groups. Similarities may offer the opportunity for reassigning activities to another provider group or in many cases standardization of activities across provider groups, while differences are scrutinized and discussed with practitioners to yield deeper insight. Focus group discussions with providers help to identify providers' opinions about the current care model and their priorities for a new model.

This analysis and discussion allows the identification of opportunities for improvement. Part of this work involves distinguishing between direct activities (i.e. tasks involved in patient care) and indirect activities. Indirect activities are considered either necessary (e.g. data entry is required but not directly related to patient care) or potentially wasteful (travel time, waiting time, correction of errors or tasks that could potentially be eliminated or be performed by more appropriate staff).

**Table 2. Percent reduction in rates of outcomes among surgical patients in hospitals with high nurse staffing (75th percentile) compared to the rates in hospitals with low nurse staffing (25th percentile)**

Outcome in surgical patients	Amount by which rates are lower for:	
	High RN staffing	High staffing, all levels (RNs, LPNs, aides)
Urinary tract infection	5-6%	3-14%
Failure to rescue	4-6%	2-12%
Hospital-acquired pneumonia	11%	19%

**Note:** Difference is expressed as a range of values (e.g., 2-12 percent) because several statistical models were used in evaluating the relationship between nurse staffing levels and each adverse event.

**Source:** Needleman J, Buerhaus P, Mattke S, et al. Nurse-staffing levels and patient outcomes in hospitals. Final report for Health Resources and Services Administration. Contract No. 230-99-0021. 2001. Harvard School of Public Health, Boston, MA.

Note: Difference is expressed as a range of values (e.g., 2-12 percent) because several statistical models were used in evaluating the relationship between nurse staffing levels and each adverse event.  
 Source: Needleman J, Buerhaus P, Mattke S, et al. Nurse-staffing levels and patient outcomes in hospitals. Final report for Health Resources and Services Administration.  
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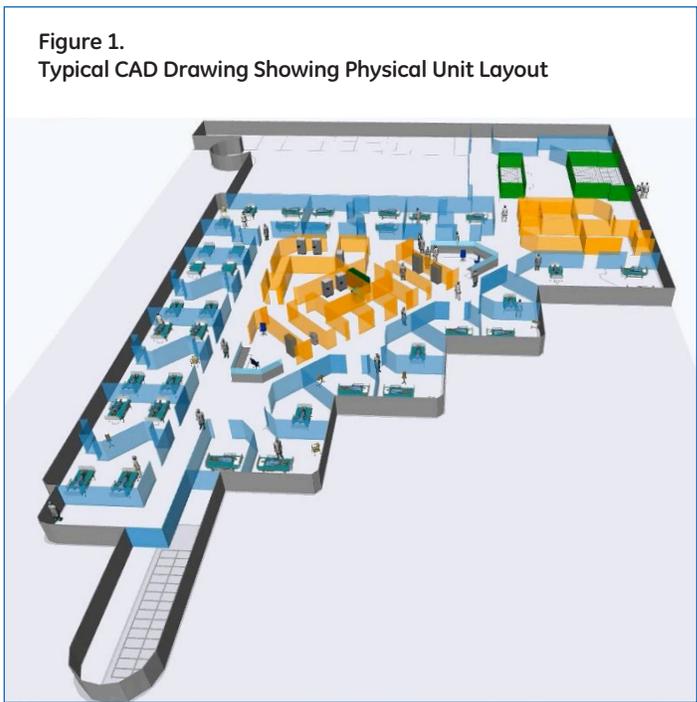


Figure 1. Typical CAD Drawing Showing Physical Unit Layout

### Stage 4: Consultation

The team presents its findings to the organization's decision-makers. Together they discuss opportunities for improvement, taking into consideration best practices and evidence-based practice literature and alignment to the organization's strategic, fiscal and cultural objectives. Decision-makers rank the improvement opportunities in order of priority and (if desired) define clusters or groups of priorities that can be tested simultaneously.

### Stage 5: Experimental design and testing and review of results

The team creates a number of alternative care models based on the proposed changes. The new models may include improvements such as reshaping provider roles or defining a new, more efficient provider mix. The different models are tested through computer simulation, generating previously defined metric results for the leadership team to review and discuss. Based on those results, additional simulation scenarios may be tested. In the final stages, decision-makers choose a new model of care, taking into consideration simulation scenario results, organizational priorities and region staffing availability.

**Figure 2. The care redesign process**

Are care design and simulation modeling relevant to my organization?

Care redesign and the use of simulation to model operational parameters can be used to optimize care delivery across the continuum of care: a hospital ward, a surgical unit, a hospital or a group of hospitals, a rehabilitation centre or a long-term care facility. Outpatient or community facilities can also be modeled across the continuum of care.

The ability to model operational parameters offers health care organizations the opportunity to test alternative models of care in a virtual environment. This testing provides outcome data that allow decision-makers to confidently choose the model that best suits their organization's needs and priorities – prior to implementation.

## CARE REDESIGN IN ACTION: EXAMPLES

The benefits of care redesign are best illustrated by concrete examples.

### Scenario 1: Optimizing shift structure

At an acute care hospital most patient care activities are traditionally performed by nurses. Some activities are scheduled for specific times of day. In response to a predicted nursing shortage, decision-makers reassess the model of care. Analysis of the current model reveals that changes to the shift structure will allow the hospital to deliver high-quality patient-centered care with fewer nurses.

Responsibility for some tasks (such as bathing) is shifted to personal support workers, freeing nurses' time for more role-appropriate activities. Activities previously performed at fixed times are now scheduled according to patients' needs and workflow. Instead of being administered during the first two hours in the morning, medications are dispensed at different times of the day according to patient clinical needs and pharmacological best practices. Discharge times vary according to patient readiness to leave the hospital, reducing wait times and spreading staffing demands for discharge related activities throughout the day instead of concentrating demand at a single peak time. Whenever possible, activities of daily living that can occur at any time of day are carried out at the times patients prefer, with the result that fewer staff members are required to perform these tasks at any given time, while patients report increased satisfaction.

### Scenario 2: Increasing direct patient interaction time

Decision-makers at a rehabilitation centre learn that increased interaction between patients and clinicians is associated with greater patient and staff satisfaction and a reduced likelihood of readmission. A review of evidence-based practice literature indicates that purposeful interaction is key: organizations that focus on interactions designed to educate patients and actively engage them in their recovery are most likely to produce positive results. The care model is reviewed and redesigned to offer the greatest possible opportunity for interactions that focus on improving patient health and ensuring that they maintain their health status after they are discharged.

The new model emphasizes the importance of educating and involving patients at every opportunity and schedules ample time for interaction. Instead of merely dispensing medication, clinicians have time to provide the care and teaching they have always wanted to do. They have the opportunity to explain the purpose of each medication and discuss related topics such as dosing frequency and possible drug interactions instead of providing care that is better suited to another member of the care team. Physiotherapists and other health providers take a similar approach. Patients are encouraged to ask questions and staff are encouraged to take the time necessary to both answer any questions and ensure that answers are understood. When appropriate, patients are given disease- and medication-specific educational materials. Finally, each patient receives follow-up telephone calls after discharge to answer any questions and ensure recovery is proceeding smoothly. One year after the new care model is implemented, patient and staff satisfaction ratings are significantly higher and readmission rates have decreased.

### Scenario 3: An optimized provider mix

Analysis of care provider activity in a medical unit shows that RNs are spending a significant percentage of their work time finding and delivering equipment and supplies they need to provide advanced clinical treatment as well as on basic activities of daily living for patients. Both types of tasks could be performed by nursing assistants (NAs) or other unregulated or unlicensed providers. When this work is assigned to NAs, RNs are freed to perform activities such as intermediate or comprehensive assessments, mentoring, education and quality improvement initiatives. The end result is more effective use of a limited care resource, and potential cost savings from the use of more appropriate staff.

## CONCLUSION

The nursing shortage is already a global problem, and one that is only expected to worsen in coming years as the population ages and more nurses retire than are available to join the workforce.

Together, care redesign and advanced simulation tools offer health care organizations the opportunity to maintain or improve their standards of care while increasing efficiency, minimizing costs and potentially improving patient care. Carefully mapping and closely analyzing the current model of care permits the identification of opportunities for improvement which can then be incorporated into alternative models that are tested using simulation technology, allowing organizations to prepare for and adapt to an ever-changing health care environment.

The future state model used to develop and test scenarios can be further used over time to test care model requirements with what in many cases are shifting organizational priorities.

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