

# Ultrasound at the Bedside: Benefits for Patient Care and the Bottom Line

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In many acute care units, patients needing diagnostic ultrasound exams must be transported to the ultrasound department for imaging. Unfortunately, moving any critically ill patient places the patient at great risk. And at St. Paul's Hospital (Vancouver, British Columbia), this practice also left the intensive care/cardiac care units (ICU/CCU) frequently short of skilled staff while disrupting the normal workflow and revenue generation of the ultrasound department (USD).

St. Paul's Hospital is a 520-bed acute care, teaching and research hospital that is home to many world-class medical and surgical programs, including cardiac services, HIV/AIDS, and kidney care. St. Paul's is part of Providence Health Care, a large Canadian faith-based health care organization operating 14 sites in Vancouver, BC.

Aware that emerging technology, including miniaturization, has allowed for faster, smaller portable ultrasound systems with excellent image quality, St. Paul's Hospital decided to investigate changing current practice by bringing the ultrasound exam to the ICU/CCU patient's bedside. Wireless connectivity, also now available on these smaller systems, could remotely connect the sonographer at the bedside to the radiologist in the USD, further improving patient care by generating timely diagnostic reports.

But would the obvious advantages of scanning at the bedside also translate into cost benefits and greater efficiency for St. Paul's Hospital? That was the crucial question.

## ***A High Stress Environment***

In 2008, current practice at St. Paul's Hospital was to transport critically ill patients from the ICU/CCU to the

USD for ultrasound exams. A fatal event during transport was a grave concern as was spread or cross-contamination of infectious diseases. In 2007 (the most recent statistics available), at least 25% of St. Paul's ICU/CCU patients were infected with methicillin-resistant *Staphylococcus aureus* (MRSA) and/or vancomycin-resistant enterococci (VRE).

If a patient could be moved, ICU/CCU teams (comprising nursing staff, a respiratory technician, and porter) needed to accompany the patient during transport, leaving the units critically short-staffed during their absence. Preparation and transport back and forth took at least 60 minutes, and all monitoring equipment (including respirators) had to be portable and connected to the patient during the move.

The USD prepared by leaving a room ready for the patient for at least an hour. If the patient became unstable at the last minute, the exam would be cancelled, leaving nursing staff, porters, technicians, and the USD with unproductive time. Further, the USD, with a workload of approximately 25% inpatient and 75% outpatient, was struggling with increasing wait times for booked outpatients, and the waiting list was growing. The wasted hour of a cancelled ICU/CCU exam meant two outpatients did not get scanned and the USD lost billable revenue.

If the ICU/CCU were unable to transport the patient, the USD would send a radiology resident to the bedside with a large, unwieldy, old technology ultrasound unit that had poor image quality. As a result, a repeat ultrasound or additional diagnostic imaging was sometimes required, causing delay and increasing costs.

These factors were creating a high stress environment with little or no control of patient workflow and poor management of staff resources.

## ***Stakeholders and Concerns***

Stakeholders in this process at St. Paul's included ICU/CCU teams, an information technology (IT) team, sonographers, radiologists, and the ultrasound vendor. Patients were also considered stakeholders, their interests represented by nurses who work closely with them.

Among the concerns were exams being done in a timely matter with little or no disruption to patient workflow, possible lack of nursing support for USD while scanning in the critical care units, proper triaging of exams, and increases in the number of ultrasound exam requests upon arrival on the ICU/CCU wards. Other concerns included image quality, stable networking, and difficult or complicated cases requiring radiologist support. All stakeholders, of course, were intent on reducing risk to patients and improving patient care.

## ***The Plan Takes Shape***

St. Paul's Hospital chose a small, battery-powered ultrasound unit (z.one ultra Convertible Ultrasound System, ZONARE Medical Systems) with excellent image quality that was capable of wireless networking. The vendor lent the USD the ultrasound unit worth approximately \$80,000.00 for the six-month pilot study.

The ultrasound vendor worked with IT to establish stable networking. The cost of upgrading the ICU/CCU departments to support wireless networking was \$24,000.00.

Protocols and guidelines were established by the stakeholders and distributed to all concerned. Participants kept in daily contact, whether in meetings or by phone calls and emails, everyone working to support positive outcomes, especially for the patient.

Senior sonographers (with 5 years' experience or more) who would be performing the bedside exams familiarized themselves for a month with the new ultrasound unit.

The pilot program would evaluate:

- Efficiency and cost of not transporting patients to and from the USD
- Effect of bedside exams on USD outpatient wait lists
- Image quality of portable ultrasound unit (any repeats scans required?)
- Reliability of remote wireless networking to ensure timely reports

## ***Up and Running***

The ultrasound system arrived on July 14, 2008. On August 18, 2008, the first portable ultrasound was performed in the ICU. The USD went live with wireless networking on September 23, 2008, delivering diagnostic reports directly to the bedside. Since then, St. Paul's Hospital has been regularly and successfully scanning ICU/CCU patients in the units with the new portable ultrasound machine.

Feedback has been positive among all stakeholders, and the hospital already has plans to expand the program to the emergency department and eventually the medical and surgical wards.

## ***The Bottom Line***

Scanning ICU/CCU patients at the bedside clearly alleviates the considerable risks involved in moving critically ill patients. But is it also cost effective? What is the approximate cost of moving a critically ill patient? Or the cost of leaving an ultrasound room open for ICU/CCU patients while revenue-generating outpatients are waiting in line? Would the costs outweigh the cost of a portable ultrasound unit? Could these costs even be estimated? These are some of the questions the stakeholders had to consider.

After reviewing the available data, St. Paul's Hospital found that in 2007, before USD began scanning in the critical care units, the total costs for moving these patients was \$35,809.18, and the total loss of USD revenue was \$49,804.32 (see Figure 1). The elimination of these costs due to bedside scanning could easily offset the cost of the new handheld machine.

In addition, if emergency, medical, and surgical patients were also scanned on the wards (as is planned), cost recovery could easily cover the equipment and wireless networking setup costs within a year, and would certainly cover the salary of one fulltime healthcare worker. Moreover, the additional bedside scanning could create the availability of at least 400 outpatient appointments that could help with current USD wait lists.

The additional time saved in room clean-up could also be significant. The 2007 statistics revealed that 25% of ICU/CCU patients had MRSA or VRE. This number is likely underestimated but is significant enough to cause concern regarding the time required for proper cleaning and the risk of spread.

## ***A Lean Green Imaging Machine***

Several sonographers noted that the ultrasound system has no heat output. It turns out the unit uses less power than standard larger units and is a green machine. This alone has meant a great deal to the staff – the fact that the hospital is creating a better environment.

In addition, sonographers that scan at the bedside do not have to be concerned about finding a plug or unplugging the unit and pulling it away from a patient during a critical event in the ICU/CCU.

## ***A Beneficial Mode of Service Delivery***

There has been nothing but positive feedback from the ICU/CCU teams (including nurses and physicians); the ultrasound department has generated respect for providing timely exams; and everyone is relieved that patients are not placed at risk and the ICU/CCU departments are not left short of staff.

Due to the success of this pilot project, St. Paul's Hospital USD will start scanning at the bedside of patients in the emergency department in April 2009, eventually followed by the medical and surgical wards.

The limitations remain to be seen. As the program expands, likely there will be a need for additional portable equipment and staff. New processes will need to be clearly articulated. The wait list for the USD could be reduced by providing even more booking slots for outpatient work.

The future applications of this technology could include house calls, i.e., going to patients within the community. With wireless connectivity, images could be sent to the hospital's radiologist and interpreted in minutes, just as is now done in the hospital. Further investigation of the costs of inpatient care versus using the new technology in the community setting needs to be done.

In the final analysis, St. Paul's Hospital has found scanning at the patient's bedside to be a beneficial mode of service delivery with a favorable cost impact.



*Scanning ICU patient at the bedside. St. Paul's Hospital, 2009.  
Images are transmitted wirelessly to the Ultrasound Department's PACS.*

## ***Figure 1: Costing Assumptions***

Note: All ICU/CCU patient statistics are based on 2007 statistics (the most recent available from St. Paul's Hospital)

- Staff required to transport ICU/CCU patient to USD: ~4 (nursing staff, respiratory technician, porter, and sometimes a sonographer)
- Total labor costs per hour: ~\$128.81 (all labor wages based on average for each job description)
- Preparation and transport of patient back and forth: ~1 hour
- Amount of time USD room is made available for one ICU/CCU patient to be scanned: ~1 hour
- Approximate cost per USD outpatient exam: \$98.04 (technical and professional costs combined)
- Number of outpatient scans performed in USD per hour: 2
- USD lost revenue per hour for cancelled ICU/CCU patient exam: \$196.08
- Average number of ICU/CCU patients requiring ultrasound for 2007: 278

### ***Results:***

- Total labor costs for transportation (\$128.81 per hour x 278 patients): \$35,809.18
- Total loss of USD revenue: ~ \$49,804.32 (~ 254 hours or 508 exams)