Findings of a Comparative analysis of Operating Room Fluid Waste Removal at Hospital for Special Surgery

A Randomized Study Comparing the Stryker Neptune Waste Management System to Suction Canisters.

Rita Patel, MBA

Abstract: A study was done comparing the Neptune Waste Management System to fluid collection in suction canister, the method currently used at the Hospital for Special Surgery. HSS collects fluid in canisters and disposes of it by pouring it into the drain. The study analyzes 15 procedures with canisters and 14 procedures with the Neptune system and compares the time to transport and dispose of the waste after surgery. It also analyzes the safety of the system, comparing splashes during and after surgery, looking at transportation and disposal. The Neptune system was found to show an 87% timesavings to dispose of fluid after surgery. Additionally the Neptune system proved to be much safer, showing zero splashes and spills compared with 13 while using canisters.

A t-test was conducted to evaluate the difference between the mean time of each system. A probability of 0.0013 resulted indicating that there is 99.87% likelihood that there is a difference between the Neptune and current HSS system in average time to dispose of O/R fluid waste. The standard deviation for each system indicates that the individual values for each observation fall within a large range.

The safety and efficacy of surgical fluid waste removal are important considerations in appropriately managing hospital operating rooms (O/R's). Stryker Instruments has developed a self-contained fluid waste management system (Neptune Waste Management System- "Neptune System") to address these concerns. Stryker Instruments, Inc. has contracted with Hospital for Special Surgery (HSS) for the purpose of performing a comparative analysis of the Neptune system and the current HSS for operating room fluid waste removal at HSS. The objective of this study is to assess the differences in O/R turnaround time and safety between these two systems.

The two primary areas of importance are safety and operating room turnaround time. In order to assess these two factors, the following data points were collected for each observation: date, type of surgery, amount of O/R fluid used, amount of O/R fluid waste collected, number of unit assistants to clean room, time to dispose of O/R fluid waste, occurrence of spills en route to waste room, occurrence of splashes per O/R fluid dumping/flushing, flush per fluid dump (HSS system), proper docking (Neptune system).

Data was gathered from observations of shoulder and knee arthroscopic surgeries in ambulatory O/R's at HSS. These types of surgeries were chosen because they are common ambulatory procedures and they generate the most O/R fluid waste of the ambulatory surgeries at HSS. Observations were made by the same investigator.

The study was designed to minimize surgeon variation regarding use of O/R fluid; therefore, the data collected in each system were matched by surgeon (5 surgeons) and type of surgery (arthroscopic knee, arthroscopic shoulder).

There were 15 arthroscopic surgery observations in the current HSS system group (7 knee and 8 shoulder). There were 14 arthroscopic surgery observations in the Neptune system group (6 knee and 8 shoulder). All data was collected between November 25, 2002 and June 4, 2003.

Results—Time Analysis

The following data are the results for time. The total amount of O/R fluid waste collected during the observed surgeries was comparable between the two systems. The total aggregate fluid was 201,488ml for the 15 cases using the current HSS system, and was 201,238ml for the 14 cases using the Neptune system.

The average fluid collected per case using the current HSS system and the Neptune System was 13,433ml and 14,374ml, respectively. There is a difference of 941ml (7%) between the averages of the two groups. This was

deemed as not a significant variation between the two groups. As a result, any variation between groups in O/R fluid waste collection would not be attributable to the amount of fluid used during the surgeries.

Below is the data related to amount of time that the unit assistants required to dispose of the O/R fluid waste under each system. The data is presented to represent the disposal time required to gather, transport, and dispose of the medical waste after surgery.

***(End of surgery analysis)**:*

	HSS System	**Neptune System**
Total Aggregate Time of disposal (all cases combined)	3,720 seconds (62 minutes)	448 seconds (7.47 minutes)
Average time to dispose of fluid waste	248 seconds (4.13 minutes)	32 seconds (0.53 minutes)

	Turnover Time	
Time Difference on average To dispose of fluid waste	216 seconds (3.6 minutes)	Neptune system: 87% time savings

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Results—Safety Analysis

Safety was measured by observed spills and splashes. A spill was recorded during collection/removal of O/R fluid waste phase when the unit assistant travels from the O/R to the waste disposal room and fluid from the containers/bag liners leaks or spills on the floor along the pathway until he reaches the disposal point. A splash was recorded during the disposal of O/R fluid waste at the disposal point. A splash constitutes any fluid that does not directly flow as a clean line into the hopper during pouring of the liquid. Under the HSS system, there was one occurrence where there were spills observed from 20 possible occurrences (5% incidence rate) and none under the Neptune System. Per each disposal there were 12 occurrences where there were splashes observed from 20 possible occurrences (60% incidence rate) and none under the Neptune System.

Safety:

	Total occurrences of Spills		**Total occurrences of Splashes**	
HSS system	1	5%	12	60%
Neptune system	0	0%	0	0%

Overall, in this study population, the Neptune showed no potential for a spill or splash. Neptune is a closed system that requires no direct contact with O/R fluid waste. With the current HSS system, there is more direct contact and handling of the O/R fluid waste. The spills and splashes contribute to an environment where contact with the O/R waste fluid could occur as well as possible slippage of personnel. In addition, as a closed system, the Neptune removes the reliance on the unit assistant to flush after the O/R fluid waste is poured into the hopper, as is the case with the current HSS system. The flushing does not necessarily remove all of the O/R waste.

Discussion

The Neptune System allowed for quicker and safer disposal of fluid after surgery. Depending on how much O/R fluid waste collection capacity is remaining in the Neptune rover, it may not need to be emptied (disposed). In this case, the disposal time required is 0 seconds. Observations show that if disposal is required with this system, the time spent is less than that spent with the current system. On average, per case when using the Neptune there was 216 seconds (3.6 minutes) time reduction over the current HSS system at the end of surgery. This time can allow the unit assistant to do other O/R cleanup and setup activities as well as give more care to other activities. It also contributes to a reduction in turnover time between cases in the O/R, which could potentially increase productivity in the O/R. It is necessary to note that the Neptune system may fill up beyond it's 20 liter capacity during surgery.

In these situations it is important to have another Neptune readily available in the room to change to a new collection reservoir. If there is not a Neptune available this may present a different set of data.

Financial Impact:

	Cost per Minute	Potential savings using Neptune
Operating room time	$30.00	$108.00 per case (3.6 min. * 30)

Discussion-Financial Impact

The Neptune Waste management system can save a significant amount of time between cases and is safer than the current HSS system. HSS runs their operating rooms very efficiently and to consistently save 3.6 minutes per case is substantial. A minute of operating room time is estimated to cost at least $30, even by the most conservative estimates. An analysis of these numbers shows that the Neptune System can save an average of $108 per case in operating room time. At a hospital performing 5 surgeries per room a day, you could expect to see a potential savings of over $100,000 per year / per operating room. The goal of every operating room is to reduce case delays, decrease turnover time, cut overtime payments, enhance productivity, and increase the use of rooms for surgery. Use of Neptune systems in multiple rooms may allow a facility to add procedures to their surgery schedule and increase revenue. A recent industry study shows the average OR runs at only 68% capacity, and because many OR resources can be considered "fixed" expenses, improving throughput by just one additional procedure per day per OR suite can generate up to $4,000,000 in increased annual revenue for the average-sized organization.[i] Additionally, the timesavings could decrease the amount of overtime.

Operating room fluid splashes and blood borne pathogen exposure can also be very expensive to a hospital facility. The average non-infectious employee exposure splash is estimated to cost a hospital $660.00. This cost is made up of testing, follow-up protocol, vaccinations and medicine.[ii] If a staff member is infected by a splash this can cost the facility thousands of dollars in future healthcare for the employee and possible litigation that can settle in the millions. The CDC reports that the estimated cost for each person exposed to a blood borne pathogen to be $200,000 for a six-month course of therapy[iii]. The Neptune system is closed and eliminated the splashes and spills of infectious waste that we observed with canisters. Based upon the data we collected the Neptune can have a significant financial impact on a hospital facility.

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[i] "Achieving Operating Room Efficiency through Process Integration." http://www.hfma.org/FeaturedTopic/McKesson%20report.pdf

[ii] Newsedge Corporation, Heads Up, Your Story Request. Research Reveals Costs of Blood Exposures. Order number 575528. Burlington, MA.

[iii] "Infection Control: Recommended Follow-Up of health Care Workers after Occupational Exposure to Hepatitis C." http://www.hivdent.org/infctl/cdchepc.htm.