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The Integrated OR:

Technology evaluation is considered a must in today's healthcare systems, especially when a significant monetary investment is required. Such evaluation is to be conducted before the introduction of a new technology by means of a multidisciplinary approach that should take every aspect into account. Evaluations can also useful as a follow-up verification, especially in cases where little literature is available due to recent introduction on the market or very limited access to technology. Moreover, managers might be interested in verifying if statements, data and stakeholders introduced during the acquisition process are real or need to be redefined. Varese Town and University Hospital in Italy performed such an evaluation of their integrated operating rooms.

The integrated Operating Room (OR), otherwise referred to as "digital OR" or "interventional suite" is a technical solution mainly dedicated to minimally invasive surgery where environment (lights, climate, etc.), medical devices and video distribution are controlled via one or more PCs and activated via a single graphic interface. In such an OR each and every control is in the surgeon's reach, allowing him to interact and control the system using a boom-mounted, sterile touch screen that can be placed right on the operating field. A computerised video matrix controlled by the same touch screen distributes images to boom mounted monitors thus allowing the best viewing angle to each operator. Only solutions granting video distribution and medical device control should be categorised as an integrated OR.

Vendors state that boom-mounted devices, the possibility to view images on many displays that can be best fitted for the surgeon and surgeon's direct device control connote the digital/integrated OR as a very efficient and effective environment, providing enhancement in flexibility and integration of information. This aspect is to be investigated and verified. At the time being, there are many installations worldwide of such Integrated ORs which differ by vendor, degree of integration available, surgical specialty they are destined to, etc. Nevertheless, it is not clear whether this technological solution is useful, effective or worth the economical and organisational effort needed to implement it in a new or existing hospital.

In Varese Town and University Hospital 20 digital ORs [15 Olympus Endoalpha®, 2 Karl Storz OR1®, 3 Smith & Nephew Digital OR™ have been recently built to fulfill the needs of ten surgical specialties. The imaging distribution control can be performed using a multiple choice of monitors available as destination, i.e. one or more boom-mounted displays, a 40" plasma monitor on the wall, a video-conference system, a DVD recorder or centralised storage. If the OR is fully integrated, a medical device control is also present.

Objectives

After two years from installation, the hospital management and Clinical Engineering Department wanted to evaluate the surgeons' and staff nurses' satisfaction and comments on the ORs. Such evaluation is considered an assessment of the acquisition process, assessing whether expectations had been fulfilled or how they had been missed or over-considered. A qualitative study based on clinical staff opinion was conducted and was considered a valuable judgment of the solution implemented. Moreover the evaluation is by all means needed by the entire scientific community due to the lack of literature on the subject. Although the data is limited in its scope, referring to a local situation only, it still represents a valuable set of data for hospital management.

Methods

A multiple answer questionnaire was handed to surgeons and scrub nurses. 17 surgeons and nine scrub nurses were interviewed. Interviewees were all fully integrated OR users in order to allow a complete evaluation, especially on the device control integration. Only surgeons and scrub nurses were interviewed as they represent the real direct users of the OR. The interviewees belong to different affiliations (mainly general surgery) and have different experiences; they also use different products since three different solutions are in use. There are some common questions asked to both surgeons and scrub nurses. These common questions made it possible for us to evaluate the different profession's approach to the digital OR. Multiple guided answer questions were proposed; the interviewee had to define a level of importance by distributing 100 points among the available options. Questionnaires were answered with the interviewer present; this encouraged detailed comprehension and more reliable answers.

Results

Six subjects are considered in this article. The first one aims to test the usefulness of the integrated OR. Answers available ranged from the reduction of patient risk to hospitalisation time, rehabilitation, quality of surgery, surgical stress, and surgery time. Surgeons classified enhanced quality of the surgical act as the best option (total reached scores: 520 points) while the second choice was stress reduction (475 points total), followed by reduction in surgical time (375 points total) (see Fig. 1, p.34). It's interesting to read the same data in terms of classification: quality of surgery has been chosen as the best option by 47 percent of surgeons vs only 11 percent of scrub nurses, while 35 percent of surgeons rank it as second option, resulting in an overall 82 percent of surgeons stating that the integrated OR augments quality. Both surgeons and scrub nurses agree that the integrated OR can reduce stress related to intervention (35 percent of surgeons and 44 percent of scrub nurses chose this as the best option) and reduce surgery time (29 percent of surgeons rank it as first, 24 percent as second and 24 percent as third, 22 percent of scrub nursed rank it as first, second and third).

The fact that the integrated OR can reduce risk related to surgery has been voted with 315 points, and obtained a total (first and second place considered together) percentage equal to 48 percent and 44 percent of surgeons and scrub nurses respectively.

In order to acquire more details on the subject, a specific question was proposed about surgical time reduction. Surgeons think that time

reduction can be achieved in surgery scheduling phase while staff has the impression that surgical act duration and devices set up phase has been reduced. Scrub nurses in particular stressed the point that also anesthesia preparation procedure became shorter due to the integrated OR facilities.

Moreover automatic presetting functions (a tool that allows to store in the system functional parameters which have to be set on each device for a defined user) can help staff reduce theater preparation time (53 percent of surgeons and 67 percent of scrub nurses).

OR layout was then analyzed to evaluate available functions such as the usefulness of the computerized video matrix for images acquisition and distribution, the control system use, the utility of mounting devices (endoscopic camera, light source, CO2 insufflator, electrosurgical unit) on a single boom and the possibility to orient more than one display on independent boom arms. 47 percent of surgeons rank video acquisition and distribution most important (first place, and a total score equal to 470 points) (Fig. 2) while on the contrary, 78 percent of scrub nurses rank device control in first place with a total assigned score of 295 points. A different judgment regarding the need for boom mounted devices can be seen to: it has been voted with 330 points by surgeons (35 percent of surgeons rank it in 1st place and 29 percent in second) and with 145 points by scrub nurses (mainly ranked as third place). The judgment on the availability of more than one display is comparable.

Options regarding medical device control were: Increased reactivity to events, reduced setting errors, reduced confusion and reduced displacements of devices and monitors. Both surgeons and scrub nurses stated firstly that direct control can grant better reactivity to events that occur during surgery (this point was particularly emphasised by scrub nurses). On the other hand, both surgeons and scrub nurses observed that such a system can reduce device setting errors (surgeons a little more than scrub nurses – 35 percent as first place vs 22 percent). It has been additionally noticed that device control implemented inside integrated ORs can reduce mess and racket and the number of displacements of devices, monitors etc, during surgery although scrub nurses don't consider this aspect as most relevant.

Teaching capabilities of the integrated OR were considered. The majority of the interviewed surgeons (76 percent) think primarily that a better "point of view" on the surgical field can be achieved and therefore that a higher amount of surgeries can be viewed. Scrub nurses also indicated the chance to have more interventions available for learners.

Evidently there is still more work to be done; surgeons and scrub nurses agree that there is first of all a need for education (i.e. knowledge of how to operate the integrated OR) and how a correct operation can affect organisation. Moreover nurses evaluated as a relevant problem the lack of integration of specific medical devices (i.e. ultrasonic scalpels, electrosurgical units) and think that there is a significant cultural problem when approaching such technology (Fig. 2).

Conclusions and Discussion

The results of the questionnaire show substantial satisfaction by both surgeons and scrub nurses, given that the installed technology grants multiple advantages to workers and patients. Among such advantages we can enumerate increased quality of patient treatment and reduced stress during surgical act (Fig. 3), reduced time for device setup and surgical act, increased reactivity for urgent decisions and reduced setting errors and racket. These advantages are mainly obtained using features of the integrated OR such as video acquisition and distribution and medical device control. The use of medical device control and availability of different types of information can improve security and efficiency of the surgical act, as stated by other authors.

In fact, the main conclusion derived from results, while considering the data as a post installation impact, is that a relevant improvement in quality has been introduced with the integrated OR and a less stressful and shorter surgical procedure has been achieved.

The results presented above show a different approach to technology between surgeons and scrub nurses, the latter being more concerned about workflow and surgical process in general. This is confirmed by answers given to the question concerning layout (where little interest was reserved to video acquisition) and to utility of medical device control and presetting. Surgeons appear to be more concentrated on the surgical act itself; such conclusion is endorsed by the ranking given to availability of images from surgery, reduced surgery time and increased quality (Fig. 3) rather than device control, setting errors or process standardisation. The results shown outline that it is clear that the Integrated OR can help overcome the usual problems of modern ORs, i.e. a conspicuous presence of high tech devices with little care to ergonomics of the OR itself.

The data presented illustrate that the integrated OR is a technical solution that should be evaluated by each institution wanting to enhance its healing capabilities and its organisational structure. The great need for education, a modification of cultural approach and coordination between surgeons and scrub nurses (Fig. 3), with related costs, can be used as other drivers to define if the solution is to be acquired or not.

Education of surgeons and scrub nurses on the advantages of such systems as providing substantial and literature-evident improvements in treatment, organisation and, as a direct consequence, economy, could help to impact on the users' approach and then corroborate the thesis that the Integrated OR is by all means a valuable technology.

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