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Simulation Sessions as Engines of Improved Hospital Care Quality

Cecile Boulard, Cecile Falzon, David Rozier and M. Antonietta Grasso
Xerox Research Centre Europe
{name.surname}@xrce.xerox.com

Abstract. With increasingly complex practices, improving the quality of hospital care must include infrastructures to support communities of practice. We argue simulation sessions are ideal opportunities, if managed well, to create successful communities of practice.

Medical Knowledge Generation and Simulation

Infrastructures in support of healthcare quality are either systems dedicated to governance or re-purposed systems, such as electronic health records, designed to support clinical care but also serving managerial objectives of increased efficiency and patient throughput. In this paper we will examine quality from the perspective of the medical knowledge as used 'in practice', and examine how medical simulation settings, increasingly used for training, can naturally become a quality tool for hospitals, supporting virtuous cycles of continuous knowledge creation and sharing from the (simulated) field to the daily medical practice. Our reasoning is grounded in the existing literature and two own user studies: first a set of four interviews of practitioners, secondly a field study of a medical simulation setting in a hospital (Boulard Masson et al., 2016).

The healthcare domain is transforming rapidly, with patient centric approaches and precision medicine. In this paper we will examine the aspects linked to

medical knowledge. Medical science has greatly progressed and continues at a steady peace. Atul Gawande, reports that there are today around 4000 medical and surgical procedures, with around 6000 drugs that doctors are authorized to prescribe (Gawande, 2011). Other sources confirm this, for example (Vincent & Amalberti, 2016) state that in five years, half of the knowledge in a medical speciality has changed. This fast generation and update of knowledge has several important implications. Firstly it is increasingly harder to master this progress and we are getting to a turning point where no single practitioner can master it all. Secondly, there is an increasing complexity of the hospital care: Gawande mentions the evolution of how many clinicians it takes to care for a hospitalized patient: in the 1970s, two and an half full-time equivalents of clinicians (a nurse and a doctor), and by the end of the 90s more than 15 clinicians (specialists, physical therapists, nurses). This increasing knowledge complexity has therefore two impacts: on the capability of doctors and paramedical staff to master it and on the capability to accomplish care through the enactment of large coordinated teams with many different profiles.

Facing this increasing complexity, we have noticed, in a number of practitioners interviews we carried out, that participation in Communities of Practice (CoP) (Wenger, 1998) is mentioned as an effective support of the required continuous learning. This is aligned with a meta study (Ranmuthugala & al., 2011) showing a growing interest to understand what shapes effective CoPs in the medical sector, even if it still "requires a greater understanding of how to establish and support CoPs to maximise their potential to improve healthcare". In particular, there is a lack of understanding of what setting and communication medium may best support them. Starting from the core characterization of them as constituted by a joint practice (what is shared by the community) and sustained by interactions involving a mutual engagement, we observed that simulation sessions in hospitals, and especially the debriefing element of them (Boulard Masson et al., 2016; Horcik & Durand, 2011), can facilitate CoPs systematic creation and adoption, towards a continuous knowledge creation cycle. This result is based on the analysis of our field study debriefings, that indicates they provide an excellent opportunity to gather feedback on the reality of work and produces new knowledge to improve it. In (Boulard Masson, 2016) we provided several examples of the type of knowledge that would benefit real practice if taken into account. We highlight here three main forms of it: firstly the refinement of existing medical knowledge on the base of the practice, secondly, the sharing of good practices and teamwork dysfunction and thirdly the improvements of the teamwork organization.

Refining Medical Knowledge

Drawing examples from our field study, below is a discussion from a simulation debriefing, about the rate of norepinephrine that should be given to a patient

recovering from an anaphylactic shock. The anaesthesia nurse chose to put 0.05 mg/h norepinephrine where normally the prescription is 0.1 mg/h or 0.2 mg/h. During the debriefing the trainer came back on that decision.
Trainer: "*Maybe in another context you would have chosen 0.2 or 0.1?"*
Nurse: *"No, not necessarily, a patient without any medical history, on a minor surgery, I feel comfortable to start with 0.05… Then if I have to hand off to a colleague I will carefully explain the situation [as it differs from the prescribed rules]."*
A following discussion with the trainer allows us to understand that this anaesthesia nurse is working in the cardiac surgical service and that, in that specific service, they are used to have patients who strongly react to norepinephrine. In that case, it is interesting to see that some anaesthesia nurses choose different dilutions from the prescribed ones, potentially for good reasons, such as the specificities of a service. To go further, the trainer, if supported by the organization to do so, could during future debriefings with other practitioners raise this practice to inform them that, in some specific context, it is possible to use another dilution or to recall the importance of communication on dilutions as sometimes practitioners do not strictly follow the prescriptions.

Sharing of Good Practices and Teamwork Dysfunction

During debriefings, we were able to observe the sharing of good practices where practitioners, in reference to the situation they just experienced in the simulator, describe also what their resources in real situations are. Here, the trainer tries to understand how the trainee identifies the worsening of the situation.
Trainer: *"It seems that the first signal that alerted you was the desaturation."*
Nurse: "*I really pay attention to this sound since a supervisor made me aware of this little sound to which I was not attentive, and brings so much information*".
This beeping sound is therefore identified as a core element for the anaesthesia nurse in order to perform safely. This comment also shows that this sound is not necessarily widely used: "*to which I was not attentive*". As a follow up, the anaesthesia nurse adds "*I often find myself in rooms where the beep has been cut off, but you're on the job, […] so after a while you give up, after you've been asked to turn it off once, twice, three times*". In this debriefing, we see an opportunity to share good practices, which are not necessarily the prescribed ones but more the work-arounds that allow the practitioners to perform better. The idea is not to motivate all practitioners to follow this specific work-around, but more to share the opportunity of such good practices and leave it to the practitioners to decide when and whether he/she can use it. A second level is addressed here according to the use of the beeper and targets the teamwork. The trainee mentioned that sometimes surgeons said they were disturbed by the beep. This type of feedback could lead to discussions between anaesthesia practitioners and surgeons on the ways they can achieve together safer surgical operations.

Discovering Improvements of the Teamwork Organization

The last example we want to raise is a situation where a critical care resident, who is reaching the end of her training to become an anaesthesia and intensive care doctor, is discussing her position in the simulation compared to the position she usually holds in real situations.
Intensive care resident: *"I had the feeling to be in the position of the leader doctor that is new to me. During my three months residency at the 'déchoc' [where trauma patients are admitted when arriving in the hospital], I only held the position of the follower [main role is to perform technical tasks such as catheter insertion]. I never really made any decision on critical patients."*
Following this first statement, the trainers and trainees discuss as peers about possible changes they may initiate in order to improve the global training supported by the "buddy" experience.
Trainer (Intensive care doctor): "*Actually, we should reposition ourselves, when we can be several intensive care doctors, and let you [the residents] hold the position of leader. We can't really be the follower*."
Intensive care resident: "*Otherwise it could imply bringing in two intensive care residents, one with the senior doctor saying "you manage the situation, I stay behind", and the other one to equip the patient"*
Trainer (Intensive care doctor): *"Yes indeed when it's possible, we should maybe do it that way"*.
At the end of their discussion, trainers and trainees have agreed on an improved way to get things done, yet without taking risks and allowing residents to face situations they will face as doctors without really practicing them.
Besides the several examples described above, other useful information for CoPs and for organizations are shared during debriefings. It can be very concrete and target equipment dysfunction, obsolete procedures, or incomplete protocols (Boulard Masson et al., 2016). Through the data collected in our fieldwork, we demonstrate that discussions occurring during post-simulation debriefings reveal a high potential for understanding actual practices performed in the field, where improvements are possible and propositions for improvements are formulated.

Toward an Infrastructure in Support of Quality

We believe some well-designed technology can help preserving and systematizing benefits of simulation sessions in the longer term to sustain organizational learning, beyond individual training.
Central aspects of such infrastructure need to be around knowledge modelling and knowledge governance, to support effective sharing amongst stakeholders, both of which need to be sustained by additional specific research insight, in order to inform technology design. But we can already pinpoint that a major issue in this

reflection is about how to move from verbal discussions that are mostly informal and confidential to written information that can easily be more formal and less confidential. With this in mind, we can already provide some elements of reflection related to the IT infrastructure.

Today we envisage two different types of infrastructures that could support simulation sessions while also putting them at the service of organizational learning. However, although similar, we believe they offer a different approach to governance: in the first case the system is encoding strict validation procedures to assure an *a priori* verification of insights coming from simulation sessions and ensuring that appropriate validation steps occur before any new knowledge comes to the surface, while in the second approach the system is much more open and it is only *a posteriori* that the knowledge governance is put in place.

The first type follows the spirit of an ecosystem of interconnected web applications targeted at different stakeholders with for instance two main modules: 1) A practitioner's module, with a personal area, for practitioners to: keep track of simulation sessions, of real practice noticeable events they would log in, and receive propositions for further training. This module should include also a CoP area, allowing them to provide feedback on training and simulation sessions, to submit real practice noticeable experiences, and to argue opinions on new guidelines; 2) A hospital module would provide each hospital management team with a dashboard to manage quality improvement of their practice by monitoring training requirements and identifying risks and need for personal and organizational evolutions. This module would be a tool to examine new insights and decide if and how to turn them into explicit and consensual new practices.

Another type of infrastructure could take the form of a bottom-up collaborative system such as a wiki. This format became famous from its usage as the base for the Wikipedia encyclopedia, but it is also used in private environments (Brichni et al., 2014 and Grasso and Convertino, 2012) as an infrastructure for knowledge management.

What we propose here is that the simulation sessions and their associated debriefings serve as a way to extract and create knowledge that can be capitalized through more informal knowledge sharing in a wiki and utilized towards quality improvement. In (Brichni et al., 2014), different axes have been identified to evaluate the appropriateness of this tool as an infrastructure for quality improvement, which was the goal of the wiki described in the study. These dimensions can serve as a relevant guide for a wiki infrastructure to be assessed and designed for quality improvement in healthcare.

Additionally in (Brichni et al., 2014), more commonalities can be found with our proposition. Firstly we both aim at sharing and connecting practical knowledge (*know-how*) in the field with listed procedures: these two aspects are often opposed although they were here seen in synergy in the industrial case. The web base structure of the wiki allowed the use of hyperlinks to easily create seamless

navigation between know-how and procedures. Secondly, the existence of several different groups of users is a common feature: the groups were members of the IT Service on one side, and members of the manufacturing operations on the other side, differentiated through the use of login procedures and customized tools. The two groups had both common and differing interests. In our case, we could use the same strategy to offer different ways for practitioners, simulation professionals or hospital management staff to leverage the information.

Beyond the set-up and maintenance of the infrastructure itself, which is fairly light, the effectiveness of the self-regulation and *a posteriori* approach needs to be validated, firstly in relation to the validity of the information. In most wiki systems, communities manage to more or less self-regulate the validity of the content. How appropriate these self-regulated dynamics are in a hospital environment should be assessed, even if champions were distributed through the organization to constantly monitor what new knowledge comes to the surface though simulation sessions. Secondly, validation is needed in relation to confidentiality: here the risk is that curation would come into action after the 'damage is done', for example after the names of colleagues are mentioned and seen by readers.

Despite these needed verifications, we believe such types of infrastructures should be considered as necessary tools to be put in place so that simulation programs can become an effective mechanism towards the enhancement of care quality.

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