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Decoding the perioperative process breakdowns: A theoretical model and implications for system design

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ABSTRACT

Background: Breakdowns in communication and coordination are situations of mismatch between actual and expected conditions in joint activities. Breakdowns have been identified as the leading cause of adverse events in healthcare, especially in the Operating Room environment. As a result, researchers have started to examine breakdowns in healthcare as emergent dynamics of teamwork. However, the occurrence and consequences of breakdowns related to inter-team processes are yet to be addressed at a fine level of detail. In this paper we seek understanding of breakdowns at the systemic level, and its relevance to design.

Objectives: The objective of this study is to bring forward an in-depth understanding of the impact of breakdowns on the surgical process by expanding the focus of analysis beyond teamwork dynamics, to the level of hospital system processes. This study also aims to examine the implications of such understanding of breakdowns for the design of clinical systems.

Methods: Properties of breakdowns and repairs were inductively derived, and developed into a formal coding scheme, which was applied over a set of observed breakdowns from an elective surgery unit in a North American hospital. Systematic content analysis was employed to quantify qualitative data spanning 79 h of observations, followed by statistical hypotheses testing for relationships between variables of breakdowns and repairs.

Measures: Breakdown type, theme, tangibility, coordination scale, breakdown lifetime, repair strategy, and repair cost.

Results: The results reveal that properties of breakdowns determine properties of repairs. The majority of breakdowns were outside the scope of teamwork – at the inter-team coordination level. The results also demonstrate that breakdowns usually propagate downstream in the surgical process, affecting the work of multiple teams, and the longer they propagate the higher the communication cost associated with the respective repair. The implications are two-fold: in terms of theory we develop a conceptual framework of breakdowns in perioperative work, and in terms of system design we propose a design framework informed by the acquired understanding of breakdowns.

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Conclusions: This study achieved an initial understanding of the deep features of breakdowns from a process-oriented perspective, which allowed us to build the groundwork for a theoretical model of breakdowns in perioperative activities and to propose a design approach that tackles breakdowns during early stages of system development. The direct association between breakdowns and repairs can be exploited in both IT-system design and organizational design. The patterns of repair work can inform design so as to provide clinicians with the types of information that will prevent breakdowns from occurring or to mitigate the impact of breakdowns. The results reveal that preventing breakdown propagation should be a prime target in surgical applications design.

1. Introduction

Breakdowns in communication and coordination are situations of mismatch between actual and expected conditions in collaborative work. As such, breakdowns present an obstacle to the successful completion of an activity that leads to shift of focus from routine practice to problem solving [1]. Breakdowns are caused by failure of tools, of coordination and of cognitive processes. The root causes, however, go beyond individuals – it is the combination of people, latent and proximal factors related to the socio-technical system-level information transfer (i.e. between units in an organization) that contribute to the instantiation of breakdowns. In healthcare, process breakdowns lead to adverse patient outcomes, particularly in surgical units [2,3].

Although breakdowns have been identified as the leading cause of adverse events, most studies of breakdowns are reactive in nature, i.e. post hoc event analyses [3–7]. Very few studies have taken on the proactive task of exploring breakdown conditions and processes in the clinical setting, as they occur in daily practice [1,8,9] – i.e. as latent factors that did not necessarily manifest themselves as serious adverse events. These latter studies looked at communication and coordination patterns, human errors, efficiencies and inefficiencies in team dynamics. They identified patterns of problematic communication and types of critical situations when breakdowns occur. The insights provided have deepened our understanding of teamwork in high-risk clinical care and are valuable within the teamwork frame. However, a number of adverse events investigations have identified breakdowns at the macrohospital or healthcare system levels, i.e. between multiple teams/groups/units, as the cause of accidents. The studies on team dynamics confined the focus of analysis of breakdowns to the view of one role or collocated group/unit – i.e. focusing on intra-team communication processes within operating rooms (OR), emergency centers, etc. Therefore, the findings related to teamwork processes are insufficient to offer input beyond the teamwork frame – at the hospital or healthcare system levels.

Recently, a shift in focus to the macro hospital-level system issues was marked by a few studies with a proactive approach. Ethnographic work reported several coordination breakdowns at group boundaries in the perioperative setting, and their consequences [10,11]. For example, issues of tracking patients throughout the surgical journey, as patients were transferred between providers of care (i.e. between teams), resulted in tensions related to clinicians' work within and outside the OR. These studies denote an important turn to the proactive investigation of latent factors at the system level of hospital operations, with a focus on inter-team breakdowns. It was these types of healthcare system factors that were the output of earlier reactive adverse events analyses. However, being pioneers in this endeavor, the proactive studies have yet to mature – the reported findings in the aforementioned research were based on observational notes and on interviews, and no formal data coding and analysis were applied. A step in that direction was taken by another recent study at a preoperative admission unit that ventured beyond qualitative descriptions – the researchers categorized observed breakdowns at the inter-team level according to criteria of interest and produced frequencies of observed types of breakdowns and their consequences [12]. What the authors found was that the leading issues were missing, delayed, unclear, and incomplete information, or poor communication. The most frequent consequence of breakdowns was that the care provider was required to track down and/or follow-up on the missing patient information. However, no mapping between breakdowns and consequences was provided.

In order to address potential quality, efficiency, and safety issues inherent in proximal and latent healthcare system factors, there is a need for a better understanding of breakdowns in healthcare processes through systematic formal studies that go beyond qualitative descriptions of observed phenomena and address breakdowns at the healthcare system-level [2,13]. Further, operational efficiency in hospitals will be enhanced by a recognition of the factors that contribute to breakdowns, and by eliminating repair overhead that is very costly [14]. The fundamental value of an appreciation of the deep features of breakdowns and respective repairs is that it is a rich resource for human-centered information technology (IT)-system design solutions [15–17]. Thus, our goal is to acquire and use such knowledge about breakdowns to inform and improve the design methods for clinical technology. By addressing breakdowns in clinical work during the early stages of IT-system design, future technology will adequately meet the communication and coordination demands of clinical work. As a result, adoption and safety will be enhanced.

The study reported in this paper is a first step in the directions described above – a formal systematic study of coordination breakdowns at the hospital system-level, addressing inter-unit coordination, communication cost, and repair strategies. In Section 2 we integrate the existing knowledge on process issues in and outside of the perioperative setting into an initial basic set of properties to be explored in the formal analysis of breakdowns. We derive the prop-