Balancing clinical team perceptions of the workplace: Applying ‘work domain analysis’ to pediatric cardiac care

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A B S T R A C T

The safety, reliability, and stability of the pediatric cardiology workplace are continuously challenged. These challenges include the complexity of patient care, keeping up to date with evidence based practice, harnessing the implications of innovations in technology, and adapting to changes in the structure of health services and facilities. The differences between individual clinical team perspectives and impressions formed by other teams across the organization produce divergent perspectives on clinical work. This paper makes a case for investing in a social science framework entitled ‘work domain analysis’ to better understand how health teams function reliably within the wider healthcare organization. Work domain analysis was developed to equip people in complex work environments with the skills and awareness to identify and adjust the margins for safety in normal work by making the boundaries between management imperatives, workload and safety (in this case, pediatric cardiac care) more apparent to a wider range of people. Healthcare can no longer afford to be precious about methods adopted from other industries due to the high complexity of the clinical workplace. The paper outlines an approach to work domain analysis that can greatly enhance the engagement and awareness of clinicians. The opportunities for practical applications of work domain analysis to pediatric care are discussed.

Introduction

“People are a very important safety resource, not only an error source” [4].

This second special issue provides an opportunity to consider proactive organizational strategies that can help to actively shape the pediatric cardiac clinical workplace [1]. This agility will help teams and organizations become more adaptive, flexible and resilient in response to change [2,3]. Pediatric clinicians need to think about the role of human factors tools and methods in the future of pediatric cardiac care [5]. Human factors interventions applied to healthcare concern more than isolated applications of medical technology and devices [6,7]. Human factors methodologies such as ‘work domain analysis’ [2], the subject of the present paper, will become increasingly important in the face of the growing complexity in the delivery of patient care and significant future changes in how care is provided and delivered [8].

A key argument in the following discussion is that the sociology and organization of clinical work are more open and fluid than physical and biological systems suggest. It requires a different mode of inquiry than the rational cause and effect reasoning that dominates medical thought (e.g., evidence based medicine produces causal explanations of therapy based on randomized clinical trials). However, a medical worldview based on prospective analysis in a closed system will not adequately equip clinicians to deal with the ambiguity of informal, transient, temporary work systems that clinicians use when they ‘come together to work on complex tasks’, and which are shaped by local conditions and patient/provider relationships [9].

There are good reasons why healthcare professionals tend to seek advice from each other (based on their normative rational models of thought) rather than consult cognitive scientists (e.g., human factors practitioners). Many clinicians view the methods of quality improvement and patient safety initiatives as lacking in rigor. However, a preference for rational norms tends to overly simplify the ‘uncertainty, ambiguity and time pressure’ of real work and the situated nature of clinical decision making in less than perfect conditions [10]. A perceived distance between the ‘hard science’ of clinical knowledge and the ‘soft’ qualitative methods of quality and safety initiatives is also a factor. Quality and safety initiatives in health services have tended to focus on causal explanations of adverse events (e.g., root cause analysis), writing new policies and procedures, and benchmarking global data about organizational incidents. In contrast, human factors approaches such as ‘work domain analysis’ focus on understanding the underlying...
cognitive, social and interpersonal factors that constrain work in highly complex environments such as healthcare organizations [8].

By way of an example of a shift away from the traditional medical model, Westmead Children’s Hospital in Sydney, appointed a senior pediatric surgeon as their clinical risk manager in preference to engaging a professional risk manager. Positioning a pediatric surgeon on the clinical governance team provided access to senior clinical expertise in clinical review and enabled direct input into the clinical setting. Improvement can then be embedded in everyday work where there is peer support, leadership, and sensitivity to the needs of pediatric patients [11]. This approach is uncommon and requires adequate funding, release from frontline clinical work, and the creating of opportunities for clinicians to develop the requisite expertise [6,12,13].

What value do proactive human factors strategies add to the clinical workplace?

Proactive human factors strategies identify how to best equip staff to respond and adjust their practice in the face of unexpected situations in the clinical workplace rather than simply mapping the trajectory, and counting the number of errors. Proactive human factors strategies promote ‘resilience’ as a systemic quality that defines interaction and communication in organizations. Moving to a resilient style of organizational management will require ‘shifting analyses from surface characteristics to deeper patterns and more abstract dimensions’ in the system of care [14].

The patient safety and clinical quality movements have generated their own language for talking about healthcare risk management under the ‘clinical governance’ umbrella. In addition to providing patient care, clinicians are asked to integrate across care teams, implement evidence based medicine, conduct clinical audit, participate in clinical risk management, learn from complaints, provide education and training, gather quality data, and investigate their adverse events [15]. Given this jumble of new terms and increasing demand on their time, it has not been straightforward for clinicians, pediatric or otherwise, to engage in the ‘improvement’ conversation about the future of care or the clinical workplace. The way pediatric cardiac care teams perceive the care they deliver can be very different when compared to the perceptions of other clinical and administrative personnel. This dissonance distances clinicians from a wider appreciation of factors such as the interdependencies in decision making, dynamic nature of emerging events, time pressures on acute procedures, and the implications of decisions made by other members of the care team [1].

Both local and organization-wide perspectives are integral to safe pediatric care and clinical work. Yet the more traditional (retrospective) approaches to clinical governance and human factors rely on analyzing observed problems and lack models and frameworks to capture how clinicians adapt and adjust to changes in the naturalistic, real work settings of the clinical workplace [16]. Moreover, the models of the clinical workplace developed in isolation from practice are not always reliable. Aggregated data about clinical work, causal models of clinical events, statistical techniques that average clinical problems, and studies that do not include the clinicians — the owners of clinical problems, can have many limitations [16].

What steps need to be taken to better equip clinical teams and the organizations they work within without adding further to the expectations placed on clinicians and managers?

Work domain analysis

Work domain analysis, also known as the ‘Rasmussen’s Framework’ [17], aims to equip people with a framework and skills to adjust the margin for safety in normal work by making work processes (in this case, pediatric cardiac care) more transparent to a wider range of people [3]. Work domain analysis can help pediatric cardiac care teams make sense of the formal organizational structures that regulate care delivery. The informal pathways of interaction and communication that clinicians use to shape and constrain risks are key to understanding how to control the safe delivery of pediatric care.

A roadmap emerges from work domain analysis based on the study of how clinicians shape their understanding of:

1. Normal everyday activities within their natural workplace setting; and the
2. Interaction and communication as they negotiate patient care in their organization.

There is a wide range of perspectives between local clinical workplace interpretations of care and the impressions formed at a managerial level based on comparative (quantitative) data [9]. The local or insider view of pediatric care produces different kinds of information that is meaningful to specific clinical teams. There is no universal ‘clinical team’ to be rationalized and defined — each clinical team has its own intelligent routines, habits, heuristics, characteristics and language to describe how it functions [18,19]. Outsider observations, by way of contrast, may be generalized across a number of disciplines and specialties, or use organizational level information generalized for hospital management, government policy makers, management consultants and researchers (e.g., meta-analyses of patient safety and clinical quality data).

A key reason why many clinical improvement programs fail to gain momentum is due to a common but serious false assumption that locally constructed meanings and rules can be de-contextualized as raw data for comparative analysis and research. In reality, there are many levels of interaction that need to be considered in the context of particular episodes of pediatric care. These interactions operate between clinical teams, across clinical departments, often in non-routine and almost always in unpredictable ways. The importance of taking different levels of risk, work, expertise and decision making into consideration is not new, and is supported by the skill acquisition models advocated by Dreyfus [20] and Benner [21]. The ‘fabric’ of highly technical clinical work and the decision making it entails is ‘messy’ and unpredictable. Making this ambiguity visible resists the tendency to reduce the work to a mechanical set of linear steps [6]. Rule making and clinical judgment in clinical practice are inherently local, making insider accounts beyond the reach of the so-called impartial policy maker (and equally problematic for the application of generalized evidence based clinical criteria). Clinicians continuously negotiate the means/ends distinction between the formation of professional practice (i.e., how the work gets done), and the structuring of organizational systems and processes to deliver safe outcomes in a pediatric service [22].

Developing a ‘work domain analysis’ framework clinicians for

Work domain analysis looks at how various levels of information in the workplace can be used to structure the means/ends relationship in clinical practice [2]. A framework is necessary that can interpret particular situations as representative of the pediatric cardiac work domain and, map the landscape of pediatric cardiac care in terms of its ‘goals, functions, resources’ and ‘capabilities’ while respecting the constraints that limit healthcare delivery [2].

A good test of a congruent framework is whether it can demonstrate that pediatric cardiac teams function differently within the workplace. We propose to consider all levels of abstraction (e.g., from local clinical teams through to cross-team interaction between organizational departments) that are represented in the clinical workplace. This is achieved by drafting a framework for clinical teams that respects the nuances of local pediatric care but also moves beyond generalized global assessments. It does this by making meaningful judgments about the clinical ‘microsystem’ as the basic unit of system analysis, measurement and in-built resilience [23]. In
construct they only makes sense when viewed in a particular task environment or event, and can be easily misinterpreted [26].

How does ‘work domain analysis’ compare to more traditional clinical analyses?

By way of an example, evidence based guidelines do not operate in a vacuum but involve clinical team level decision making about what care is appropriate for an individual patient. Evidence based guidelines tend to be written at the level of what is transferable or generalized across organizational contexts, while local clinical teams translate and interpret evidence, taking the specific situation presented by a patient into consideration when applying evidence. The strength of the evidence for particular interventions in patient care is measured by its applicability according to criteria such as research design, results, consistency, etc. whereas clinical team judgment or making sense of the evidence is ranked lowest [27]. What is involved in making decisions about the best evidence in different clinical situations with differing levels of experience is less clear in stepwise evidence based guidelines that limit interpretation [27]. Explaining how clinical teams make ‘shared judgments’ under real world conditions, where sensitivity to ‘context and nuance’ is crucial, exposes the practical limit of rational medical models [28]. The complexity of real time evidence-based decision making by clinical teams is raised as an example of the importance of understanding the variation between work domains in pediatric cardiac care. Developing a functional framework of means/ends relations that distinguish the levels of abstraction in clinical decision making can demonstrate the vital role of human judgment in patient care [28].

Pediatric cardiac care is distributed between clinical teams that make up an integrated system of pediatric cardiac healthcare delivery [29]. A dynamic view of the constraints on pediatric care takes into consideration the complex relationships between the clinical work environment, evidence based guidelines, the roles of different clinical departments, and their often competing goals for patient care [2].

Another example of the need for a comparable framework can be gleaned from incident management practices now common in most acute pediatric care settings. When a clinical team reflects on an adverse event in the delivery of child care it is from the point of view of their direct experience. There is often an expectation that other members of the clinical team will understand in sufficient detail so that only variations from local practice receive attention, or only variations from the local standard of care. At an organizational level the comments about an adverse event are sorted and categorized as representative of any similar events elsewhere in the organization [16]. However, these two views can clash, as the local clinical team is selective in what it records, rather than being systematic. The lack of conceptual clarity in attempts to classify adverse events likewise points to the need for a functional framework to frame and interpret variations in practice [30].

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Fig. 1. A funnel diagram showing how the scope for identifying patterns can change depending on the perspectives at different levels of the workplace.

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1. The language of ‘levels’ is useful for building models but in reality individual clinicians interact with varying ‘control, influence and authority’ and distinctions between parts of an organization are arbitrary when tracking clinician movement [9];
2. Local clinicians will need to think beyond their own experiences to grasp activity at the level of the work domain (e.g., microsystem); and,
3. Assumptions made at an organizational level should make sense to clinicians distributed throughout the clinical workplace.

The purpose of inquiring into the clinical workplace from the vantage point of different ‘levels’ is to improve the visibility of the different groups of clinicians that contribute to the delivery of pediatric cardiac care [2]. The local ‘insider’ perspective and organizational ‘outsider’ observation, viewed pragmatically, both provide a window into the clinical workplace. An outside observer trying to make sense of clinicians’ perspectives will use categories of information that need to be confirmed with local clinicians if they are to be meaningful and gain traction [2]. The closer the proximity of information gathering is to an individual local clinical team, the more likely the viewpoints will reflect specific routines and heuristics, based on a particular clinical unit’s structure and culture. This in turn will influence how risks and the work are negotiated and managed.

The benefits of identifying how patterns of activity change across an organization are that it provides a useful starting point to make sense of the local team information from which more general patterns can be identified (Fig. 1). The interpretation of particular patient care situations can then be tested for recognition of differences between clinical teams at various levels of knowledge and understanding, e.g., from novice to expert practitioners [20,21,24]. The levels of abstract thinking and action in a work domain are not linear, fixed in number or particular to a discipline; but rather, the levels demonstrate possible performance variations based on experience, local practice, and expertise.

In practice, clinicians will move to get the work done imperceptibly between different levels of abstraction in thought, and rely on varying technical (clinical specialty specific) and non-technical (cognitive, social and personal) skills, depending on how routine or unusual the situation is [25]. A framework for work domain analysis can be used when faced with a challenging problem in pediatric cardiac care to represent information that makes sense to healthcare facility managers and clinical leaders as well as to local clinical (microsystem) teams. The context-specific data gathered from individual clinical teams provides contrast and surfaces different features across various work domains. There will be a range of practice variation within a clinical team and across teams that has to be acknowledged while viewed in context. Clinical data analyses use language such as ‘safety’ or ‘risk’ or ‘error’ and while each is a theoretical
The procedure for adverse event classification in New South Wales, Australia, for example, involves classifying an event from a selection of human factors categories such as communication, knowledge/skills/competency, work environment, patient factors, equipment, policies/procedures/guidelines, or the safety mechanisms or controls [31]. Different members of the clinical team will often have varying perspectives and which categories to emphasize. The classification system is only meaningful to the local clinicians when considered in the context of a specific event or patient. Yet, the organizational perspective, and by extension, the policy maker’s perspective, is that the categories themselves are meaningful, and therefore informative about the system of care independent of context. This paradoxical dissonance emerges because there is no functional framework to connect the levels of abstraction across work domains, that is, from the individual clinical microsystem (insider perspective on patient care) level to the whole organizational mesosystem (where the conditions for clinical operations are developed) [32].

An interpretive framework for understanding clinical work domains could help alleviate the tendency toward stereotypical labeling of clinical events. Defining where you are in the work system alters the options available and your scope for problem solving. A systemic view of the workplace moves away from linear accounts and universal themes to making sense of practice variations and why they occur in particular situations at different levels of the workplace (i.e., sense making as a systemic activity distributed across the healthcare organization) [9]. The distortions introduced by individual clinical teams are alleviated through the application of a work domain analysis framework that captures the means/ends relations in the workplace [4]. Competing and contrasting viewpoints represent elements of a complex system of care that are important. The conditions that produce the differing perspectives are likely to be more valuable than the facts of a past event in pediatric care. The conditions will tell us something about the structure and interconnectedness of the team and the levels of organizational functionality in the workplace that will impact future events [2].

Balancing the local clinical team accounts of practice with different levels of comparative organizational data is an ongoing challenge in all improvement initiatives. Interpreting routine administrative data using tools such as the Hospital Standardized Mortality Ratio (HSMR) or an exploratory data analysis tool such as Variable Life Adjustment Display (VLAD) demonstrates the problems with relevance to the clinical setting due to the need for constant updating of clinical indicators [33,34]. The lack of comparability between facilities, the extent of variation over time, and loss of specificity about current practices in complex environments such as in specialized children’s hospitals further challenges robust comparisons. The following table (Table 1) illustrates the data differences in broad terms between the perspectives of management and the local clinical team in contrast to the type of inquiry facilitated by the work domain analysis.

The ease of movement between the roles and functions at the varying levels of abstraction differentiates the three perspectives: from the control of work across an organization, to the constraints on work within individual teams, and, through to a functional perspective on what is required to optimize the operating dynamic of the whole work system. A basic tenant of work domain analysis is that people have an important means/ends relationship to their work [2]. This relationship can be expressed as a ‘loose’ or ‘tight’ coupling of clinicians to their work [35]. Coupling provides a measure of the nature of the relationship between complexity and unpredictability as people interact (loose coupling), and the limited scope to vary actions within an available timeframe for highly technical processes (tight coupling). The acute pediatric cardiac healthcare work domain is one of the most challenging because commonplace situations involve mostly tight coupling. Regular work can easily become unpredictable and complex, and even more so under resource constraints.

The application of ‘work domain analysis’ to pediatric cardiac care

Future advancements in pediatric cardiac care are likely to increase the complexity of interactions between clinicians, medical technology and patients. Complex healthcare organizations are marked by variable and dynamic workplace conditions. These conditions include a rapid pace of change, increased scale of clinical operations (producing more ‘rare’ events), integration of clinical operations across teams while coupled to new technology, resource constraints and tighter boundaries and scrutiny for safe outcomes — all complicated by changes in the healthcare workforce [16]. The combined effects of these trends are that a functional model of the clinical workplace will be needed to capture the complex dynamic that operates across the pediatric cardiac care system.

Rasmussen proposes a framework for modeling the structure and the dynamics of work across all levels of an organization [2]. Safe clinical care involves identifying the operational (structural) boundaries that control work processes and help to identify the context-specific pressures and constraints (dynamics) of the coal-face clinicians in the work environment. Identification of the safe boundaries of work involves a continual adjustment to the changing conditions in the organization [36]. Clinicians at the local level will have a tendency to look for an acceptable level of risk that satisfies organizational standards for safety in order to keep up with high productivity and maintain reasonable safe conditions. Clinicians really need the skills to manage the boundaries of safe clinical practice, and make the boundaries more visible to them and their managers [3]. Ultimately, it is the actions and the nature of the interaction between clinicians that will make care safer, not the presence of a framework. A framework for work domain analysis can help build such a capability in the healthcare workplace: ‘a capability to recognize the boundaries of safe operations, a capability to steer back from them in a controlled manner,

Table 1
Comparing local clinical team accounts of practice with comparative organizational data and contrasted with work domain analysis.

<table>
<thead>
<tr>
<th>Organizational level data</th>
<th>Local clinical team perspectives</th>
<th>Work domain analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choose and define the categories of measurement for clinical teams</td>
<td>Develop categories as they emerge from practice settings</td>
<td>Develop a model of the complex dynamic at work</td>
</tr>
<tr>
<td>Prescribe evidence based practice according to guidelines</td>
<td>Interpret evidence based practice as it emerges in real time patient care</td>
<td>Map information processing strategies in the work domain (i.e., process mapping)</td>
</tr>
<tr>
<td>Use local clinical events to make universal statements</td>
<td>Consider what made sense to people at the time of an event (e.g., what were they thinking?)</td>
<td>Identify the relevant actors (and their tasks) with a functional role in work system</td>
</tr>
<tr>
<td>Use the language of improvement to discuss events</td>
<td>Situate an event within the context of the flow of care</td>
<td>Develop a taxonomy based on analysis of the work system</td>
</tr>
<tr>
<td>Use clinical guidelines to interpret local clinical practice</td>
<td>Accept that implementing guidelines requires judgment</td>
<td>Map the function and organization of activities in the work domain (i.e., cognitive tasks analysis)</td>
</tr>
<tr>
<td>Discourage variation from best practice and violation of rules</td>
<td>Look for opportunities to apply what is learned from practice</td>
<td>Establish priority measures of acceptable limits and variations in the domain</td>
</tr>
<tr>
<td>Insist on the integrity of evidence based recommendations</td>
<td>Encourage discussion and debate about implementation</td>
<td>Systematic evaluation of the work system and its design (i.e., fish-bone diagram analysis)</td>
</tr>
</tbody>
</table>
and, a capability to recover from a loss of control if it does not occur. A capability to detect and recognize the phases of operation when the margins are skirted and crossed is vital for safe outcomes [3].

A practical starting point for exploring safety, for example, in pediat-

ric cardiac catheterization services, is to establish the purpose of a work domain analysis and the constraints in building a functional model for the particular pediatric cardiac care work environment (i.e., a cardiac catheter lab, operating room, etc.). The boundaries of interaction in the work system will vary for different activities, levels of coordination, and levels of control. The constraints will also vary for different pediatric cardiac care services, as will the sources of information about how the system works. A number of iterations of the model will be required before a working model is achieved. A useful strategy for validating the model and managing 'cognitive rigidity' is to share the model with different members of the clinical team and see if it fits with their mental models and understanding of the clinical workplace [28]. Over simplifying the clinical situations through superficial analyses is a continual risk by people removed from the coal-face of risk. Clinicians need time to work through ambiguous ele-

ments, express their doubts about assumptions being made, and experiment with the data and practices. They need to consider the range of possibilities before deciding what will work for this specific child in their pediatric operating room environment [9]. It is important that the model is representative of a range of perspectives and of varying levels of experience and expertise.

The following framework (Table 2) provides a guide to the catego-

ries of information needed across three levels when building an initial model:

The model balances the task break down with the level of abstraction and the detail required at the appropriate level in the system [2]. The goal setting and definition of constraints on practice at the top of the table relate to regulation, legislation, and sets of rules, such as na-

tional requirements for minimal surgical cases per surgeons, and evi-

dence based clinical guidelines in pediatric cardiac care. The second tier involves interpretation of regulations across the different clinical service groups (e.g., medicine and surgery) in the organization according to the strategic intentions of the health service. The third tier describes the application of the organization's strategies to partic-

ular clinical departments (e.g., cardiology), and the fourth tier repres-

ents the role of senior clinicians and the medical director (e.g., Head of Cardiac Surgery). The fifth tier describes the distribution of work between clinical team members (e.g., intern, resident, and attending physician). The sixth tier describes the sequence of tasks completed by individuals (e.g., hand over, patient assessment, and ordering of tests). The model can also be represented as a figure showing the bottom-up and top-down dimensions (Fig. 2):

Rasmussen's schematic takes into account the complexity and loose coupling between activities. Communication of health service objectives flows downward and is interpreted at each level of the or-

ganization by different decision makers. When applied to a pediatric clinical service it captures the division of work, facilitating a debate about the safe boundaries, the judgment and negotiation of require-

ments to control the interactions in response to changes in the local work environment [4]. Decisions made at all levels have implications for system safety and for reducing the risk of drift (of rules and prac-

tice) into system failure [3]. Pressures and stresses at different levels of the system operate on different scales, and changes made at one level of the system need to be coordinated across other levels of the work system. Otherwise, an uncoordinated crossing of boundaries of safe operations will increase the risk of failure and increase the prob-

ability leading to patient harm. The key message for those who man-

age pediatric cardiac services is that in order to avoid the unintended consequences of new policies and regulations we need to understand the boundaries of safe operations. We need to make these boundaries visible, and equip clinicians with the tools to control the drift they experience at the boundaries.

The role of clinical teams and interpreting complexity

It cannot be assumed that the demands placed on clinical tasks and activities will be stable and operate under routine conditions due to the complex characteristics of the clinical work environment in a pediatric cardiac service. Clinical teams need to be equipped to deal with unpredictable and unfamiliar situations. The routine process for delivery of a particular aspect of pediatric cardiac care must support the local adaptation by clinicians at differing levels of expertise. The challenge in planning for patient safety is to question current practice, observe what produces a change in routine practice, and identify how critical changes are made [2]. Modeling the boundaries of safe operation for a pediatric service using Rasmussen's framework assumes that the clinical team will remain open to the possibility of failure while continuously adapting their behavior as they improvise care. It will do so by developing an 'ability to reconfigure patterns of behavior, to modify effective routines, to combine elementary rou-

tines in to new patterns, and to generate new work procedures on de-

mand' [2].

The role of clinical expertise is to develop a working knowledge of what is reasonable given a range of clinical contexts. The objectives of clinical practice guidelines, the requirement to deliver clinical work at different levels of responsibility, and the resources available to the clinical team delimit the boundaries of safe practice at any given mo-

ment. Individual clinicians need to have the latitude within these boundaries to organize their work and complete tasks in different se-

quences in order to provide safe patient care. Clinicians need to be given the freedom to select and create new patterns of work within the boundaries of safe practice, i.e., to create safety boundaries that make sense to them at the level of a clinical microsystem where deci-

sions are made and episodes of care are bracketed [9]. Developing a framework to model a pediatric cardiac care service enables all team members to become aware of the boundaries or constraints oper-

ating in their work system. The model does not need to wait until an adverse patient event has occurred, such as a wrong-sided proce-

dure, in order for the boundaries and constraints to be identified.

The challenge for the practical application of work domain analy-

sis to pediatric cardiac care is to identify the domain specific catego-

ries such as the implementation of clinical pathways to use a common task as an example. The model does not represent individual instances of clinical pathway use but the activity of implementing

| Table 2 |
| Model building information categories sorted by levels of control, coordination and work activity. Adapted from Rasmussen and Svedung [4]. |

<table>
<thead>
<tr>
<th>The three levels of the work system</th>
<th>Level of control</th>
<th>Level of coordination</th>
<th>Level of work activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levels of abstraction — from detailed to general</td>
<td>Global climate of practice</td>
<td>Strategic intent of service</td>
<td>External governance (e.g., national guidelines)</td>
</tr>
<tr>
<td>1. Setting of policy</td>
<td>2. Regulation of practice</td>
<td>3. Constraints on work</td>
<td>4. Overall activities</td>
</tr>
<tr>
<td>7. Interfaces</td>
<td>Distribution of work</td>
<td>Concrete specified outputs</td>
<td>Individual clinical work (e.g., ordering tests)</td>
</tr>
</tbody>
</table>

Fig. 2
clinical pathways for monitoring cardiac conditions as a tool for patient care delivery [37]. Clinical pathways do not always contain the latest evidence for best practice, and many times there is disagreement about the reliability of the evidence, making novel judgments necessary in order to provide cardiac care within the boundaries of safe practice [37]. Adapting a clinical pathway to manage the constraints of working with different levels of clinician knowledge is not as effective as adaptations made by frontline clinicians and advanced practice nurses familiar with appropriate lengths of stay and discharge preparations [37].

Implementing clinical pathways in pediatric care ranges from manual updating of printed pathways through to portable electronic devices that download the latest evidence, and that do not rely on having to make a physical change to a database. However, the technology alone cannot produce the needed change in cardiac care. Consensus among clinical team members in cardiac care is often required. This is particularly true in the pediatric operating room, cardiac catheter lab, emergency department and the ICU where the evidence is not conclusive, and the outcomes of different approaches to care need to be communicated across a facility and made available to all clinical teams [37].

Work domain analysis can be used to identify how and when clinicians need access to the latest evidence. WDA can provide strategies to deal with constraints in the transmission of best practices, such as with the availability of evidence at the bedside monitor or via portable electronic devices such as the iPhone. Modeling how clinicians use information during clinical decision-making can be mapped for a wide range of situations, including the novel and unexpected. Clinicians are likely to switch between different approaches in accessing evidence based on the demands of the task at hand, time available, and their levels of experience.

The coupling of complex pediatric cardiac care systems

Rasmussen describes the coupling of clinicians to different categories in the work system [2]. Different members of the clinical team are

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**Table 3**

An example exploring a particular clinical issue using Rasmussen’s ‘levels of abstraction’ and ‘levels of decomposition’ across a work system.

<table>
<thead>
<tr>
<th>Level of abstraction (means/ends relations)</th>
<th>Questions to guide inquiry (human factors involved)</th>
<th>Level of system (decomposition of part-whole relations)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization</td>
<td>How purposes of the work system achieved?</td>
<td>Objectives of the service?</td>
</tr>
<tr>
<td></td>
<td>What are the operational constraints? How are results compared?</td>
<td>Stability of staffing?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Communications systems?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Culture and interaction?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Management style?</td>
</tr>
<tr>
<td>Clinical departments</td>
<td>How are priorities set in the work system?</td>
<td>Access and location?</td>
</tr>
<tr>
<td></td>
<td>What are the measurable outcomes of care?</td>
<td>Standardized procedures?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Staff roster practices?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Level of collaboration?</td>
</tr>
<tr>
<td>Clinical unit</td>
<td>Why these processes and activities?</td>
<td>Availability of senior staff?</td>
</tr>
<tr>
<td></td>
<td>How functional are they in enabling the work system to perform?</td>
<td>Use of briefings?</td>
</tr>
<tr>
<td>Clinical team</td>
<td>How are roles, functions and activities organized to ensure functionality of the local work system?</td>
<td>Definition of roles?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Access to regular team?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lines of communication?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Limitations on practice?</td>
</tr>
<tr>
<td>Patient care tasks</td>
<td>How is the work configured and what resources are available at the local level to ensure functions can be completed?</td>
<td>Match of experience to task?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ability to control workload?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Time constraints?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Layout of workspace?</td>
</tr>
</tbody>
</table>

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**Fig. 2.** Adaptation of Rasmussen’s schematic model of the bottom–up and top–down coupling between people and their work in their healthcare settings.
able to adopt different care delivery strategies depending on their relative position in the work domain. The example (Table 3) looks at how perspectives in pediatric care about the quality of post-operative care can change according to the relative positioning of different clinical team members within the hospital. The aim of this example is to demonstrate how a work domain analysis framework can be used to identify how (the means) and why (the ends) people distributed across the various parts of the organization involved in pediatric cardiac surgery interact and function. Making the work process more visible is necessary because of the complexity of pediatric cardiac care. Clinicians constantly look for some sense of order so that they can make sense of post-operative care issues. The effort involved in bringing people together through structured interactions to discuss their work system has significant potential to build trust. These get togethers can and improve patient safety through shared earning across the work system, and increasing the level of cross-specialty respect. An improved visibility of work makes individual clinicians less likely to justify their own position and instead develop a respect and understanding of the perspective of other clinicians or clinical teams. This will also help clinicians appreciate the human factors constraints that undermine their care [38]. Once the support of a few clinicians is secured for ‘local proactive safety methods’ the opportunity to make tools such as work domain analysis a regular part of organization becomes more feasible, as is evidenced in other high-risk industries such as nuclear power where standardization of work practice is a reality [39].

Conclusions

The paper has provided an overview of work domain analysis that can be applied to pediatric cardiac care. The overall objective of developing a resilient organization is to adopt a fluid and flexible approach to mapping various trajectories of care in the clinical workplace using the work domain analysis framework. The method of building a model does not follow a set sequence and will involve a number of iterations. The common steps in Rasmussen’s framework include identifying the work purpose, the constraints on the workplace, the boundaries of safe practice, and the variety of perspectives among the clinical team members. The difficulties in using models of the clinical workplace that are too general and de-contextualized, and the limitations of individual clinical team narratives have been outlined. In addition, the limitations of retrospective approaches to clinical quality and patient safety were contrasted with the proactive framing available in work domain analysis. The contribution of work domain analysis in making sense of the constraints and boundaries of clinical work was described in terms of using Rasmussen’s framework to build a functional model of the whole system within which pediatric cardiac care is situated. It is worth remembering that all models are not fixed, and they require ongoing adaptation in response to changes at one or more levels of abstraction and the task decomposition in the work domain [2].

While the example of a pediatric cardiac care service was used, Rasmussen’s framework can be generalized to all healthcare systems and services. The practical considerations and external generalizability of work domain analysis are clear. The methodology is accessible enough that a clinical team could develop their own document, database or web application to model and map the levels of a work system, across the categories of control, coordination, and content of work activities [4]. Healthcare can no longer afford to be precious about methods adopted from other industries. The paper is limited to an overview of work domain analysis with the objective of introducing the approach to pediatric cardiac care clinicians. There is a wealth of theoretical support for, and available research about, work domain analysis. Further exploration of the literature will provide the necessary background and methodological rigor to apply a model of the clinical workplace that makes the constraints and boundaries of clinical operations visible and leads to higher reliability of care [40].

References