Observing, spanning and shifting boundaries: working with data in non-clinical practice

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Abstract

Purpose – Effective use of data across public health organisations (PHOs) is essential for the provision of health services. While health technology and data use in clinical practice have been investigated, interactions with data in non-clinical practice have been largely neglected. The purpose of this paper is to consider what constitutes data, and how people in non-clinical roles in a PHO interact with data in their practice.

Design/methodology/approach – This mixed methods study involved a qualitative exploration of how employees of a large PHO interact with data in their non-clinical work roles. A quantitative survey was administered to complement insights gained through qualitative investigation.

Findings – Organisational boundaries emerged as a defining issue in interactions with data. The results explain how data work happens through observing, spanning and shifting of boundaries. The paper identifies five key issues that shape data work in relation to boundaries. Boundary objects and processes are considered, as well as the roles of boundary spanners and shifters.

Research limitations/implications – The study was conducted in a large Australian PHO, which is not completely representative of the unique contexts of similar organisations. The study has implications for research in information and organisational studies, opening fields of inquiry for further investigation.

Practical implications – Effective systems-wide data use can improve health service efficiencies and outcomes. There are also implications for the provision of services by other health and public sectors.

Originality/value – The study contributes to closing a significant research gap in understanding interactions with data in the workplace, particularly in non-clinical roles in health. Research analysis connects concepts of knowledge boundaries, boundary spanning and boundary objects with insights into information behaviours in the health workplace. Boundary processes emerge as an important concept to understand interactions with data. The result is a novel typology of interactions with data in relation to organisational boundaries.

Keywords Health, Boundary spanning, Data use, Information behaviour, Workplace, Boundary shifting, Non-clinical roles, Organisational knowledge, Public sector

Paper type Research paper

1. Introduction

Big data developments – underpinned by societal, organisational and technological changes – have been the focus of considerable attention in most industries and research disciplines. In health, technological and clinical aspects of big data have been viewed as particularly important. Health services, however, are supported by many non-clinical departments, employing a considerable workforce that is essential for the functioning of health systems. The COVID-19 pandemic has brought to the fore the critical importance and connectedness of health-related data and work processes, from basic data gathered locally to multinational data sets. As a significant part of data work is performed by non-clinical staff, it is important to understand how non-clinicians interact with data.

With this background, the study into data use in non-clinical practice was conducted at a public state-based health system in Australia. Health services are provided by 120,000 full-time equivalent positions on staff for the population of 7.9 million. Like most health systems, the organisation recognises that clinical and non-clinical staff need to work together to maximise data use and enhance patient care in the current information environment (Lavelle *et al.*, 2019). Complex health systems depend on the effective use and flow of information through all organisational parts. We must understand data use not only at the patient's bedside but also in offices of many different professional groups, including accountants, educators, data analysts and linen suppliers, to name some. Understanding the broad interactions with data is critical to inform organisational decisions, including education and training.

The main focus of this paper is on data use in the workplace. Relevant literature and methodological details are followed by a description of types of data used in non-clinical practice, with a particular focus on organisational boundaries. Finally, the implications of the research results are discussed.

2. Literature review

We consider the current state of research into data use in the workplace, particularly in health, and review the literature concerning the dynamics of evolving knowledge boundaries in organisational contexts that emerged as a key issue in our research. The concept of community of practice is also considered.

2.1 Data use in the workplace

Data use in organisations, in general, and in the non-health public sector, in particular, has been investigated. The concept of using data for accountability, organisational learning and achieving equity are applicable to the public health sector, but have not been interrogated to the same extent as in education and business (Williams *et al.*, 2019). Existing literature focuses on data use in the public health sector tends to be specific to clinical health outcomes, cost-effectiveness or efficient health services delivery (Carvalho *et al.*, 2019).

While the public health sector is under constant pressure to reduce costs and improve health-care services (Wu *et al.*, 2016), the potential of data use in health and its benefits are numerous. Optimised health and clinical data analysis allow the identification of health patterns that can contribute to disease prevention and cure, improving patient safety and quality of life. Increased digitisation enables the capacity and capability for data analysis (Carvalho *et al.*, 2019). In parallel, reliable, efficient and agile data analytics systems are being developed to cope with the exponential growth in the volume, complexity and sources of health data (Wu *et al.*, 2016). Data collection and storage in health care organisations are evolving with advancements in automation, artificial intelligence, deep learning and robotics. A considerable strategic investment is warranted for data management and

analysis to extract and acquire intelligence. With all the significant changes, the potential for public health services to capture and use data is largely untapped (Raguseo, 2018).

The emphasis on data-related competencies, coupled with skills development and demands for organisational support, are emerging rapidly. Auffray *et al.* (2016) purport that data plays a more important role in health than in most industries and that the workforce is the most important success factor in optimising data use. While it seems intuitive that clinicians would use data from patient and client interactions for quality improvement, the skills, data literacy and organisational structures needed to collect, analyse and operationalise changes to policy or practice are hard to achieve within the scope of clinicians' practice. The complexity of data work requires support from different specialisations. Therefore, it is imperative that health services employ or engage data experts, giving them access and opportunities to liaise with clinicians to gather and interpret data to suit the clinical context and needs of health services (Wills, 2014). A report from the American Medical Informatics Association stressed the importance of a co-ordinated approach to data stewardship principles and effective approaches, including investment in workforce training (Hripcsak *et al.*, 2014). Raghupathi and Raghupathi (2014) reported that the managerial issues of ownership, governance and standards are pivotal data-related considerations.

To benefit from the opportunities afforded by technological advancements, data needs to be embedded in everyday work practices. Understanding of information landscapes in health organisations is crucial to ensure the most effective interventions supporting data-related practices. Scant studies in this area rarely include the use of information by non-clinical staff. Bossen *et al.* (2014) investigated the role of medical secretaries in the care of records in health care infrastructures. The authors pointed out the relative invisibility of these work roles despite their importance in new workflows due to the fewer boundaries in digital work environments.

While insights from existing literature are relevant, there is a significant gap in our understanding of how current research findings apply to non-clinical work practices. Furthermore, studies conducted in other contexts are insufficient to understand data use in multi-professional, highly complex PHOs. It is particularly important that a limited understanding of data-related practices of a significant proportion of the health workforce impedes evidence-based improvements in practice.

2.2 Knowledge boundaries

The concept of knowledge boundaries in organisations is particularly relevant in the context of this study and warrants special attention. Current data developments are part of a continuum of technological, cultural and organisational transformations where knowledge boundaries constantly evolve.

In the previous section, we noted that the literature about data use in health identified the importance of co-ordinated organisational approach. Complex organisations, however, depend on established and new knowledge developed and practised by many organisational units and specialised groups. Carlile (2002) commented that specialised knowledge within organisations is problematic as the knowledge that drives innovation in one function can hamper innovation across functions. Carlile (2002, p. 442) noted:

> It is at these "knowledge boundaries" that we find the deep problems that specialized knowledge poses to organizations. The irony is that these knowledge boundaries are not only a critical challenge, but also a perpetual necessity because much of what organizations produce has a foundation in the specialization of different kinds of knowledge.

Although knowledge boundaries are a necessity and perpetual challenge, they may be hard to detect and understand as they are determined by invisible processes. All organisations, particularly large health systems, rely on accepted practices. Established procedures and processes, however, are based on years of accumulated tacit knowledge (Gerson and Star, 1986) that may not be obvious to newcomers and outsiders. Even common data-sharing systems, such as information technology (IT) or data management systems, are often invisible infrastructures (Steger *et al.*, 2018). As Steger *et al.* explain in an overview of previous studies, common infrastructures are often taken for granted and embedded in use to the extent that they become invisible. According to Steger *et al.*, they may also support the functions of one group while impeding the work of another or enable sharing at one time while blocking it in the future. These contradictions are highly applicable in the public sector, which is typically complex and based on practices established over many years. In large PHOs, in particular, there are many groups with various specialised knowledges and ways of working. Furthermore, health thrives on both innovation and strict regulation.

Work around boundaries is significant in dealing with differences and negotiating new ways of working (Oldenhof, Stoopendaal, Putters, 2016). Work across boundaries, however, tends to be resisted. Carlile (2002, p. 442) reflected on work across functional divisions:

> [. . .] I describe knowledge as localized, embedded, and invested in practice (Bourdieu, 1977, Lave, 1988). This specialization of "knowledge in practice" (Carlile, 2002) makes working across functional boundaries and accommodating the knowledge developed in another practice especially difficult.

People typically find it costly to change their knowledge and skills, considering the time and effort invested in learning. People from different functions need to be willing to adjust their knowledge and be capable of influencing the change of knowledge in another function (Carlile, 2002). Carlile (2004, p. 557) noted that ". . .as novelty increases, the amount of effort required to adequately share and assess knowledge also increases." Expertise plays a part in the change. Broniatowski and Magee (2017, p. 14) found that "knowledge boundaries are not present when experts are able to recognize that their specialized knowledge does not apply". Broniatowski and Magee found that in most novel situations, experts are able to avoid the "competency trap" when they realise the limitations of their knowledge. Common knowledge, shared objects, methods and trade-off methodologies all play a part in working across boundaries (Carlile, 2004).

The role of boundary spanners in crossing knowledge boundaries is well recognised in the literature. Haas (2015, p. 1034) overviewed literature on boundary spanners, gatekeepers and knowledge brokers and defined "boundary spanners as links between a unit and its environment". Haas described gatekeepers as a subcategory of boundary spanners and knowledge brokers as people who do not belong to any of the groups to which they provide information. Long *et al.* (2013, p. 2) described brokers as people who "reach across a structural hole". Boundary spanning, according to Long *et al.*, is a form of brokerage and includes the crossing of organisational, departmental and disciplinary boundaries to aid knowledge exchanges.

Professional tribes and silos are common in health care (Long *et al.*, 2013), so it is important to consider health-specific exchanges on boundaries. Fox (2011) noted that medical technologies can act as inhibitors or facilitators of innovation depending on how they connect with existing knowledge, roles and understanding of the scope of practice. Several studies considered boundary-spanning in health practice in relation to particular roles (Fick-Cooper *et al.*, 2019; Meyer *et al.*, 2014; Swaithes *et al.*, 2021).

Learning in practice and by doing play an important part in crossing boundaries in health. Johannessen's (2018) investigation of professional boundary-blurring work, where nurses learn and apply medical knowledge, found that learning by doing and participation in a community of practice facilitated professional crossover. This type of learning gave agency to nurses and helped in solving practical problems, but Johannessen acknowledged that there were reservations and issues of legitimacy inherent in crossing professional boundaries. The concept of *logic bootstrapping* is used by Burton-Jones *et al.* (2020) to explain how institutional entrepreneurs achieve their goals in a health setting. Entrepreneurs' goals are, by their nature, outside current practices. Burton-Jones *et al.* explained that proponents of competing logic start a process of *act-learn-adjust*, similar to bootstrapping, to negotiate a change.

The concept of boundary objects is used to explain how some of these contradictions are resolved in practice:

> Boundary objects are objects which are both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. They are weakly structured in common use, and become strongly structured in individual-site use. These objects may be abstract or concrete. They have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable, a means of translation. The creation and management of boundary objects is a key process in developing and maintaining coherence across intersecting social worlds. (Star and Griesemer, 1989, p. 393)

Star and Griesemer (1989) identify types of boundary objects, including repositories, such as libraries and museums; diagrams or atlases that enable symbolic communication; and standardised forms, which help to overcome local uncertainties. Star (2010) explained that boundary objects arise from information needs, and information and work requirements. They "are a sort of arrangement that allow different groups to work together without consensus" (Star, 2010, p. 602). Rehm and Goel (2014) consider the use of a boundary cluster where artefacts may not be boundary objects in their own right.

The selection of boundary objects is highly political and is important as it may signify a professional identity. Fox (2011, p. 81) described the cultural meaning of boundary objects at the time when the practice of sterilisation was introduced: "Sterile clothes, masks, heat-sterilized instruments were boundary objects because they had the secondary function of assigning surgeons the role of healer, both within their own community and perhaps in a wider lay community also". Kimble *et al.* (2010) note that the political nature of boundary objects requires that brokers are involved in object selection.

Over time, standardisation of boundary objects begins, usually initiated by administrators and regulators. However, "all standardized systems throw off or generate residual categories. These are categories that include 'not elsewhere categorized', 'none of the above', or 'not otherwise specified'. As these categories become inhabited by outsiders or others, those within may begin to start other boundary objects [. . .] and a cycle is born" (Star, 2010, p. 614).

The literature on organisational knowledge boundaries highlights mechanisms and processes that inhibit and aid boundary crossing. It also highlights the significance of practice and local contexts in which exchanges happen in complex dynamics between human and inanimate players.

2.3 Communities of practice

In thirty years since Jean Lave and Etienne Wenger formulated the concept of communities of practice (CoP), this idea has been a cornerstone of thinking about knowledge processes

and learning in organisations and professional settings. People who gather freely to develop their knowledge in a particular domain and improve their practice form a CoP. Wenger (2004) recognised three elements of CoP: domain, community and practice, with each having significance. Brown and Duguid (2001) stressed the importance of practice, which had been often neglected in favour of community. CoPs often exist in organisations, but they are fluid formations (Brown and Duguid, 1991) and need to be distinguished from formal work groups, teams and informal networks (Wenger and Snyder, 2000).

CoPs have a critical role in continuing the history of the practice and ensuring growth beyond its boundaries (Wenger, 2010). Considering CoPs as complex learning systems, Wenger (2010, 182) saw a "profound paradox" in the "coexistence of depth within the practices and active boundaries across practices". This contradicting processes are mutually dependent and enhance each other, according to Wenger. Organisational structures and power relations also determine the existence of CoPs, their nature and boundaries (Fuller *et al.*, 2005). While CoPs are important for professional learning, it is important to remember that they are not always the main form of support for organisational learning, and many important practices exist and develop without CoPs.

3. Rationale
Significant attention in research and practice has been given to big data and associated technological and organisational changes. In health, the focus has been predominantly on clinical work over everyday interactions in different settings. Data use in workplaces is ubiquitous, underpinning prominent organisational changes and work results. However, there remains a substantial gap in our understanding of everyday interactions with data. The limited understanding has particular significance in health, where a large proportion of employees work in non-clinical roles, supporting and enabling clinical work. As information and consequent data flow rarely happen in silos, it is critical for the health care sector to develop a deeper understanding of the dynamic of data use in non-clinical practice. While studies of other work groups exist and may be applicable, it is impossible to recognise similarities and differences in information behaviours without the research-based understanding of non-clinical practice in health as a reference point.

In the context of connected data with far-reaching impacts on health care, the current research gap is significant. Research into interactions with data in non-clinical roles will contribute to much-needed evidence for decision-making in health organisations. Because non-clinical work has many similarities with other organisational settings, especially in the public sector, results are likely to be relevant and applicable to other contexts. This novel research needs to connect with the existing understanding of knowledge development and organisational change to support theoretical and practical advancements.

4. Methodology
The study was designed to explore issues underpinning employees' interactions with data in the workplace in non-clinical health settings. This paper will focus on the following questions:

Q1. What constitutes data in non-clinical practice within a public health organisation (PHO)?

Q2. How do people in non-clinical roles in a PHO interact with data?

The individual, project and organisational issues underpinning interactions with data were explored in semi-structured interviews.

4.1 Study design
The exploratory study used a predominantly qualitative methodology. A survey was used as a quantitative research method to complement insights gained through qualitative explorations and enable data triangulation.

"Data", the central concept in the study, has several possible variations in meaning. The following definition of data clarifies the intended meaning of this project: "Information is any pattern of organization and data is information selected for further processing" (Sukovic, 2008, p. 81). The scope of this definition includes additional details:

> Information means a pattern of organization, which can be contained in any physical manifestation, and it is given meaning by a human being under certain contextual conditions. The concept of information includes the physical manifestation, the process of making sense of that information or 'being informed,' and contextual considerations. Data means information produced, selected, and/or assembled for further processing. (Sukovic, 2008, p. 73)

Because interactions with data assume personal meanings in a context, the exploratory part of the study was designed to elicit participants' reflections related to a variety of situations. The phenomenological approach and hermeneutics as the "art and science of interpretation" (Robinson, 2002, p. 196) provided a philosophical background and broader framework for the study. Grounded theory, with close connections with phenomenology, provided suitable analytical methods and techniques. A literature review was also guided, to an extent, by grounded theory. In the initial literature review, the project team searched for papers related to the research topic. An in-depth review of the literature related to knowledge boundaries was performed after analysis of the research data and was informed by study findings.

4.2 Data-gathering
The study was conducted at four sites, each providing different types of support to the system. Sites were selected to provide a variety of participant roles and experiences. An important consideration was the elimination of any ambiguity between clinical and non-clinical work. Consequently, selected research sites were non-clinical and all provided services across the whole system.

Data were gathered in two stages using mixed methods. In the first, exploratory stage, qualitative methods were used to investigate issues of data use and identify main themes. In the second stage, a survey was developed on the basis of the qualitative study to investigate the extent to which identified themes were applicable to a broader cohort of participants. Table 1 shows a summary of data-gathering methods.

4.2.1 Data-gathering methods. Semi-structured interviews and discussions in one workshop were used to obtain data for the exploratory stage of the study. Qualitative data includes 22 h of recorded discussions and field notes.

4.2.1.1 Interviews. Critical incident technique, well established both in health and information studies (Urquhart *et al.*, 2003; Hughes *et al.*, 2007), was used to structure

Method	#
Qualitative: Interview	25
Qualitative: Workshop recording and ethnographic notes	1
Qualitative Total # participants	44
Qualitative Total # recorded hours	22
Survey	177 responses

Table 1.
Data-gathering
summary

conversations about participants' experiences of data use. Introductory questions were asked about a participant's job, and further discussions evolved around two critical incidents. Firstly, participants were asked to discuss a project or an instance of a regularly performed task where it was easy to find information and work with data. Examples may have referred to complex projects or tasks, but the process of working with data was satisfactory and suitable for the task. The second critical incident concerned an opposite example. Participants were asked to discuss an example where it was difficult to work with information and data.

All interviews (25 in total) were conducted by members of the research team, including the Chief Investigator. Interviews lasted about 45 min on average. The longest interview lasted about 1 h and 10 min, and the shortest lasted 30 min. All interviews were fully transcribed.

4.2.1.2 Workshop. The workforce skills and training working group, as part of the state health analytics initiative, conducted a workshop at a partner university to discuss a draft data capability framework. Members of the research team observed the workshop and recorded ethnographic notes. The event was recorded and fully transcribed. The workshop recording lasted 2 h and 10 min.

4.2.1.3 Survey. The survey was developed to complement qualitative data by eliciting a larger number of responses to specific questions arising from qualitative explorations. The survey was administered via Qualtrics. The questionnaire returned 177 responses from employees at the four data-gathering sites. Responses were not forced, so the questions yielded a different number of responses.

4.2.2 Participants. Participants interviewed during Stage 1 were volunteers who had responded to a call for participation or were recommended by someone in their workplace. Snowballing technique was used to identify participants. Purposeful sampling was used in the final stages of qualitative data-gathering to obtain inputs needed to understand the emerging themes and ensure data saturation. The workshop participants were selected by the organiser.

Maximum deviation sampling was used to identify a variety of job types and levels, including senior managers, in each organisation. Participants' work roles encompassed a wide range of job types and levels, including jobs in administration, health education, finance, design, data analytics, reporting, human resources and clinical support. Most study participants were from the state capital city, but some lived and worked in regional centres and rural areas. Overall, the number of male and female participants was balanced (Table 2). Some survey respondents did not provide information about their gender, although "other" was an option.

4.3 Analysis

Audio recordings, transcriptions and notes constituted the qualitative data from the workshop and interviews. Software used for analysis included NVivo for qualitative analysis and SPSS Statistics for survey analysis.

Data gathering method	Number of participants	Male	Female
Participation in workshop	19	9	10
Interview participation	25	15	10
Survey	162	75	87
Total	206	99	107
Percentage (rounded)		48%	52%

Table 2.
Study participants by gender

Analysis of interviews and the workshop started at the time of data-gathering. Listening to recorded interviews and reading transcriptions allowed emerging themes to inform further data-gathering. Layers of coding were developed at different levels of abstraction. Grounded theory techniques were used for analysis (Corbin and Strauss, 2015; Strauss and Corbin, 1998), especially open and axial coding. Process coding was used to understand the project development described in the interviews. Flip-flop techniques (Strauss and Corbin, 1998) were also used to ask questions about the data from the opposite direction.

Descriptive analysis techniques, including multiple response analysis, were used to analyse the survey data. Independent samples test, analysis of variance (ANOVA) and multiple regression were used to analyse the data and test hypotheses.

4.4 Ethical conduct of research

Approval to conduct the study was obtained from the Hunter New England Human Ethics Committee (approval number LNR/17/HNE/296). All participants who provided qualitative data granted their consent for data-gathering. All transcripts were deidentified.

Detailed data-management procedures were developed prior to the onset of the study to ensure appropriate management and confidentiality. Audio files and transcriptions are archived at a secure location.

Reporting of research findings aims to reveal as much information as required to support results while preserving privacy and confidentiality. A numerical system was developed to identify participants. Excerpts from interviews are cited in a numerical form, meaning Site#/Participant#. For example, Participant 1/2 means the second participant at Site 1. Site-specific details were removed from transcripts to protect individual and organisational confidentiality.

4.5 Limitations

The study was conducted within one health system. It is a large system, likely to be similar to public sector organisations around the world, especially in developed countries, but every organisation is also unique. Data were not gathered from a representative sample of participants. For these reasons, study results cannot be generalised.

The reliability of the study was ensured by careful study design, including the selection of data-gathering and analytical methods appropriate for the research questions. Participants, employed in a wide variety of roles in urban and rural areas, were able to comment on a wide range of experiences. Triangulation enabled a deeper understanding of the research phenomena. The qualitative methodology allowed the exploration of meanings and experiences from participants' personal perspectives, whereas the survey enabled data-gathering from a larger pool of participants to further investigate findings arising from qualitative research. The reliability of the study was further ensured by researchers' individual and group data analysis.

5. Research results

The research results are presented to answer two research questions related to data use in organisational contexts. Firstly, types of data used in non-clinical practice are considered to answer the question of what constitutes data in non-clinical practice. Some relevant survey results related to information sharing are included in this section. Secondly, findings arising from reflections about participants' interactions with data in their workplace provide responses to the second research question and are central to this section.

As discussions of organisational issues have a prominent place in participants' accounts, this paper focuses on organisational aspects, particularly on the theme of working around

boundaries. Three types of data work in relation to organisational boundaries emerged from the analysis of the discussions about issues experienced during interactions with data: observation, spanning and shifting of boundaries.

5.1 Types of data used in non-clinical practice

Interviewees explained how they derived data from clinical information, including information about patients, medication and equipment; corporate information, such as financial and workforce-related; instructions, evaluation results and other types of organisational information; and specific subject matter information. Commonly used information sources ranged from organisational documents, various databases and grey literature to publicly available information from the internet. People, including colleagues, subject matter experts and professional networks, were recognised as a significant source of information. Participants were heavy users of corporate data, which was used most frequently and perceived as a priority over clinical and patient data.

Survey results confirmed and further clarified qualitative findings. Respondents were asked to select all the types of data they use for their work (Table 3) and to prioritise the used data types (Table 4). Most used and most important types of data were Corporate data – organisational (i.e. policies, emails, administrative), workforce and financial data. The least used type of data was Clinical: observation (i.e. patient data). This is not surprising because the respondents worked in the non-clinical units. It is also worth noting that the survey respondents used the whole spectrum of data.

Three survey questions elicited responses about the clarity of reason for data collection, data availability and data accessibility. The five-point Likert scale was used for responses

Type of data	Response frequency	Percentage of total responses
Clinical: Patient level transaction (i.e. hospital data)	23	7.2
Clinical Observation (i.e. patient data)	14	4.4
Corporate: Organisational data (i.e. policies, emails and administrative)	92	28.9
Corporate: Financial	50	15.7
Corporate: Workforce	61	19.2
Corporate: Capacity data (facilities)	24	7.5
Population: Demographic and socio-economic data	27	8.5
Population: Health survey	27	8.5

Table 3.
Survey responses: frequency of data types used (106 responses)

Type of data	Response frequency	Percentage of total responses
Clinical: Patient level transaction (i.e. hospital data)	14	5.6
Clinical Observation (i.e. patient data)	13	5.2
Corporate: Organisational data (i.e. policies, emails and administrative)	79	31.7
Corporate: Financial	47	18.9
Corporate: Workforce	54	21.7
Corporate: Capacity data (facilities)	13	5.2
Population: Demographic and socio-economic data	16	6.4
Population: Health survey	13	5.2

Table 4.
Survey responses: data types perceived as most important (103 responses)

(almost never, rarely, sometimes, often and almost always). These questions yielded 110 responses. The following percentage of respondents chose "often" or "almost always" as their answers to the three questions:

(1) Reasons for information collection in their teams were clear to 84% of respondents.
(2) Information needed for work is available at their workplace, as reported by 53% of respondents.
(3) Access to the information they need was reported by 46%.

The results from an independent samples t-test show that there was no significant difference between males and females regarding easy access to information ($t(107) = –1.409$, $p = 0.162$) or perception of information-sharing culture at their workplaces ($t(99) = –0.510$, $p = 0.611$). There was no significant difference between those with a supervisory role and those without a supervisory role regarding understanding reasons for collecting data ($t(108) = 1.095$, $p = 0.276$) or ease of access to data ($t(107) = –0.172$, $p = 0.864$). A one-way ANOVA test indicated there was no significant relationship between years of working experience and the perception of easy access to information ($F (3, 105) = 1.225$, $p = 0.304$).

5.2 Data use and organisational boundaries

Participants' reflections on fitting the novel demands, challenges and opportunities arising from data use into existing structures of a large public service sector featured prominently in the study data. Intra-organisational boundaries were the consistent thread arising from the data, at all levels, across influencing factors, between organisation types and the spectrum of participants. Three types of interactions with data were described in relation to organisational boundaries:

(1) *Observing boundaries* when data use happens within organisational boundaries or is limited by the boundary enforcement.
(2) *Spanning boundaries* when people work across boundaries, often creating boundary objects and practices to respond to new challenges and opportunities.
(3) *Shifting boundaries* when intentions and practices are focused on opening boundaries and creating new spaces to enable effective interactions with data.

Table 5 summarises aspects of data work in relation to organisational boundaries. The matrix categorises issues experienced during data work into Professions and disciplines; Work roles; Work practices, including policies and procedures; Access to information; and Complex organisation. The matrix highlights how boundary issues emerge and play out across boundary work.

5.2.1 Boundary issues. In this section, we look more closely at how participants describe boundary-related issues that underpin their work. Boundaries sometimes defined or influenced data work, and in many cases, they had to be challenged and negotiated.

5.2.1.1 Professions and disciplines. Study participants described a strong sense of professional identity, often defined and differentiated in relation to other professions and knowledge disciplines. Data use is determined, to an extent, by profession-defined boundaries, which were also seen as an impediment to workflows.

5.2.1.1.1 Observing professional boundaries. Rigid professional boundaries were generally described as an impediment to effective work with data. This experience arose from an inability to understand the language of another professional group, from different meanings being assigned to terminology and from differing perspectives of multiple

Boundary issues	Observing boundaries (within)	Spanning boundaries (across)	Shifting boundaries
1. Professions and disciplines	• Working with set professional boundaries • Fixed language and meaning • Information seen from own professional perspective • Disconnect from other professional groups	• Cross-professional aptitude and practice • Ability to "speak a language" of another professional group • Understanding information needs of other professional groups • Networks and broad connections	• New areas of interest and work • Deep understanding of other professional groups and the way they use information • Planning for inter-professional work in the near future
2. Work roles	• Distinct work roles; lack of clarity around the extent in which data work is part of the role • Hierarchical role divisions reinforced creating blocks	• People in senior positions seen as supporters and enablers of boundary spanning • Open communication between people in different roles	• Moving boundary objects and practices towards standardisation • Distinct qualities of "boundary shifters"
3. Work practices	• Structure stifles exploration • "Red tape" • "Ticking boxes" • Helpful procedures	• Flexibility to meet project or audience needs • Personal initiative	• Engaging others to develop boundary objects and processes • Work to develop shared meanings and processes
4. Access to data	• Perception of access blockages because of bureaucracy, control or poor customer service • Culture of control • Issues with big data management	• Technological solutions to manage restrictions • Positive collaboration	• Building new data pools for sharing • Developing IT solutions to connect disparate systems and manage data fluidity
5. Complex organisation	• Lack of communication and transparency • Local needs, decisions and systems • Difficulty in connecting high-level decisions with situation on the ground • Difficulty in maintaining an independent voice	• Process developed to communicate sensitive findings arising from data analysis • Open and direct communication	• People and teams acting as connectors • Creating opportunities to experiment and work together across the system

Table 5.
Data use in relation to organisational boundaries

professions. Different understandings of information may add another layer of complexity to cross-professional communication. The following excerpt about communication between pharmacists and IT professionals illustrates the complexity of cross-professional communication:

> [...] Clinical people which have a pharmacy background with no technical skill and the technical team is technical people with no clinical knowledge or anything. Yeah, I saw several emails sent by the technical team asking questions, but the clinical team couldn't answer because the terminology used by the technical team is not the same. *They don't see the information the same way*. The technical teams see code and linkage in the table when the pharmacy team see the product (i.e. pharmaceutical product). (Participant 2/5)

Other participants discussed major issues when data analysts or the IT team lacked an understanding of business needs. A major finance project, for example, was managed around blocks imposed by a key IT unit that, according to the manager of the finance unit, did not support the finance team or consider business needs. Similarly, participants who had worked or wanted to pursue working across professional boundaries found it difficult to convince their team members from different professional backgrounds to collaborate. Firm professional boundaries manifested for many participants in strict adherence to rules and mistrust around what constitutes appropriate data use.

5.2.1.1.2 Spanning professional boundaries. Participants who understood different professional fields described ways that they spanned boundaries. An ability to understand the language of another professional group and understand their needs was critical in obtaining and providing data. Expressions like, "I've been taught the same language as them" and "I can talk that language", are used by people who successfully work across professional boundaries.

Creating boundary-spanning opportunities often depends on people with different skill sets finding ways to apply them. Participants interested in the broader organisation, outside their team and profession, often created or led the successful collaboration. Novel projects and individual boundary-spanners benefit from connections through informal networks. People invited others to participate in broader initiatives often due to previous contact and awareness of their work, using personal connections to enrich and change local practices.

5.2.1.1.3 Shifting professional boundaries. The Workshop participants discussed how data capabilities would look like in practice and how to create new professional boundaries. Understanding how different groups work with information is critical for making connections. Workshop participants saw benefits in the environmental approach, so capabilities could be seen and applied in different settings. In an example cited above, different views of information were seen as an impediment to cross-professional communication. Similarly, a deep understanding of how different groups interact with data was seen as a primary enabler to tailor information for a team and individuals within the team.

Participants who worked in different professional roles or on a range of tasks described how a broad range of capabilities enables someone to deal with new problems. Some noted a gradual blurring of professional boundaries and education and training provided in modular chunks as a future trend. For these participants, the opening of professional boundaries is not about if but how it is going to happen.

5.2.1.2 Work roles. Work roles are about job descriptions and established work delineation. Work roles are related to professional and disciplinary boundaries, but they are not necessarily the same.

5.2.1.2.1 Observing role boundaries. The issue of role hierarchy concerns people's ability to access information or manage projects. Participants who managed data-oriented projects often had to manage vertically and bring other sections of the unit or organisation on board. In the absence of power leverage, participants had to find other ways to achieve their goals.

Divisions around work roles were discussed as unhelpful practices. Similar to observing professional boundaries, enforced divisions around work roles were perceived as the inability or unwillingness of staff to see possible opportunities for contribution or collaboration. Participant 2/6 described how his technical team of people with different professional backgrounds was dismissed in the planning stages of project development despite some of them having good knowledge of the subject matter. IT was not embedded in all stages of project development as these roles are seen as separate. Participant 2/6's recommendation was to "rather than come to us with a solution, have us be part of the solution".

5.2.1.2.2 Spanning role boundaries. Barriers to data-oriented work were discussed as coming from people in higher positions in the hierarchy. However, hierarchies were also noted as useful by some, providing pathways for the resolution of the obstacles around role divisions.

Participant 3/3 would seek the support of his supervisor, who understood the value of doing work outside strict role descriptions. Similarly, this may happen across divisions when a senior manager talks to a manager in another unit to overcome obstacles in their area of responsibility. In these instances, people in positions of authority support and enable boundary spanning.

Open communication and team members who are empowered to apply their judgment have a significant impact on spanning role boundaries and improving outcomes. Participants discussed successful interventions outside their regular role as a solution to address broader or unresolved issues that improved results for the whole team.

5.2.1.2.3 Shifting role boundaries. Boundary shifters are key in creating boundary objects and processes and then creating spaces for new roles. They have typically worked as boundary spanners for some time or are in a position to plan boundary shifting. Participant 1/7 explained how "super users" regularly facilitate the implementation of new technological systems: "Once you're a super user, generally super users are super users for lots of things. They become conduits for information, and they direct all sorts of processes that they have to look after."

Participant 4/1 wanted to implement a major change that challenged existing boundaries. This participant purposefully employed a business analyst with knowledge of IT, and business needs to enhance communication between the relevant units. In this case, the business analyst worked as a boundary spanner to enable the planned boundary shift. The role of boundary shifters and their characteristics will be discussed in more detail later in the article.

5.2.1.3 Work practices. Work practices encompass official procedures as well as work processes and "ways of doing things." Practices assume repetition and are often fostered by the unit and team's culture.

5.2.1.3.1 Observing boundaries around work practices. Public service rules and regulations provide a structure for work practices, but they are also perceived as burdens; "red tape" and ineffective "ticking boxes" for compliance purposes. Determining and enforcing structures early in a project can have value, but can also stifle exploration:

> We wanted to do additional, kind of, more forward looking programs or more advanced projects focused on more of how do we use our clinical data, for example, in a more meaningful way, while

they [sic! Ministry] were more focused on establishing the foundations, like, the governance, the definitions, the so-called architecture, et cetera. They wanted to do that first instead of playing in that space. (Participant 2/1)

On the positive side, structure and rules are viewed as a transparent way of doing business. Procedures, in this case, allow people to focus on the content of their work and reduce possible risks.

5.2.1.3.2 Spanning boundaries around work practices. Participants described their reasoning behind boundary-spanning behaviours as primarily being concerned with connecting to the purpose of what they were doing or trying to achieve. Participant 1/6 described significant data work done in his own time as necessary to rescue a project and avoid challenges resulting from approval delays. This behaviour demonstrates an understanding of consequences and organisational pressures outside of the participant's own role. Participant 4/2 initiated a sizeable piece of work to revise the way data was managed and shared in the unit by acting on her professional insight. Similar to spanning role boundaries, personal initiative and professional judgement play a key role in spanning boundaries around established practices and developing new ways of working with data.

5.2.1.3.3 Shifting boundaries around work practices. Boundaries around work practices usually start shifting after a period of boundary spanning. Boundary spanners become shifters as they develop boundary objects and then process to frame discussions about new practices. With persistence and alliances with the right people, they modernise processes.

5.2.1.4 Access to data. Issues around access concern predominantly big data. It is an area where high-level organisational decisions, as well as practices and culture in smaller units, play a part in restricting data use or developing sharing solutions. Similar issues arise with other data when organisational restrictions create unnecessary data boundaries.

5.2.1.4.1 Observing data boundaries. Restricted data access was raised by a number of participants, many noting it as a great source of frustration. Some participants attributed blockages caused by data restrictions to bureaucratic processes, a lack of collaboration and customer service, and even controlling behaviour. A senior manager grappled with the issue of access to big data:

Right now, I feel the *data is being held hostage*. We have a business analytics group in [one unit], we have a business analytics group within [another unit]. There are walls being built around it saying that nobody can just simply access data. And that's fair enough off the cuff, but these groups are filled with technicians who can grab data out of a database, but [...] they don't actually understand the business problems that are trying to be resolved and they don't understand the businesses that they're working with. (Participant 4/1)

The same participant attributed blockages to the exercising of control and described the problem in the following way:

There are certainly some entrenched positions around "our information, your information" and I don't think really, we've got clarity around who owns the data rather than who is the custodian of - and who is the custodian of managing the data.

Another senior manager, however, explained restrictions as necessary to protect confidential information, avoid system crashes and inefficient use of team's time. Participant 2/6 summarised this line of argument:

A lot of people when they talk about data, they'll say [...] I need data. 'What do you need?' 'Oh, just give me everything and then I'll work it out'. That's hard to do because obviously can't give everybody everything. So, it's really having a firm idea of the types of data that you want and the type of business questions you're trying to answer.

5.2.1.4.2 Spanning data boundaries.When participants discussed ways of dealing with restrictions, they frequently mentioned issues with problem identification followed by the development of technological solutions. Participants talked about finding alternative routes after experiencing blocks. For some, this meant avoiding people who blocked access or, when restrictions were perceived as reasonable or unavoidable, concerted collaboration was needed to get access.

Participant 3/1, for example, described how managing restricted data access required contacting another organisational unit to obtain and summarise data on their behalf. Participant 3/1 discussed the issues and solutions with his team, developed a program based on the obtained data, and added comments to his coding to help others understand the rationale behind decisions. The final program was passed to the original organisation as it concerned their work, and they wanted it. Flexibility and openness to sharing are a prerequisite for this type of interaction.

5.2.1.4.3 Shifting data boundaries. The importance of long-term solutions to restricted data access was discussed by participants with a deep knowledge of technological solutions and business needs. One participant was employed in a new role to do this type of work. Participant 2/3 explained his plans to develop a data pool with agile access as a method "that can quickly empower the end users of the data to make decisions and doesn't require a six-month translation project for each hospital site".

5.2.1.5 Complex organisation. In a very large public service, the strategic direction and goals of the whole organisation need to be part of local decisions. However, organisational complexity and competing interests influence work on the ground.

5.2.1.5.1 Observing complex organisational boundaries. Many restrictions to work practices in a complex organisation arise from the intricacy of communication. In system-wide projects, data are gathered from different work units. Measures and codes used in local hospitals and other units are based on local practices and may not be clear to other parts of the system. This results in major issues in working with data across the system, leading to the loss of "faith in data" and a sense of working in isolation. Participants explained, however, that complete standardisation or centralisation may not be appropriate either.

On the other side of the data cycle, communicating the results of data analysis can have a major impact on recipients and decision-making. Fine-tuned, individualised approach is necessary. "The politics of messaging", as Participant 3/2 described it, involves careful consideration and decisions around communication. This participant explained how their unit analyses data and reports, including "the good, bad and ugly". The reports are reviewed by the senior management before decisions are made on further communication. Participant 3/2 noted that it is about "balancing that independent voice while still recognising the impact".

Finally, broad high-level decisions may be made in one part of an organisation and apply to the work of others without a good knowledge of their context. These decisions may have significant unintended consequences and further reinforce a sense that units work in silos.

5.2.1.5.2 Spanning complex organisational boundaries. Since communication and connection between different parts of the organisation can be a major issue, the creation of avenues for information sharing and discussion is important for work across organisational boundaries. Participant 1/8 described a complex initiative with many different stakeholders who were invited to work together simultaneously and communicate formally and informally:

> They can see the data together and actually say what this means together. To me the key thing I'd like to see is that opportunity to continue because it's been very powerful in terms of helping to drive service change [. . .] It overcomes some of the issues around power and balance without directly confronting them.

Similarly, participants reported that solutions for communication of sensitive results across units were found after a series of conversations about the meaning of results before they became public.

5.2.1.5.3 Shifting complex organisational boundaries.   Specialised units functioning as connectors may have an important role to play in spanning and shifting organisational boundaries. Participant 4/2 worked in a team described as "the middle of the funnel, we get the information from one side about the other side and work out what we can do with it and how we can help".

Engaging stakeholders in the development of new services and practices is a well-known strategy to create something new, but could be used more often in data-related non-clinical work. Participant 2/6 suggested an innovation week or a hackathon when people from different sectors could work together. Participant 4/1 discussed the importance of developing tools to demonstrate new ways of using data to give them meaning. For this participant, it is about improving business by understanding the value and use of data.

5.3 Boundary work: summary and role of boundary shifters
Observing, spanning and shifting are three types of work with data in relation to boundaries. In the previous section, we considered the five issues emerging in interactions with data. We showed how the issues are experienced and addressed by observing, spanning or shifting boundaries. In this section, we will provide a summary of the three types of boundary work and focus on the role of boundary shifters.

5.3.1 Observing, spanning and shifting boundaries. As previously noted, structure and boundaries are necessary for the organisation to function effectively. While rules and procedures are noted as helpful to provide structure, observing boundaries in data-related work is experienced predominantly as restrictive divisions. Data work inside organisational boundaries is characterised by experiences of difficulty in establishing shared meanings, unhelpful divisions between professions and roles, stifled innovation and efficacy due to rigid procedures and practices and a lack of communication and transparency.

Work across organisational boundaries, on the other hand, is described as more effective and positive. It is enabled by employees' ability to participate in inter-professional collaboration, support for data work and cross-division assistance from people in positions of authority, and particularly, by open and effective communication. Boundary spanners have an important role to play in initiating and driving work across boundaries. The creation of boundary objects and processes is an important part of working across boundaries.

In situations when working across boundaries is not the best response to the needs and opportunities, and under suitable conditions, the process of boundary shifting starts to happen. It requires a vision to see new possibilities and actively create spaces for new roles and types of work outside existing divisions. On the boundary-shifting level, a broader circle of people is engaged when creating boundary objects and processes to model new ways of working and open conversation and negotiation. In some instances, data itself became a boundary object as people from different sectors discussed how to reconcile data, which led to conversations about sources and the potential of shared standards. For example, Participant 4/2 discussed significant work involved in "data cleansing", consideration of data sources and practices involved in all stages of data use in her area of work.

People who work as connectors, formally or informally, notice gaps and are often in a position to initiate or lead changes, resulting in small and big boundary shifts. In some instances, new work roles or even teams are created to enable and support boundary shifting.

5.3.2 Boundary shifters. Boundary spanning and shifting concerns local work in relatively small organisational units as well as large and ambitious initiatives with far-reaching impact. Regardless of organisational size, boundary spanning and shifting change work dynamics and may have long-term influences.

Prominent boundary spanners in the study described their consistent work in the area they understood well. They also saw shortcomings in existing practices and opportunities for improvement. Through their professional vision and consistent work over a period of time, they became boundary shifters. In most cases, participants primarily viewed the change as a work in progress and did not describe a completed organisational shift. In rare cases, when they described a successfully completed change, it was discussed in the context of continuous improvement and a development mindset.

An important part of the boundary shifters' work is the creation of boundary objects and processes that serve as a material point of discussion. Boundary objects provide an example of what a change could look like. While other participants also referred to boundary objects (collaborative documents often served this purpose), boundary shifters referred to a suite of objects, interactions and processes. For boundary shifters, these objects served as a point of discussion and negotiation as communication across different units and professional groups were constant part of their work. They also were used in attempts to establish collaboration and ensure improvements. Boundary shifters often progressed or hoped to progress their work to the point of official acknowledgement and standardisation, such as an adjusted job description or title.

Boundary shifters typically had educational and/or professional backgrounds in more than one disciplinary area. They often had two degrees, one in a clinical area and another in IT. Alternatively, they combined work experience in their discipline with a strong technical background developed through any combination of personal interest and skills acquired on the job. In their current roles, they continued to tap into a range of their skills and experiences and saw it as a normal way of working. One of the Workshop participants explained it in this way: "I suppose I look at things from the perspective of I started working life as a clinician, then program manager, and now I'm managing an analytics performance team. So really, for me, it should be seamless".

A need for roles that enable new types of work and seamless transitions was described by a number of experienced employees. Participant 2/7, for example, managed connections between the health system and a large data bank. By the nature of her work and background, the participant observed cross-system trends. The main current gap in her area of work was the role of "translator", establishing a service link between users and the IT system. Participant 2/7's requests to create this type of role illustrated a need to standardise some of the boundary-shifting work.

In terms of personal characteristics, boundary shifters often mention a keen interest in understanding problems. They do not compartmentalise their work and use a range of experiences to initiate a change. Three vignettes showcasing boundary shifters are used to provide examples and illustrate the points raised in this section.

Vignette 1

Participant 2/5 has a degree in a clinical field, and master's in digital data. She works in a unit with separate teams of clinicians and technical staff. Her role is clinical, but she observes work processes holistically. Participant 2/5 works as a link between the two teams, hoping to make this part of her job description.

During the interview, she referred to an intervention that illustrated the creation of a boundary object. As described by Participant 2/5, "the top hat" and the new button created for clinicians symbolised an aspiration to create seamless connections between the two teams.

We have a way to inactivate a drug [. . .] I've noticed yesterday that they were doing it in the clinical team without mentioning anything to the technical team. Obviously, this has an impact on the technical team[. . .] Yesterday, I asked everyone what was the exact requirement to inactivate a drug and translate this requirement into data kind of, the top hat, the record – it's just a character we add on the top of the description.

I sent the email to the technical team to explain what this top hat means within the system and that they should inactivate another field that will be now out of scope. The technical team understood, and they are going to make the change today. They are going to create a button within an application for the clinical [team] to click this button to realign the technical content to their requirement.

Vignette 2

Participant 3/3 is a graphic designer, gamer and coder who studied programming at college. His role is to design reports from data provided by data analysts. When he started, graphic designers produced visualisations separately from data sources. Every change in data was replicated manually in reports. Participant 3/3, however, understood data work enough to interpret what the analysts were doing, but not enough to do it himself. When he began asking for data to automate data visualisation and reduce double-handling, he described being pushed into the "designer corner".

The participant saw opportunities for collaboration and was supported by his supervisor, but convincing others was difficult. Accessing data was not in the scope for his role. He had to demonstrate his ability to "data custodians" to overcome trust issues around the perceived risk. Over time, by connecting with analysts, he produced examples of automated visualisations, which were successful. As a result, he introduced a new consultation process to model the type of practice he wanted to achieve. New reports and closer collaboration between analysts and designers served as a boundary object and boundary process that ignited discussions and further negotiation. When asked what he would tell a new person about the most important aspects of the role, he said, "It's really understanding the data and how to build something from that data that's visual". It is a different area of work from traditional graphic design.

Vignette 3

Participant 4/1 worked in a senior finance role and wanted to use another unit's data combined with data available in his unit for a deeper understanding of issues. The goal was to create a better tool for trend prediction. There were many obstacles and challenges in accessing data from another unit. Participant 4/1 worked top-down to shift formal organisational boundaries and processes while trying to progress the project. He saw an organisational issue in the limited understanding of business problems and broader thinking about the use of data. The following example from his experience served to illustrate the thinking that he wanted to foster, involving shifting existing boundaries ingrained in practices and regulations at his workplace:

I've worked with individuals back in the health sector in New Zealand; one was a former engineer; he was the chief executive as well and also entered the finance and he brought in (IT application)… So we could understand or relate back to the care we were providing, why do we treat some patients in the same diagnostic group in an entirely different way with this clinician and this one is using something that seems to work a lot better in terms of efficacy of care, but also in terms of the efficiency of how we provide that care?

Facilitator: So, you think it is about understanding and interpreting data?

Interviewee: It's more than – it's also applying it to the business and applying it through to a culture and thinking, what does this mean for us?

6. Discussion

Data use in the workplace is a complex phenomenon; it is embedded in practice and contextual. One lesson the research team learnt during the interviews is that there is no such thing as a simple data-related task in the workplace. We confirmed throughout the project the observation that "[n]o piece of information is simple [. . .] even something so seemingly simple as what is a disease and how much does a treatment cost is enormously uncertain and complex" (Gerson and Star, 1986, p. 267). Study participants discussed the most sophisticated projects based on enormous data sets and high-end analytical capabilities as straightforward, and spent a big part of the interview explaining seemingly simple tasks fraught with difficulties imposed by territorial behaviours, inaccessible information, the lack of collaboration on one side or the successful use of organisational structures to promote work and achieve goals, on another. Boundary objects, processes and people in the roles of boundary spanners are key for our understanding of how interactions with data happen in practice.

Teams perceived as open and supportive, and those with rigid rules and limited communication both reportedly advanced their practices by working around and across boundaries by using boundary objects and processes. Findings about the use of boundary objects support Carlile's reflection that

[. . .] the capacity of a boundary object is two-fold: both practical and political. Practical because it must establish a shared syntax or a shared means for representing and specifying differences and dependencies at the boundary. Political because it must facilitate a process of transforming current knowledge (knowledge that is localized, embedded, and invested in practice) so that new knowledge can be created to resolve the negative consequences identified (Carlile, 2002, p. 453).

Boundary process emerged as an important concept in the study, combining work with boundary objects and boundary clusters, in which, as described by Rehm and Goel (2014), individual artefacts may not be boundary objects. An important aspect of the boundary process is that work with artefacts is combined with attempts to negotiate new communication channels and collaboration opportunities. The thrust of transformational work and realisation of Carlile's "political capacity of a boundary object" is in boundary processes. Boundary processes include different boundary objects, clusters and communication channels aiming to achieve immediate and long-term goals. Boundary shifting is a result of continuous work across boundaries.

Boundary-spanning mechanisms depend on the organisational context (Evans and Scarbrough, 2014). These authors identified two approaches that were used to support knowledge translation in health: a "bridging" approach involving designated roles and activities to span boundaries between communities, typically to work across strong boundaries; and a "blurring" approach to de-emphasise boundaries and enable knowledge translation in daily practice. In the study, participants discussed both mechanisms. One participant, in particular, who worked in a "bridging" team, described instances of connecting units and communities, but also "blurring" boundaries in daily practice. An insight from the study is that boundary spanners and shifters tend to work in any way that is available to them and appropriate for the task at hand.

The role of individuals who work on reshaping boundaries is well recognised in the literature. Haas (2015, p. 1033) identified six functions performed by boundary spanners and all, except "access to markets and commercialization of outputs", were identified in the study. Boundary spanners frequently aid information exchange. They support access to resources, sometimes by being able to manage blockages, but often by aiding intellectual access using their ability to interpret information from other disciplines. In some cases, they are group representatives. During later stages of change, boundary shifters trigger organisational change and take the roles of coordinators and facilitators. As Haas noted, shifters' competencies are hard to develop, can be slow to emerge, and they may not achieve their goal. Nevertheless, their work challenges the status quo.

While it is reasonable to expect that a community of practice plays a part in the boundary processes, we have not found any evidence that this was the case. All study participants referred to groups, which could be classified as work teams and, in a few cases, networks rather than CoP, according to the distinction made by Wenger and Snyder (2000). Brown and Duguid (2001) rightly emphasise the importance of practice, which creates an epistemic difference. Even with this distinction, a sense of community of practice was not evident in this study. While we cannot draw any conclusions from this finding, the presence of CoPs to support data work is worth further investigation. Snyder *et al.* (2003) discussed the potential of CoPs to bridge formal boundaries and aid beneficial boundary crossing in public organisations. A better understanding of how they function in everyday work may provide useful evidence for practice.

In the qualitative stage, we did not find evidence that experiences of boundaries as blockages depended on an employee's place in the organisational hierarchy, and we explored this question further in the survey. Fifty-three per cent of respondents said information was available often or almost always in their workplace, but 46% said it was available sometimes or rarely. The hypothesis that this depended on the position in the organisational hierarchy was rejected as there was no difference between people in supervisory and non-supervisory positions. These data indicate that organisational complexities in data-related interactions described in interviews are not isolated and are experienced at all levels.

The study opened a number of new questions which could not be adequately answered within the scope of this study. An area for further investigation with important practical implications concerns the nature and source of boundaries. Particularly relevant are practices involving paper-based and digital technologies. Boundary spanners and shifters try to introduce methods and practices suitable for digital environments. The nature of boundaries in the public sector, however, is often defined by rules, procedures and artefacts with a long paper-based tradition. Even in the highly technological health sector, data are kept on local spreadsheets and key pieces of information are discovered "in drawers" – residual practices that contradict the possibilities of new ways of working. Forms, procedures, authorisation requests, all common in public services (and often directly translated from paper-based versions), create boundaries around interactions with digital information. From this perspective, organisations need to consider the technological and cultural origins of work practices to remove unhelpful boundaries and enable convergence.

Advanced data use has a significant potential to improve health care. It requires the co-ordinated effort of the clinical and non-clinical parts of a health organisation. Study findings indicate that any organisational initiative aiming to advance data use in health needs to incorporate non-clinical work and workers. Digital capabilities are important, but they are only part of the picture. Education and training are critically important, but they need to be combined with targeted interventions to address work practices and organisational issues. While more work needs to be done to fully understand health organisation boundaries, practical initiatives to advance boundary spanning and shifting are advisable. It is particularly important to understand the role of local boundary spanners and shifters, and consider possibilities to provide formal and informal organisational support for boundary processes. The question about the optimal speed of change is important and answered on every organisational level – from decisions on the executive level, implantation by middle managers and in everyday practice.

7. Conclusion

The study contributes novel research findings relating to boundaries and data work, with implications for the workplace and improvement of health care. Investigations of data-related boundaries, the nature of boundary processes, and work around observing, spanning and shifting boundaries contribute new insights to the literature in organisational and information studies. These study findings are relevant to a broader public sector and applicable to similar work settings.

The study raises some interesting questions for future studies. Organisational structures and practices which inhibit and promote data work require further investigation. There is also a need to enhance understanding of the workforce involved in different aspects of data work, particularly to deepen insights into the characteristics and behaviours of people who assume the roles of boundary spanners and shifters in data-related work. This is particularly relevant in areas such as health, in which innovation and standardisation are both of critical importance. Further research into the transition from a paper-based public sector to a digitally enabled system, in which clinical and non-clinical work is considered holistically, would provide insights of practical and theoretical significance.

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