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Routledge
Taylor & Francis Group

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ABSTRACT
A policy aspiration is that evidence should inform decision-making on introducing health service innovations. Internationally, innovation adoption has historically been slow and patchy. Three innovations in the English and Scottish National Health Service were analysed qualitatively: stroke service reconfiguration; revised national guidance on cancer referral; and 'virtual' glaucoma outpatient clinics. The authors identify three sociomaterial mechanisms through which evidence and context shape each other in decision-making: connecting, ordering, resisting. Shared preferences for research evidence enabled the medical profession to exert influence on decision-making, while other professions used alternative evidence. Implications for promoting inclusive public management around service innovations are discussed.

KEYWORDS Healthcare; service innovation; decision-making; evidence; sociomaterial; power

Background

Healthcare is a context where adoption and diffusion of innovations has historically been slow and patchy in the UK (Department of Health 2011) and internationally (Whittington et al. 2015). A range of processes mediate the translation of innovations into practice, including organizational characteristics (Demircioglu 2019), production costs (Lehoux et al. 2019), political environment (Williams, Brown, and Healy 2018), leadership style (Van der Voet and Steijn 2020), and evaluation requirements (Morris, Wooding, and Grant 2011). This paper focusses on the mediating role of evidence in decisions about *introducing* innovations (initial adoption by one site or diffusion to new sites) which can be differentiated from approaches analysing further processes of innovation *implementation*.

There has been debate among researchers about the relative role of evidence and context in shaping responses to innovations. Some, influenced by evidence-based medicine (EBM), emphasize the strength and quality of *evidence* in decision-making (Sackett et al. 1996; Evans, Snooks, and Howson et al. 2013), while others highlight the

receptivity of the *context* (Rogers 2003; Greenhalgh, Robert, and Macfarlane et al. 2004). It is now recognized that the relationship between evidence and context influences innovation adoption (Dopson, Fitzgerald, and Ferlie 2008). Rather than limit the use of evidence in healthcare to research, especially findings derived from quantitative studies, we subscribe to a broader definition of evidence that recognizes its varying sources and measures of its credibility (Rycroft-Malone et al. 2004). Employing an eclectic definition, evidence use can be seen to encompass tacit and codified knowledge (Kislov et al. 2019), including academic research, patient experience, professional opinion, clinical guidance and local data. Moreover, the perceived value of evidence on innovations is linked to the context in which it is applied. Healthcare is a complex or 'crowded' context with multiple and distributed stakeholders, often with divergent interests, with the consequence that knowledge is often fragmented; multiple forms of evidence are relied upon stemming from the different actors involved (including tacit knowledge associated with the 'craft' of medicine and more standardized or explicit knowledge embodied in protocols); and the existence of professional and organizational boundaries promotes localized choices and interpretations of evidence (Nicolini et al. 2008).

Context is defined as subjective, interacting processes that can impact on practices of improvement or innovation (Bate 2014). The subjective aspect indicates that context is not a universal background that has common effects on all actions; rather, it is perceived and experienced in relation to particular actors and activities (Law 2004). The interacting processes of context can be divided analytically into different levels or layers of the environment that may shape the characteristics of a particular object of study. In relation to evidence use, aspects of context at the professional, organizational, and local system level influence how evidence is interpreted, applied and legitimized in decision-making (Turner et al. 2017). Such aspects of context may also interact as processes at one level are able to influence others (e.g. professional behaviour is likely to be influenced by an organizational context that values particular types of evidence, and vice versa, where preferences for evidence among professional groups inform how organizations' prioritize evidence). Relative to other areas of the public sector, the professional power and status of clinicians (especially medical physicians) in healthcare is an important contextual factor that shapes the planning and implementation of organizational change (Flynn 2002; Best et al. 2012). For instance, in a comparative analysis of UK reforms of healthcare, broadcasting, and postal services (Turner, Lourenço, and Allen 2016a), healthcare was distinctive as a context in which claims to professional autonomy allowed physicians to resist change at the clinical service level (middle managers had a much weaker status for resisting market-based reform in broadcasting, for example).

This study contributes to debate in public management on strategic and operational management of public services by examining the mechanisms that influence public sector innovation (Chen, Walker, and Sawhney 2019; Cinar, Trott, and Simms 2019a; Gieske et al. 2020) and the roles of different forms of evidence in decision-making practices (George et al. 2017). Research is needed on how and why particular types of evidence become influential in specific contexts, including how professional power and conflict inform evidence use in decision-making (Boaz, Baeza, and Fraser 2016; Oliver and Pearce 2017; Urquhart et al. 2019; Liff and Andersson 2020). Addressing this gap, this paper asks: what are the mechanisms through which evidence and context shape one another and mutually influence decisions about introducing service innovations?

This question is addressed through case studies of evidence use in decision-making on adopting service innovations in the English and Scottish National Health Service (NHS), a universal healthcare system funded through general taxation that provides many services free at the point of delivery. This publicly funded model of healthcare is similar across many EU countries (Oliver 2007) but differs from healthcare systems based on privately funded insurance or 'hybrid' models that include private and subsidized social insurance (see Fernando, Leticia, and Antonio (2018) on Colombia). The NHS is devolved across the four nations of the UK, with each country having separate funding and policy arrangements set by their devolved government. In England, the separation of purchasers from providers has been used to encourage competition in a marketized system; in Scotland, the purchaser-provider split was abolished in 2004, and competition among different providers is discouraged (Bevan et al. 2014).

Bringing together 'evidence' and 'context' in decision-making

Diffusion of innovations theory (Rogers 2003) has informed conceptual frameworks for mapping the role of evidence and different aspects of the context in innovation adoption and spread (Greenhalgh, Robert, and Macfarlane et al. 2004; Boaz, Baeza, and Fraser 2016). In describing organizational innovation processes, Rogers distinguished between the stages of initiation (actions leading up to the decision to adopt) and implementation (putting an innovation into use). This study focusses on how evidence informs decision-making on introducing or adopting innovations which Rogers terms 'initiation'. Initiation processes include information-gathering, defining organizational problems or needs for innovation, environmental search for new ideas, and considering the fit between the perceived problem and the proposed innovation (Rogers 2003). Evidence has a clear role conceptually in informing decision-making during the initiation stage (i.e. through information-gathering such as scanning for new ideas and being able to assess the alignment of innovation with organizational problems). Having gathered information during initiation, Rogers argues that decision-makers evaluate innovations against five general attributes (relative advantage, compatibility, complexity, trialability, observability). The innovation's performance against these attributes is socially negotiated, with Rogers noting the importance of 'champions' and 'opinion leaders' in the context of adoption.

The linear, localized and socially negotiated representation of decision-making in Rogersian diffusion of innovations theory is questionable. First, little exploration is made of the practices through which evidence are gathered during the initiation stage before decision-making passes onto the next stage of assessing innovations' attributes. For example, what is done with the evidence identified through search processes? How is the relevance of the search results to the decisions at hand judged? For example, experimental work in public management has shown that decision-makers' reactions to information are hardly rational but influenced by cognitive biases (George et al. 2017). In healthcare specifically, the evidence underpinning the diffusion of innovations has been shown to be ambiguous and contested; it often requires active interpretation and negotiation in the context of adoption in order to become 'evident' (Fitzgerald et al. 2002).

Second, Rogers' theory focusses on individual evaluators, or isolated organizational units, to the neglect of the multiple, sometimes conflicting, organizational units that can have a joint stake in organizational decision-making (Van de Ven 1991). For

example, healthcare improvement often involves multiple stakeholder interests within organizations (Langley and Denis 2011) and larger-scale service innovations can involve diverse organizations both within and adjacent to the healthcare sector (Best et al. 2012; Turner et al. 2016b). There is little recognition in Rogers' model of how evidence use (e.g. search, interpretation, and communication) is shaped by multiple stakeholder interests in decision-making on innovation that may be distributed among different units both within and between organizations.

Third, Rogers tends to view evidence as a passive or static resource that awaits activation by social processes to influence practice. In a published interview, Rogers remarked on the critical role of personal communication in innovation diffusion: 'It is people sharing their experiences with an innovation with others who haven't yet adopted that ultimately is what convinces most people to adopt a new idea' (McGrath and Zell 2001, 388). In Rogersian theory, experiences are read as a source of persuasion; experience can indeed be seen as a form of evidence in change processes (Best et al. 2012). This could help to explain why staff with longer experience of working in public organizations were found to be more innovative (Demircioglu 2019). However, this social constructivist perspective on innovation neglects how diverse evidence in healthcare is drawn upon in communication among actors (Turner et al. 2017). In healthcare, improvement activity draws on inputs of tacit and codified knowledge (Kislov et al. 2019), which combine to inform organizational learning processes, e.g. codifying or explicating knowledge has been shown to support the sharing of tacit knowledge beyond the individual level concerning patient safety (Waring et al. 2013; Turner et al. 2014). How does the evidence available to inform a typical unit meeting (e.g. financial reports, PowerPoint slides, performance data dashboards, social media feeds, polling tools) shape evaluation of an innovation's worth? Alongside the persuasive tactics of the human actors involved, evidence as a decision-making input which produces and frames innovations through particular lenses has been overlooked in shaping actors' perceptions of innovations (e.g. emphasis on clinical outcomes or patients' experiences; sharing brief PowerPoint summaries or extended management reports, and so on).

In summary, we suggest that Rogersian theory presents a somewhat limited view of evidence use in decision-making, which fails to consider how diverse evidence and contextual processes might interact and change one another. Whilst recognizing that social and organizational processes shape adoption decisions, diffusion of innovations theory says little about the reciprocal role of evidence in influencing the decision-making context. Rogers does not explore how particular forms of evidence gain legitimacy in evaluating innovations and how its value is negotiated among different organizational units. The political aspects of how and by whom conventions of evaluating innovations are established (e.g. the choice of categories to prioritize in their evaluation) and, in turn, how these shape what becomes credible or decisive evidence in specific contexts, has been neglected in Rogersian diffusion of innovations theory.

Evidence use as sociomaterial practice

This paper offers an alternative perspective on the relationship between evidence and context that can be applied to the study of decision-making on innovation. We suggest that a sociomaterial perspective is appropriate for analysing evidence use in the healthcare sector because it can take account of the political aspects of decision-

making on innovation; that is, the ambiguity of evidence associated with innovations, the multiple stakeholder groups involved in decision-making processes, and the need to take account of the diversity of evidence that can inform communication among actors. This approach draws on actor-network theory (ANT) which proposes a relational ontology or view of the world whereby realities are constructed in and through social practices (Law 2004). ANT gives equal weight to material (non-human) elements, e.g. technologies, language and physical spaces, that are inseparable from, and may therefore influence, practices of decision-making.

This alternative perspective suggests a recursive relationship between evidence and context: evidence for innovations will be shaped by the context, while evidence itself can influence the context. The context shapes evidence use because, rather than being immutable or unchanging (e.g. a research paper), evidence derives its status through the social and material contexts of its use. The context contributes to the 'unfolding' of innovations (Knorr Cetina 2001); they should not be seen as 'definitive things' that evidence helps to establish, but can be considered instead to 'unfold indefinitely' as people interact with innovations in specific contexts (e.g. through evaluative activities of observation, inquiry, technical debate and story-telling).

Evidence influences the context because it is 'performative' (Orlikowski and Scott 2008). To refer to evidence as 'performative', means to claim that it has the capacity to generate statements which simultaneously describe and *produce* phenomena like innovations. As evidence about innovations comes to inform decision-making on their adoption, it takes on a capacity to 'participate in the social world, being shaped by it, and simultaneously shaping it' (Law 2004, 12). The practices through which evidence is constructed, both socially and materially, can influence how innovations are framed and understood in organizational decision-making. For example, policy discourse advocating reform of hospital services in the UK was performative in framing decision-making in terms of clinical evidence, constraining public participation (Jones and Exworthy 2015; Fraser, Baeza, and Boaz 2017).

This alternative perspective suggests the need to study the influence of evidence on decisions about innovation as a sociomaterial practice – in which evidence and context are theorized to interact and shape each other – if we are to understand more fully how and why some innovations are adopted in some contexts. This paper attempts to achieve this by identifying mechanisms of interaction between evidence and aspects of context at the professional, organizational and local system level and explores their mutual influence on decisions about innovation.

Methods

Qualitative case studies (Yin 2013) were conducted on the use of evidence in relation to three service innovations within the English and Scottish NHS. Service providers, such as Foundation Trust hospitals, are corporatised organizations that have relative autonomy over operational and strategic decision-making, but the state retains ownership and may provide financial assistance (Allen et al. 2011). Service commissioners, such as Clinical Commissioning Groups (CCGs) and local government authorities, have relative autonomy over purchasing of services in the localities they cover; however, budget allocation and some specialist services (e.g. rare cancer treatments) are determined by the central government. Service commissioners in each locality reimbursed costs of service innovation.

Three service innovations within the NHS (stroke service centralization, 'virtual' glaucoma clinics, and new referral guidance on suspected cancer) were selected purposively to cover different settings (service areas), innovation stages (new or diffused), and predominant evidence type (research evidence, national guidance, internal pilot data) (Table 1). However, convenience sampling informed the choice of service innovations that met these criteria as links were established with the relevant communities of practice through previous research. Case selection was made prior to study commencement. It included a working assumption about the 'strength' of underpinning evidence associated with each service innovation based on the type and comprehensiveness of evidence available. The designation of supporting evidence was made by consensus among the research team. These choices have been triangulated with a hierarchy-of-evidence framework for evaluating effectiveness, appropriateness and feasibility of interventions (Evans 2003) (Table 1). The findings relate to healthcare service innovations and may not be generalizable to other types of innovation, e.g. product innovations such as pharmaceutical developments or medical devices.

Data collection

Case study data were collected (Nov 2016–Aug 2017) via interviews, non-participant observations, and documentary analysis (Table 2). The themes presented in the results section are composite accounts of processes influencing the use of evidence in decisions about innovation that draw on all of these sources of data. Analyses of sites' decision-making processes were developed through interviews with primary and secondary care providers (health professionals, middle and senior-level managers), local commissioners or purchasers of care, and a variety of pan-regional organizations (i.e. that work across a metropolitan area or locality) including charities, university–healthcare partnerships, and service-specific improvement teams. In prospective cases, decision-making was followed in 'real-time' using non-participant observations of activities. Analysing documents, including evidence presented in different forms, allowed us to trace social and material aspects of evidence use and their potential influence on decision-making. Exploring the potential agency of documents, the documentary analysis was concerned with how documents influenced decision-making or 'what objects do rather than what they say' (Prior 2008). Interviews lasted 40 minutes on average, used a topic guide, were audio-recorded and professionally transcribed. Interviewees/sites were anonymized.

Data analysis

Case study data were interpreted using thematic analysis which is used to derive qualitative themes or patterns from texts (Bradley, Curry, and Devers 2007); an abductive approach was used, as analysis involved cross-referencing ideas emerging from the empirical material with relevant literature (innovation diffusion and socio-material practice). An abductive model based on connecting, ordering, and resisting evidence (CORE) processes is provided in Figure 1. The process of abductive analysis to produce the CORE model is described in Table 3. We outline here relevant literature relating to each of these processes and then explore the relevance of these concepts in relation to the empirical findings and discussion section of the paper.

Table 1. Characteristics of innovations.

Innovation case study	Context	Innovation type	Stakeholders	Timeline	Evidence	Strength
Reconfiguring acute stroke services	The context for innovation was the aim of improving outcomes for acute stroke patients. Centralization of services into 'hyper-acute stroke units' staffed by specialist stroke teams with equipment for immediate diagnosis and treatment of stroke (e.g. brain imaging, thrombolysis) in a metropolitan area of North West (NW) England (retrospective study) and Scotland (prospective).	Diffusion	Commissioners and providers of stroke services in NW England and the Scottish metropolitan area, including stroke clinical network representatives, stroke clinicians, hospital managers, and national leaders of the review of stroke services.	NW England: April 2010 (partial centralization) – April 2015 (full centralization) Scottish metropolitan area: March 2016 (stroke review began) – June 2017 (centralization plan published)	Research showed that centralizing stroke services to create a smaller number of high-volume, 'hyper-acute' stroke units in London improved patient outcomes (Morris et al. 2014). The role of research evidence was studied relative to other information (e.g. financial impact and local need) in decisions about stroke reconfiguration.	Research evidence considered 'strong' by research team based on journal credibility and study type (quantitative, difference-in-differences analysis). Multi-centre studies are 'excellent' evidence (Evans 200).
New national guidance on referral for suspected cancer	The context for innovation was the aim of improving early diagnosis of suspected cancer. Responses to evidence underpinning the guidance were analysed in two localities covered by Clinical Commissioning Groups (CCGs): 'London CCG' and 'South West England CCG'. Analysed prospectively how different organizations influenced service planning and use of referral guidance.	New	Clinical networks, commissioners, third sector, secondary care providers, and general practitioners in primary care.	London CCG: July 2015 (new national guidance published) – Nov 2017 (revised referral form published) South West England CCG: July 2015 (new national guidance published) – June 2018 (access to FIT made available in primary care)	National guidance lowers referral threshold for signs and symptoms of cancer (National Institute for Health and Care Excellence, 2015), with aim of reducing emergency admissions and diagnosing at earlier stage.	Considered 'inconclusive' evidence by research team as assumes lowering threshold will improve timely diagnosis, but impact on demand and capacity to be established. 'Expert opinion' is 'poor' evidence (Evans 2003).

(Continued)

Table 1. (Continued).

Innovation case study	Context	Innovation type	Stakeholders	Timeline	Evidence	Strength
'Virtual' glaucoma outpatient clinics	The context for innovation was the aim of improving experiences of glaucoma services for patients with 'stable' or slowly progressing disease. Rather than seeing the patient face-to-face, the consultant eye specialist makes diagnostic decisions by reviewing patient data on a computer screen collected by other health professionals (e.g. technicians). Analysed prospectively how evidence informed diffusion of a pilot 'virtual' clinic to two other Trust sites, 'East' and 'South' clinics across Trust's organizational network.	Diffusion	Clinical academics in ophthalmology and optometry that led clinic's development; Trust's Board; Trust-wide implementation group; managers and clinicians within diffusion sites.	Pilot clinic: Mar 2011 (safety study begins) to January 2014 (pilot clinic opens) Other clinics: June 2013 (improvement programme begins) to July 2014 (East clinic opens) and July 2015 (virtual clinic opens).	Pilot data suggested reduced patient journey time (Kotecha et al. 2014), but lack of patient outcome data.	Considered 'weak' evidence by research team as based on local, small-scale case study, although journal papers based on data produced during implementation process. Single case studies are 'poor' evidence (Evans 2003).

Table 2. Data collection by site.

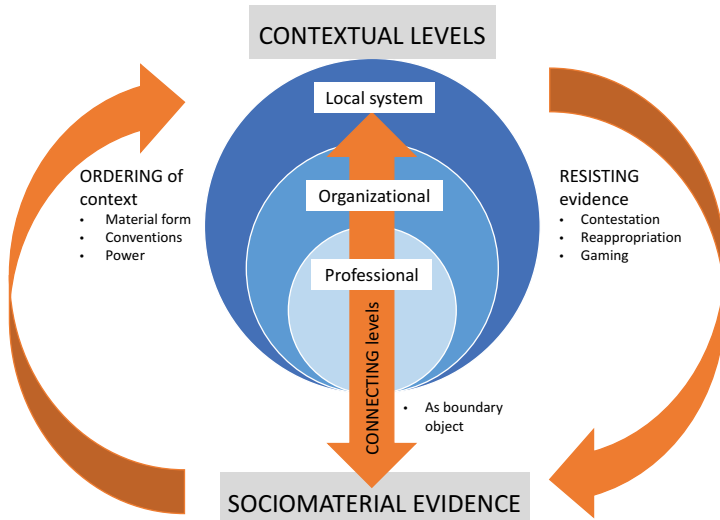| Case Study	Areas	Interviews	Observations	Documents
STROKE	Scottish metropolitan area NW England	Secondary care; 7 clinicians, 3 managers, 1 administrator	5; 10hrs	27 (25 reports, 1 meeting agenda, 1 presentation)
		Secondary care; 3 clinicians & 2 managers; 1 third sector and 1 commissioning manager	-	-
	National stroke perspective (programme leaders)	2 secondary care clinicians; 2 government managers; 1 clinical government advisor	1; 2hrs	5 (4 reports, 1 appendix)
CANCER	'London' CCG (service commissioners)	Primary care; 6 clinicians, 1 administrator; 1 secondary care clinician; 1 commissioning manager	7; 13hrs	3 (presentations)
	'South West' CCG (service commissioners)	Primary care; 8 clinicians, 2 administrators; commissioning, 1 clinician, 2 managers; secondary care, 1 clinician, 1 manager	4; 8hrs	10 (4 meeting minutes, 3 agendas, 2 reports, 1 presentation)
	Pan-London organizations (service improvement agencies, charities)	Primary care; 4 managers, 2 clinicians	2; 7.5hrs	6 (2 presentations, 1 agenda, 1 email, 1 newsletter, 1 report)
GLAUCOMA	Central Trust and clinic (where innovation introduced)	Secondary care; 7 clinicians, 5 managers	9; 16.5hrs	35 (3 presentations, 1 action plan, 5 meeting minutes, 4 agendas, 15 reports, 5 business cases, 2 policy documents)
	South clinic (diffusion site)	Secondary care; 4 clinicians, 1 manager, 3 administrators	-	-
	East clinic (diffusion site)	Secondary care; 4 clinicians, 1 manager	-	-
	External perspectives (other service providers)	Secondary care; 2 consultants	-	-
TOTAL		80; 52hrs	28; 57hrs	86

Figure 1. Conceptual model of CORE processes in decisions about introducing innovations.

Table 3. Process of abductive analysis to produce CORE model.

Abductive analysis 'involves a recursive process of double-fitting data and theories' (Timmermans and Tavory 2012, 179). This approach involves visiting empirical data with 'theoretical sensitivity' such that implications for interpreting both the data under consideration and the applicability of relevant theory are considered during the analysis process. In relation to our analytical focus on processes of evidence use, this involved seven stages:

  (1) Possessing a broad interest in, and familiarity with, research literature that emphasizes the social and material aspects of evidence use;
  (2) Tabulating the qualitative data using a multi-level framework which reflected the interview topics (evidence preferences and professional, organizational, and local system processes);
  (3) Using the tabulated data to produce summaries of evidence use in decision-making by site;
  (4) Reviewing the initial coding of qualitative data (stages 2 and 3) with ideas from the literature described in stage 1 in mind;
  (5) Looking more explicitly for patterns in the data that relate to propositions from the sociomaterial literature;
  (6) Facilitating dialogue between the coded data and theoretical propositions in order to develop new theoretical insights in relation to the existing literature on social and material aspects of evidence use;
  (7) Formalizing those insights by developing the constructs of 'connecting', 'ordering', and 'resisting' which are derived from the coded data and relevant theory.

Connecting refers to using evidence as to bring together practices that would otherwise be separate. This comes from the idea of seeing evidence as a type of 'boundary object' which can aid coordination among different professional groups, organizations, and local systems (Marabelli, Newell, and Krantz et al. 2014; Monteiro and Nicolini 2015). Connecting includes developing relationships through processes of interacting with evidence when seen as potential boundary objects (see Bryson, Crosby, and Bryson 2009 on strategic planning).

Ordering refers to influencing the social order – meaning the prevailing social structures and relationships in particular settings – through the categories, language

and intended standards inscribed in evidence. For example, Preda's (2002) ethnography shows how a bank's research reports did not present objective raw data but were standardized to enable cross-country and market comparisons through the 'vocabulary employed, the rhetorical procedures of representation, and the ordering of the representation's key elements' (p.202). The concept of ordering emerges from the idea of seeing the construction and use of evidence as an expression of power that orders or shapes social relations (Jasanoff 2004). For example, Weiss (1999) characterization of the 'subtle influence' of evaluation suggests that policy enlightenment has a linguistic basis: it takes place through the 'stories' told, use of 'language' that speaks to policymakers (e.g. cost), and delivering 'news' that allows policymakers to feel themselves to be current. Ordering processes are often underpinned by power relationships necessary to influence others (Timmermans and Almeling 2009). A systematic review of healthcare systems' adoption of technological innovations underlines the influential decision-making role of senior clinicians (Robert et al. 2010). However, the ways in which different healthcare stakeholders exert power on decisions about innovation through the use of evidence require further empirical investigation.

Resisting refers to the negotiated or non-implementation of innovations that emerge through their interaction with practice. Evidence has a potential role in enabling or addressing resistance to change. This idea was influenced by research on the implementation of technological innovations which shows how technologies can be contested or re-appropriated as they interact with social conventions of work (Allen 2013). Monteiro and Nicolini (2015) have called for research on the negative aspects of material elements in institutional settings, including 'tension, (material) resistance, and conflict' (p.74). Evidence can be seen as a technology of resistance that stakeholders can appropriate to exert influence, including 'gaming' (Bowen, Erickson, and Martens et al. 2009).

As an organizational form, the hospital has been described as the archetypal 'professional bureaucracy' (Mintzberg 1989) in which senior doctors are largely self-governing groups that exercise significant influence over decision-making due to claims of clinical autonomy and possession of specialist expertise. However, as new forms of healthcare organization have emerged, these have been accompanied by a diversity of organizational relations between managers and clinicians. For example, forms more akin to 'machine bureaucracies' have been introduced by for-profit providers in England in which managers exert greater power over the building blocks (e.g. structure, processes, culture) of organizations (Turner et al. 2011). Within contemporary healthcare organizations, little is known about how different stakeholders, including managers and clinicians, draw upon evidence during decision-making processes in order to enable or exercise resistance to change.

Summaries of innovation processes across the three case studies are outlined in Table 4. Outcomes refer to progress with adopting service innovations that emerged from decision-making; the service outcomes or financial implications of innovations were not assessed. The results explore interactions between evidence and context during decision-making in the case studies thematically using the sociomaterial constructs of connecting, ordering and resisting.

Table 4. Summaries of innovation decision-making processes in the three case studies.

Case study	Decision-making	Early outcomes from decision-making
Stroke service reconfiguration	In NW England, services were partially centralized in April 2010 into 'hyper-acute stroke units' staffed by specialist stroke teams with equipment for immediate diagnosis and treatment of stroke (e.g. brain imaging, thrombolysis). A 12-month review of the centralized services by a clinically led network for stroke services in the region found that not all eligible patients received hyper-acute stroke care and questioned the 4-hour access window following symptoms onset (in London's model all patients were eligible). In the Scottish metropolitan area, the stroke review began in April 2016, prompted by concerns about service quality (e.g. the area was not achieving national performance standards for care based on audit data over a number of years). An earlier stroke service review had been conducted, but this was dominated by planning in relation to a new hospital, delaying consideration of a more centralized stroke model.	In NW England, further reconfiguration of stroke services was implemented in April 2015 whereby all patients became eligible for treatment in a hyper-acute stroke unit (previously, only patients arriving at hospital within 4 hours of symptom onset were eligible). In Scotland, recommendations to centralize acute services from four hospitals into one hyper-acute site were published in June 2017; at the time of writing an implementation group had been established to take the recommendations forward.
New national guidance on cancer referral	For the new national guidance on cancer referral, the jurisdiction of the two bodies that coordinated responses differed. Across London, a pan-regional team (Transforming Cancer Services) developed new referral pathways and referral forms, including revised referral and investigation pathways for suspected cancer, and coordinated educational events and distributed information. The local CCG supported uptake of the guidance. In SW England, the local CCG led a multidisciplinary group to implement changes in response to the guidance.	A common outcome of decision-making across both sites was the development of a new referral form that reflected the updated national guidance to support GPs with making clinical decisions. Responses varied to other innovations varied, including changes to referral pathways between primary and secondary care.
Diffusion of 'virtual' glaucoma clinics	Decision-making occurred at different organizational levels: the Trust board oversaw an organization-wide improvement programme for outpatient services; a multi-professional group supported the implementation of innovations in glaucoma services; and the clinics to which the innovation spread informed local adoption and implementation decisions.	Implementation of the 'virtual' glaucoma clinic was protracted (due to difficulties with finding space, linking diagnostic equipment, and staff adapting to new roles). As the innovation was rolled out to other sites, it was observed during planning meetings that implementation was given greater consideration, e.g. incentivizing front-line staff.

Results

Sociomaterial mechanisms of evidence use

A summary of the results is presented in Table 5.

Connecting professional groups through evidence

Connecting refers to the sharing of evidence within and between professional groups to inform decision-making, and how evidence develops connections between professionals. In the Scottish metropolitan area reviewing stroke services, decision-makers considered both published outputs and colleagues' professional opinions to assess their practical relevance:

> As well as looking at the research papers you have to go and speak to the people as well though because I think sometimes you don't get some of the nuances if you don't actually go and look at it and say: well, how does this work and how do you do that?
>
> (Lead clinician, Cancer, clinical network, CAI5).

Making sense of the research evidence included speaking to a research team that had undertaken a national study of stroke reconfiguration, and ensuring that clinicians who had previous experience of stroke reconfiguration informed decision-making. During a planning meeting observed, the chair (SAI3) emphasized the potential for learning from other areas that had undergone reconfiguration – as *'discussions [we are] having [are] not unique here'* – with lessons discussed including taking a 'big bang' approach to change and involving ambulance services.

Table 5. Summary of results by theme.

Case study	Theme		
	Connecting	Ordering	Resisting
Cancer	• To improve guidance awareness and uptake, actors at the local system level (including cancer charities) shared evidence with GPs in different forms.	• Implications of evidence were debated among primary and secondary care clinicians, and alternative forms cited (e.g. professional experiences, politicians' views, resource pressures), to influence changes to referral processes.	• Change was resisted through claims that evidence was lacking in relation to particular aspects of evaluation (e.g. impact of changes to referral pathways on capacity/demand).
Stroke	• Colleagues' professional opinions were sought to assess the practical relevance of audit data and research findings in decision-making.	• Evidence was used creatively by 'champions' to exploit windows of opportunity for improvement; manipulating the material form of evidence helped to achieve this impact.	• Concerns from providers about implementing proposed changes to services were felt to slow down decision-making.
Glaucoma	• Local actors recognized the value of translating their research and experiences into clinical guidelines, including endorsement by professional associations.	• Senior doctors often self-identified as the main decision-makers, while assigning others (e.g. operational managers) role of implementing their decisions.	• Operational managers trying to support change used alternative evidence to influence hospital consultants (audit data on how existing clinics were performing).

Local system actors had an important role in mobilizing evidence to connect different professions, organizations, and care sectors involved. As General Practitioners (GPs) were considered to be time-poor and have other service demands to respond to, the guidance was shared in accessible forms by cancer charities that took account of these challenges, including summaries on desk easels, benchmarking data on referral rates, and face-to-face events and educational videos on recognizing cancer signs and symptoms.

Local system actors recognized that the presenter's credibility could influence responses to evidence. In planning quarterly education sessions with GPs, the London Clinical Commissioning Group (CCG), which clinically led groups that aim to influence the purchase and delivery of services for their local population, recognized that enabling one GP (the cancer lead) to lead the session should improve how the information was received by other GPs, as opposed to using a presenter with a different professional background and role. The GP cancer lead talked through the guidance with colleagues at quarterly education events, summarizing key aspects of the new guidance on PowerPoint slides and adding examples from his experience:

> we find that when [GP cancer lead] puts it in a third person, and then also explains, as a fellow GP, his challenges and what he's found then works, it's the best way to then get the message across to his fellow colleagues. As opposed to me standing up and just walking through it cold, as a manager.
>
> (Commissioner, Cancer, London CCG, CBI7)

The anecdotes told throughout the presentation included patients from the local population who had presented to primary care and experienced delayed diagnosis to encourage the doctors present to increase referrals. However, sharing evidence does not always build professional accord. The hospital consultant who presented later in the education session described the pressure in secondary care that urgent referrals cause, and suggested that the problem was not a shortage of referrals, but one of finding cancers in the appropriate way (citing challenges for secondary care where patients were referred simultaneously along different pathways or referral criteria were vague or unsupported by diagnostic tests). The different views prompted a debate between the consultant and the GP lead, with the latter continuing to emphasize the need to refer if there was any suspicion of cancer.

Translating evidence into different forms enabled findings to be shared over a wide canvas, supporting innovation spread. In glaucoma, this process appeared to mirror the evidence hierarchy in EBM, whereby local actors recognized the value of getting their research on, and practical experiences with, innovations translated into clinical guidelines to widen their impact. Those leading diffusion of the 'virtual' model for outpatient clinics sought the endorsement of speciality-specific professional associations. This was achieved by translating standards developed locally into national guidance for running 'virtual' clinics that became enshrined in professional association guidance.

In summary, research evidence and guidelines are often translated into different forms (e.g. summaries) or combined with other forms of knowledge (including anecdotes and other experiences), during decision-making processes. In relation to stroke and cancer, summaries of evidence were shared, rather than original evidence in national guidance or academic studies, and discussion weaved together views on published evidence with contextual information gained from interactions and

professional experience. The translation of evidence into different forms supported communication across the professional, organizational, and local system levels, although this often involved confronting boundaries. Translating evidence included summarizing and using anecdotes to illustrate new national guidance on referral for suspected cancer to educate local GPs (intra-professional engagement, with local system support); establishing a dialogue with external researchers, and clinicians with experience of centralizing stroke services in other metropolitan areas, to inform stroke reconfiguration (intra-professional dialogue, using peer networks); and translating research findings into professional standards for 'virtual' clinics for glaucoma outpatients for sharing among the same profession nationally (intra-professional standards, with organizational support). However, as illustrated by the divergent views on cancer referral expressed by the GP lead and hospital consultant, utilizing evidence in ways that crossed inter-professional and sectoral boundaries was challenging despite local system support.

Ordering decision-making priorities through evidence

Ordering refers to the ways that evidence is used to influence the context of decision-making; this includes both social processes (e.g. 'championing' evidence) and the material form of evidence (including length, format, and key points highlighted) which can shape stakeholders' perceptions of innovations. Evidence was used to help particular stakeholders exert influence over decisions about adopting innovations, including those where changes to professional roles and responsibilities were at stake. Senior doctors used research evidence to exert influence on how innovations were evaluated within their own professional group, while potentially excluding others who were not well versed in using this type of evidence. Across the case studies, senior doctors (e.g. clinical academics, hospital consultants, established GPs) dominated decision-making at the organizational and local system level on introducing innovations. Their preferences for evidence helped them to exert power over decision-making, as the types of evidence they prioritized (e.g. academic studies published in clinical journals) were influential. However, this could impinge on the ability of other professional groups to influence decision-making (given the need to have the relevant background knowledge to produce, interpret, and apply academic research findings):

> they [clinical academics] live in a world of studies and you can sometimes see that to them anything that isn't – the value of it is completely negated straight away because it hasn't been published.
>
> (General Manager, Stroke, Scottish metropolitan area, SAI2)

As decisions on *adopting* innovations tended to be dominated by powerful stakeholders (e.g. senior doctors), there appeared to be less consideration of the practical aspects of *implementing* innovations. In the glaucoma case study, senior doctors often self-identified as the main decision-makers in determining how clinics are delivered and should change while assigning others (e.g. operational managers) to implement or 'execute' their decisions:

> generally clinicians lead the decisions as far as how you manage patients and with our hospital management to help us actually execute that. So then you have to have a good system whereby the clinicians can all contribute to those sets of decision making.
>
> (Senior doctor, Glaucoma, East Clinic, ECI4)

The consultants became aware of the 'virtual' clinics through their contact with other consultants at uni-professional meetings (where plans, performance and evaluation of the clinics were shared), enabling the innovation to be taken forwards by consultants working at different clinics across the Trust. A decision to 'roll out' the clinics was made among consultants once they had *accepted it as a model*' and, following this, implementation resources (equipment, staff, clinical space) were sought:

> All the consultants come together regularly and because we were all happy with it at [main hospital site], and most people where the roll outs happened also work at [main hospital site], they'd already accepted it as a model. So it was more like them saying: how can I have it? I want to have it. Get me the kit and the people and the space.
>
> (Clinical director, Glaucoma, central Trust, EAI4)

Evidence was used creatively by 'champions' to exploit windows of opportunity for improvement. This study showed how manipulating the material form of evidence helped to achieve this impact. In relation to stroke reconfiguration in NW England, a nationally recognized, local stroke consultant had summarized academic research on the impact of service centralization – including the quantitative 'headline' finding derived from the study that further centralization of services could save '50 excess lives' per year (National Health Executive (2015)) – to influence local commissioners:

> We had simplified one-page summaries of the evidence and all kinds of things that went out to people. And the 50 excess lives did become fairly common currency.
>
> (Stroke consultant, NW England, SBI2)

The introduction of innovations could influence the responsibility for, and control over, clinical decision-making among professional groups, causing concern about changes to professional jurisdictions and shifting power between care sectors. For cancer, changes to referral processes shifted control and responsibility from secondary to primary care. Tensions between the sectors played out in how evidence associated with innovation was presented and discussed. In the cancer education event described earlier, the GP lead emphasized following the referral recommendations, citing data suggesting the area was one of 'low referrers' and stating that local politicians wanted to know what was happening about improving referral rates. The secondary care consultant suggested that the area's referral data may not be up-to-date and that referral criteria should be applied 'appropriately' given secondary care resource pressures. Implications of evidence were debated, and alternative forms cited (e.g. professional experiences, politicians' views, resource pressures), as both presenters attempted to order the shifting responsibility for clinical decision-making among the different professional roles and sectors.

In summary, preferences for evidence influenced which stakeholder types took a central role in decision-making and the impacts considered. Evidence played an 'ordering' role in decision-making by encouraging particular impacts of innovations to be prioritized (e.g. clinical outcomes such as stroke mortality, patient safety with regard to glaucoma clinics, and timely diagnosis of cancer), to the potential neglect of other characteristics (notably feasibility of implementation). The material form in which evidence was presented helped social actors to influence decision-making and drive service change.

Resisting: considering evidence on implementation

This concept suggests that evidence influences decision-making through a negotiated process, including tension and resistance. In the case studies, while senior doctors

sought to take control of adoption decisions, other professional groups presented alternative evidence (e.g. local data) in attempting to influence their behaviour. In glaucoma, some hospital consultants expressed doubt about making referrals to clinics where patients would not be seen by a specialist face-to-face, citing safety concerns. Although research evidence concerning safety was discussed, operational managers trying to support change presented alternative evidence to senior doctors (audit data on how existing clinics were performing) to obtain their approval for introducing new models of care:

> You could see them actually sort of turning the slide over, going wow is that really my clinic, because it was by code, so consultant code, and then it was an overall picture of the glaucoma service.
>
> (Project manager, Glaucoma, South Clinic, EBI1)

The manager was aware of the need to collect and present local data systematically to appeal to consultants' preference for 'scientific' evidence in evaluating decisions to change practice.

In the cancer case study, there was an awareness of the need to use evidence to respond to concerns among both GPs and secondary care providers about the impact on resources of changing the referral threshold within acute and primary care. In South West CCG, observations of those leading the local response to the NICE guidance showed that they recognized the need for evaluation to convince the organizations involved to implement the recommendations. As stated in a planning meeting, the challenge coming back from providers was: *'what will it cost, will you break our hospital?'* (CAI2). However, little evidence appeared to be available to examine how changes to the guidance would influence demand:

> All the diagnostic partners are already stretched […] so anything new is going to be hard for them to do. They're reluctant. They want reassurance. They want to know where it's working. They want evidence of some sort that it isn't going to cause an upward spiral of demand. Now, you know, that kind of evidence is quite hard to come by.
>
> (Clinical lead, Cancer, pan-regional organisation, London, CAI2)

The lack of evidence on the effects on demand/capacity was used by hospitals as a tool for resistance, to argue that the impact of lowering the referral threshold on secondary care could not be predicted and may represent a risk to services.

In stroke, concerns from providers about implementing proposed changes to services were felt to slow down decision-making. In response to new issues being raised constantly during the Scottish stroke review, the group's chair (SAI3) stated during a meeting: *'thought we were almost there but obviously not!'*. Organizational resources were needed to act upon evidence meaning that the involvement of other stakeholders (particularly local managers overseeing change) was needed to understand what resources were required to implement innovations. Resources to implement stroke reconfiguration were perceived to be lacking:

> I'm not confident that we're going to deliver the kind of change that the papers reflect at all because […] it takes a big decision and it takes resources and it takes prioritisation and the organisation is not good at that.
>
> (Planning manager, Stroke, Scottish metropolitan area, SAI7)

In summary, a key form of 'resisting' identified related to concerns about implementing the recommendations of evidence, including the need to determine the

implications of change (such as consulting additional stakeholders) and availability of resources available (including service capacity) before implementing the proposed changes. One way of responding to resistance was by presenting alternative evidence to allay concerns; however, the lack of evidence on how implementing recommendations made would affect experiences of delivering services was a sticking point (e.g. impact of new referral pathways on capacity/demand).

Discussion and conclusion

Sociomaterial mechanisms amplify aspects of evidence and context in decision-making

Previous research has established that decision-making on introducing innovations is influenced by the interplay between evidence and contextual processes. This study reveals mechanisms of this interplay to explain how and why particular types of evidence attract power/legitimacy in specific decision-making contexts (Urquhart et al. 2019; Oliver and Pearce 2017; Boaz, Baeza, and Fraser 2016). In particular, evidence and context do not interact and shape each other in a neutral way. As they interact, the influence of particular types of evidence and aspects of the context on decision-making is amplified through sociomaterial mechanisms that are shaped by professional or other manifestations of power. For example, in the glaucoma case study, one professional group in the context (clinical academics) dominated decision-making by developing and helping to ensure that one type of evidence was prioritized (clinical journal papers). The priority given to research evidence was used to exert power over decision-making by stakeholders conversant with this type of evidence (e.g. reproducing the power associated with medical professionalism by legitimizing a clinical perspective on evaluating service innovations). The findings indicate how senior clinicians may exert influence on decisions about introducing innovations (Robert et al. 2010) by drawing on particular types of evidence that reflect their priorities concerning the evaluation of innovations.

Turning to the conceptual model of CORE processes (Figure 1), the roles of the three sociomaterial mechanisms were explored and shown to be influential in relation to the three case studies of service innovations. *Connecting* shows how shared preferences for evidence at the professional level can support communication within professions (e.g. interpreting nuances of information). *Ordering* illustrates how power dynamics are negotiated within and among professional groups, organizations, and sectors. Senior doctors could use research evidence to exercise dominance by influencing the criteria prioritized in adoption decisions. However, this tendency marginalized other stakeholders' views in decision-making to the neglect of some evaluative aspects of innovations, notably implementation considerations. Evidence was used to influence organizational power shifts (e.g. tensions in interpretations of evidence where recommendations can affect the responsibilities of, and relationships between, primary and secondary care for suspected cancer). *Resisting* highlighted power dynamics in showing how 'alternative' evidence was presented by non-medical stakeholders to influence change, e.g. managers' use of local audit data to influence hospital consultants. Claims that evidence was lacking in relation to particular aspects of evaluation (e.g. impact of changes to referral pathways on capacity/demand) were used to resist change where professional or organizational

interests were at stake, suggesting potential 'gaming' of evidence to support particular interests (Bowen, Erickson, and Martens et al. 2009). Thus, while senior clinicians were shown to have an influential role in decision-making, other stakeholders less recognized in previous research (e.g. Fitzgerald et al. 2002), including operational managers, service commissioners, and charitable organizations, used alternative evidence in order to shape decisions about innovation. The use of alternative evidence to 'resist' the dominance of senior clinicians may reflect a recognition that a growing diversity of evidence can have a role in decision-making beyond research articles (Turner et al. 2017).

Reframing evaluation processes in Rogersian diffusion of innovations theory

This study's findings develop Rogers' concept of decision-making on innovation in three ways. First, we suggest reframing evidence use in decision-making whereby, rather than apply set criteria to evaluate innovations (Rogers' five attributes), potential adopters negotiate the relevant criteria for assessing the value of innovations through an unfolding process of evaluation. Second, rather than being informed by individual evaluators or organizational units, decisions about introducing innovations are shaped by multiple stakeholder interests. In pressing forward these interests, opinion leadership in decision-making emerges from negotiation among professional groups which compete by amplifying particular aspects of evidence (e.g. type needed, relevant criteria) in the evaluation of innovations. Third, as well as being influenced by professional power and hierarchy, decision-making is informed by interactions between contextual mechanisms and the performative role of evidence (e.g. its presentation in different formats). These interactions may take an evaluation of innovations in different directions according to the balance between the CORE mechanisms. Alongside recognizing that social processes influence decisions about innovation in healthcare (Fitzgerald et al. 2002; Robert et al. 2010), the findings from this study depart from previous research by highlighting that the material diversity of evidence – in its varying forms and uses in evaluative interactions – needs to be recognized as playing an active role in decision-making processes too.

A strength of this study is that it allowed the role of different forms of evidence for innovations to be compared. The findings suggest that policy emphasis on knowledge translation or mobilization processes (Ferlie et al. 2012) is necessary but not sufficient for enabling change: the strength of evidence being worked with matters too. In the stroke study, having 'strong' data on the impact of centralizing services on mortality and length of stay in hospital was pertinent to commissioners' decision-making within NW England, making it a good candidate for mobilization. The evidence helped to frame decision-making about further reconfiguration in terms of clinical outcomes relative to London, that had fully centralized services. In the cancer case study, while mobilization processes by local system actors (e.g. cancer charities, CCG) were similarly visible, decision-making on adopting the new national guidance was protracted because the evidence was 'inconclusive' or lacking on the impact of the incoming referral processes on capacity/demand for services.

The inclusion of stroke service reconfiguration programmes across metropolitan areas in both NHS England and Scotland allows some comparison of national health system contexts (the glaucoma and cancer case studies only related to England). One difference that stood out was the difficulty with *identifying* those with decision-making

authority and then *taking* decisions concerning reconfiguration in the Scottish site relative to England, which contributed to the stalling of change in Scotland (the English site also struggled with exerting authority over providers and commissioners but a clear decision-making process – by consensus – was followed). As well as encouraging clinical leadership, assigning decision-making authority appears to be an important component for implementing radical change (Best et al. 2012; Turner et al. 2016b).

Implications for public management theory, research and practice

Recent public management research suggests a need to shift focus from single organizations to 'systems and networks' of innovation (Cinar, Trott, and Simms 2019a) and the potential 'interaction barriers' among stakeholders raised. This study confirms that multiple stakeholder interests often shape decisions about introducing service innovations and identifies a role for evidence in shaping interactions among multiple stakeholders. As an interaction barrier, use of particular types of evidence can be used to connect up or draw in perspectives among one professional group, to the exclusion of others in decision-making (e.g. clinical academics' use of scientific research in the glaucoma study). However, evidence can also become an 'interaction enabler' where it is adapted, or multiple forms are combined, in order to draw together multiple professional groups and organizations (e.g. short summaries of academic research shared with commissioners in the stroke study, or the translation of guidance into different forms in the cancer study). Attending to multiple stakeholder interests departs from Rogers' work that related to individual organizational units (Van de Ven 1991), highlighting that the 'attributes of innovations' are not unitarily constructed but are contested by multiple stakeholders, and how they make use of evidence as a form of power, to shape the evaluation of service innovations. Public managers have an important role in enabling the participation of multiple stakeholders in decisions about innovation in healthcare by acknowledging a diversity of evidence that reflect their varied interests in innovation and developing organizational mechanisms for supporting the use of diverse evidence in decision-making processes. Recognizing that the context of healthcare retains aspects of clinical dominance over decision-making (Mintzberg 1989), public managers will need to take account of potential resistance from senior clinicians in seeking to adapt decision-making processes to reflect wider stakeholder interests.

This study has focussed on decision-making on service innovations in the UK healthcare sector. Future public management research could compare our findings with other types of innovation, public service sectors, and international contexts. The CORE model could be developed further through cross-country studies that take account of the institutional setting (echoing Cinar, Trott, and Simms' 2019b's call for international comparisons of innovation barriers and tactics), including potential differences in national systems of innovation and how health professionals and organizations value diverse knowledge (e.g. scientific and experiential forms) that may influence the dynamics of the CORE processes, or suggest mechanisms influencing evidence use additional to those explored in the UK context.

Previous research highlights the potential role of outputs from collective activities like strategic planning to act as 'boundary objects' that can promote more 'inclusive public management' (Bryson, Crosby, and Bryson 2009). This study contributes to this line of

research by showing that the role of evidence in evaluating innovations has a democratic dimension because it can be made to speak to different stakeholder interests and the evaluative role of particular pieces of evidence in decision-making are often contested. However, to encourage more inclusive practices of decision-making, it is important to conceptualize evidence in pluralistic (multiple types) and processual terms (its fluidity or plasticity) that the static term 'boundary object' conveys. More inclusive decision-making in public management could be promoted by regarding evidence use as a set of 'boundary processes' in which multiple stakeholders engage with the construction, interpretation and perceived strength of evidence in practices of evaluation.

To address recognized barriers to meaningful stakeholder involvement in decisions about innovation (McKevitt et al. 2018), evidence can be considered in processual terms, such that evidence is allowed to influence decision-making as it unfolds or morphs through stakeholder engagement, rather than being seen as a product with fixed attributes or characteristics that need to be protected, e.g. during 'tokenistic' consultation processes. Pan-regional organizations, e.g. England's Academic Health Science Networks, US Accountable Care Organizations and Patient Centered Medical Homes, and Bogotá, Colombia's District Centre for Health Education and Research, have a potential role in encouraging this 'unfolding' aspect of evidence by supporting its translation on behalf of stakeholders with a variety of power and interests in relation to service innovations.

Disclosure statement

Funding

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