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An interview analysis of coordination behaviours in Out–of–Hours secondary care

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ABSTRACT

This paper seeks to elicit and structure the factors that shape the execution and, in particular, the coordination of work in Out of Hours care. Evenings and weekends in UK hospitals are managed by specific Out of Hours (OoH) care arrangements, and associated technology. Managing care within the constraints of staff availability and demands is a key concern for both patient care and staff wellbeing, yet has received little attention from healthcare human factors. A study of sixteen clinical staff used Critical Decision Method to understand how work is coordinated and the constraints and criteria that are applied by the roles managing OoH care. The analysis identified ten types of coordination decision that, in turn, underpinned three types of adaptive behaviour – pre-emption, information augmentation and self-organisation – that were crucial for the effective performance in OoH care. These behaviours explain how OoH staff manage the task demands placed on them, individually and as a team.

1. Introduction

In the UK secondary healthcare system at present, 76% of the hours are classified as Out of Hours (OoH), including evening and overnight, as well as weekends and national holidays. During OoH periods lower numbers of clinicians, supported by fewer resources, work across hospital sites and multiple clinical specialities to provide care. Effective coordination of reduced resources is vital, balancing the care of patients matched to the right clinical resources, with the workload and well-being of clinical staff.

Change has been implemented in the UK's OoH secondary care system through the Hospital at Night (H@N) programme (Mahon et al., 2005; McQuillan et al., 2013), since it was initially piloted in 2004. This solution was a response to reductions in the working hours of doctors-in-training (junior doctors) under the European Working Time Directive, which required significant organisational and cultural adaptation (Hamilton-Fairly et al., 2014). The Hospital at Night system relies on teams of clinicians to deliver care OoH through the coordination of junior doctors, supported by senior and specialised nurse practitioners and clinical support workers. As such, the ethos of Hospital at Night is the provision of OoH medical cover by a centralized multidisciplinary team, who have the full range of skills and competencies to meet the immediate needs of patients. The central tenets include multispeciality handovers, extended nursing roles (including prescribing), bleep filtering through central co-ordination and ensuring routine work is not carried over into the out-of-hours period (Beckett et al., 2009).

The verdict on Hospital at Night is that it contributes to improvement in patient care and outcomes ("The Case for Hospital at Night – The Search for Evidence" 2008). There are, however, challenges with such a system. In the UK healthcare system, non-surgical secondary care doctors-in-training working OoH rotate around both clinical specialities (intra hospital) and geographic locations (inter hospital). They are frequently exposed to new scenarios, and have to contend with non-clinical pressures such as making sense of unfamiliar hospital systems, finding wards and equipment in unfamiliar surroundings or deciding on task priorities. Also, OoH care takes place during long hours and at night resulting in potential effects of fatigue. The cognitive, physical and organisational challenges faced by staff during OoH work can have a negative impact on their wellbeing, with a knock-on effect on the cost of care due to absenteeism and locum cover ("Hospital at Night:

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Benefits, Realisation & Business Case Report" 2007). There is also a reported increase in mortality rates (Lockley et al., 2007) during OoH, although there is debate about whether this is caused by reduced healthcare quality or other factors, such as lower probability of admission (Raspin and Bassi, 2016; Meacock et al., 2017). Work on handover between day and OoH care (McQuillan et al., 2013) has identified the challenges of balancing the need to have all specialisations together to develop a common picture of patient needs, while working around staff availability at the beginning and end of shifts. Variations in this balance can have marked effects on performance OoH, including failing at handover to flag patients that will potentially need OoH care.

Consequently, concerns about OoH care contribute to controversy around seven day services offered by the National Health Service (NHS) and make it an important area for research. There is, however, little or no research to date in the ongoing execution of OoH care once it is underway. Understanding the range of tasks that various roles are asked to perform, the time taken to perform these tasks, and what drives these tasks, is vital to make decisions around appropriate staffing numbers and grades (Sharples et al., 2015; Royal College of Physicians, 2018).

An overview representation of the Hospital at Night process is provided in best practice guidance activity mapping (Fig. 1). The example provided is of patients needing unscheduled care, and the activities depicted are coordinated by a nurse clinician, who assesses the clinical need, decides if Hospital at Night team treatment is necessary and allocates appropriate resources. Leadership provided by these nurse clinicians is identified as good practice in Hospital at Night provision ("Hospital at Night Baseline Report" 2006). The Hospital at Night model interconnects with other systems employed in hospital, such as task management (Seddon & Hay 2010; Blakey et al., 2012; Herrod et al., 2014), handover (Raptis et al., 2009; McQuilian et al., 2013) and early warning scores about patient health state (Jones et al., 2011; Gordon and Beckett, 2011; Kolic et al., 2015).

The kind of coordination scenario described above is one where actual work is often more complex than that originally envisioned. While the kind of configuration described in Fig. 1 reflects a simple, and mostly unidirectional, model of information flow, in practice different functions are more interdependent, and often demonstrate emergent behaviour (Trist, 1981; Wilson, 2014), which may provide resilience and flexibility to a system given a level of pressure or scenarios not originally envisaged by designers. Typical factors leading to divergence between planned and actual work in a team setting result from the need for all parties to have an ongoing view of system status. While this view may be achieved through ICT-based communication, this can also be supplemented by other artefacts. For example, informal notice boards are used in ER rooms to act as a shared representation of which beds are in use (Wears et al., 2007). These workarounds may be a reaction to inefficiencies in new technology, such as the use of unofficial 'shadow charts' to accompany formal records that are perceived as being incomplete (Perry and Wears, 2012). There are also many instances of informal mechanisms, cues and gestures being used to help co-located team members give each other shared awareness (Heath and Luff, 1992; Garbis and Artman, 2004). It has been noted that a lack of knowledge about how healthcare interventions are adapted in situ can lead to implementation challenges (Back et al., 2017), which has obvious implications for Hospital at Night as an approach to OoH care.

Importantly, this shared awareness building is often not only more fluid and frequent than that typically envisaged, it is also more likely to be bidirectional. For example, team members on the ground may need to work to repair the understanding of central coordination roles. This can happen when minor changes to the availability of people or resources on the ground have led to changes to plans, which lead to the coordinator's model of the system status becoming out of date. Coordinators, therefore, need to engage in information *seeking* behaviours as much as they engage in information *giving* behaviours and this requires technology with the requisite communication channels and bandwidth to enable such behaviour. Also, coordination costs time and personal resources (Clark and Wilks-Gibbs, 1986; Hoffman and Woods, 2011). The active nature of coordination comes with a workload not just on the part of the coordinator but also on the part of coordinated resources to engage in the necessary behaviours and communications required for shared understanding. This can be most challenging when senior people on the ground do not see the need to check or confirm their actions with those perceived to be in less important coordinating roles; part of Crew Resource Management in aviation and surgery is a deliberate attempt to make these executive decisions more available to all actors (Flin and Maran, 2004).

Technology can play a role in understanding the movements and patterns of clinical staff by sensing and monitoring their activity, such as through Wi-Fi positioning (Pinchin et al., 2014; Perez, Pinchin et al., 2016b) or through the interpretation of 'by-product' data (Perez, Brown et al., 2016a). The challenge, however, is that these types of data are currently purely behavioural and overt – they capture what people are working on and when, not necessarily the contextual factors that have shaped their decisions to take certain actions. Also, tasks may appear to be unanswered in the task log (so called 'legacy' tasks (Royal College of Physicians, 2018)) yet are managed by care staff. Observation studies can help (Brown et al., 2014), but again cognitive activities and

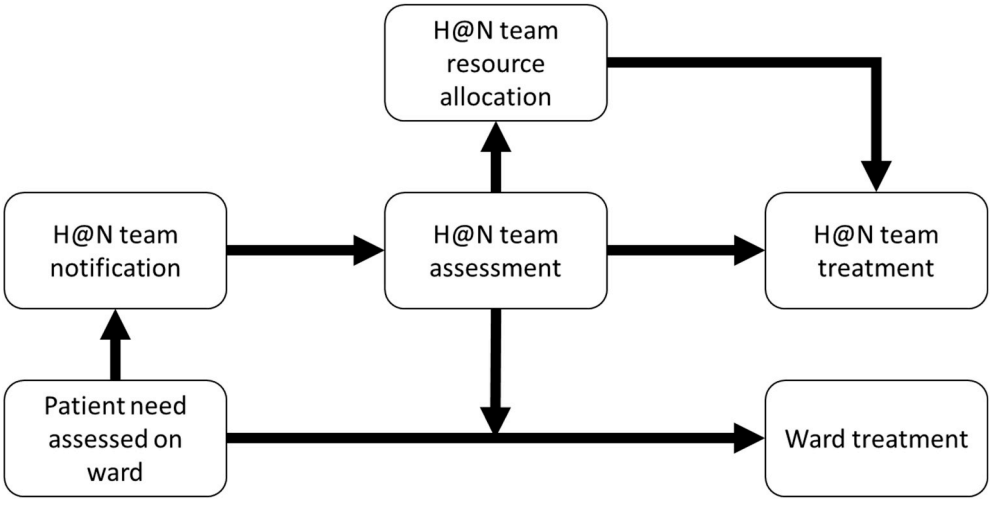

Fig. 1. Example flowchart for treatment of patients needing unscheduled care, adapted from best practice guidance, mapping Hospital at Night (H@N) activities (NPSA 2005, p7, p7).

rationale remain unobservable. Also it is not feasible to collect data simultaneously from multiple people working in a coordinated manner across locations in an OoH secondary care setting.

The following study therefore seeks to understand the factors that shape the coordination of Out of Hours care. It takes the model in Fig. 1 as a starting point, and uses care staff's experiences in coordination to understand decisions that take place for effective management of OoH care resources, and the additional information flows that may occur. As such it offers two key contributions:

1) Filling a critical gap by examining coordination *during* OoH care. This compliments work such McQuillan et al. (2013) to understand *handover* into OoH care.
2) Description of adaptive behaviours that support OoH care. While originally intended to inform the interpretation of objective data such as through Wi-Fi positioning (Pinchin et al., 2014; Perez, Pinchin et al., 2016b), the analysis uncovered tasks, roles and behaviours that were not apparent in the proposed system presented in Fig. 1.

2. Method

2.1. Approach

Eliciting the rationale behind the choices made by actors in the face of different challenges or priorities highlights the ways to effectively manage demands. This is particularly the case in OoH care where routine concerns of prioritisation and workload (Royal College of Physicians, 2018) are exacerbated in the face of new patient needs that might either have been missed at handover or have escalated during the period of OoH care (McQuillan et al., 2013).

To that end, Critical Decision Method (CDM [Klein et al., 1989; Crandall et al., 2006]) is a widely used and well understood method to capture knowledge and constraints relevant to decision-making (e.g. Blandford and Wong, 2004; Wong and Blandford, 2004). By applying a series of structured questions (see Table 1) related to types of knowledge, environmental cues and constraints, it is possible to elicit from experts the bottom-up detail and rationale of decision-making. In order to understand the breadth of decisions undertaken by care staff, the use of CDM was adapted to elicit information regarding any number of decisions that might take place within an event such as an incident or memorable situation. While the approach still uses the same set of questions, and is based in participants' experience of an actual operational occurrence, there was some flexibility in how each decision is documented in favour of identifying all decision points germane to the particular event selected by the participant. Also, while CDM is based around discussion of non-routine incidents, the data on decisions were also intended to express if and how they diverted from the norm, and therefore present a more general picture of practice.

2.2. Participants

Participants were recruited at two large urban NHS teaching hospitals in the East Midlands and North West of England, though the incidents recalled during the CDM interviews did not necessarily take place at those hospitals. This research was conducted with ethical approval from the University of Nottingham and the permission of the hospital trusts.

Participants were clinical staff at the hospitals who were currently engaged in, or had previous experience of, working OoH. Recruitment support was provided by senior clinician gatekeepers who made personal introductions of researchers to clinical staff and distributed information about the study via internal communication channels. Potential participants who expressed an interest were given an information sheet and opportunity to ask questions by the researcher, before they provided informed consent. Participation was voluntary and no monetary compensation for their time was offered. Participants had the option to enter a prize draw.

Table 1
Questions used to probe critical decisions.

Probing Questions
Regarding decision-making:
• What were the possible courses of action you considered? Why did you choose this option?
• What were your specific goals in doing this?
• How much time pressure were you under?
Regarding knowledge and experience:
• Did you seek help at this point? How did you know where to turn for guidance?
• Is this a type of event you're trained to deal with? What training or experience did you draw on?
Regarding assessment and sense making:
• Was this like anything you'd previously experienced? What about that was relevant to this case?
• What consequences of this action did you imagine? How did you think events would unfold?
• How did you feel at this point?
Regarding hypothetical alternatives:
• Can you speculate a bit about ways you might have responded differently in this situation, and how this would have altered the outcome?
• Would someone with more or less experience than you have acted differently? Would they have noticed the same things? How would they know what to do?
• What additional training, information or experience might have helped you or improved the outcome?

In total, 16 participants were recruited to the study, all of whom are clinicians with OoH experience. Six were nurse coordinators: experienced clinicians who oversee and assess care needs OoH, and allocate Hospital at Night team resources (as described above). Seven were doctors completing their training through the NHS Modernising Medical Careers programme, which involves a minimum of 8 years total training time for secondary care. Of the seven doctors interviewed, five were Registrars, which means they have completed two years foundation doctor training, are in the process of undertaking at least six years of speciality training, and are the most senior clinical staff on site in hospitals OoH. This range is valuable because it provides the opportunity to capture differences in patterns of response dependent on levels of expertise. The remaining three participants were Clinical Support Workers (CSWs) who specialise in a limited number of clinical tasks (e.g. taking blood samples) and their role in the Hospital at Night team is to take on these tasks. The role of each anonymised participant is specified in Table 2.

2.3. Protocol

Participants were recruited for individual interviews, lasting no longer than 30 min. The interviews were arranged at a time and place of the participant's choosing at their convenience. Because of the constraints of interviewing clinicians at work in a non-disruptive manner, it was necessary for the protocol to be flexible and adaptable depending on the circumstances of each interview. This meant modifying traditional CDM and condensing the interview procedure to suit the clinical research context.

The interviews followed a prepared script.[1] The first few minutes of the encounter were devoted to briefing about the study and interview process, prior to confirmation of informed consent. Participants were then asked to talk through a memorable OoH incident where resource allocation and coordination was particularly challenging, and to give an indication of the sequence of events, their duration and the length of time between them. While the participant recalled the situation, the researcher converted their description into a timeline sketched on an

[1] The full protocol is available at: https://wayward.wp.horizon.ac.uk/wp-content/uploads/2017/07/Interview-Protocols.pdf.

Table 2
Summary of memorable incidents described by clinicians in interviews.

ID	Role	Incident	Situation Type
CDM1	Coordinator	Cardiac arrest occupies coordinator (and two thirds of the H@N team) for an hour, during which time an alert is received that another patient is acutely unwell.	*Emergency*
CDM2	Coordinator	Coordinator supporting other clinicians dealing with a very poorly surgical patient, when senior staff are unavailable, providing care as well as managing H@N.	*Emergency*
CDM3	Doctor	Time consuming investigations for sick patient in an acute admissions unit mean new admissions and other jobs have to wait and are handed on to the next shift.	*Task management [prioritisation]*
CDM4	Coordinator	Coordinator reflects on helping inexperienced doctors realise a patient with heart failure (acute pulmonary oedema) needs advanced oxygen treatment (CPAP).	*Emergency*
CDM5	Coordinator	While responding to a cardiac arrest and performing resuscitation, a coordinator is alerted about a trauma patient, suspects a major bleed, and organises urgent care.	*Emergency*
CDM6	Doctor	Doctor called to a ward and discovers 9 patients require clerking. Requests assistance from another doctor to complete tasks before the end of the OoH shift.	*Task management [prioritisation]*
CDM7	Coordinator	Busy twilight to nightshift handover for an inexperienced H@N coordinator with a large existing workload and urgent admissions on the stroke ward in particular.	*Task management [prioritisation]*
CDM8	Coordinator	Coordinator managing high workload in a particular area at the start of the shift is confronted by 3 urgent tasks in the same area.	*Task management [prioritisation]*
CDM9	CSW	CSW assigned 24 tasks at the start of a Sunday night shift, some of which are longstanding, making prioritisation (based on urgency, wait length and location) difficult.	*Task management [prioritisation]*
CDM10	Doctor [Registrar]	Requests from wards for Registrar to decide whether a patient can be moved because the bed is required. Must be managed alongside emergencies and junior colleagues.	*Task management [resources]*
CDM11	CSW	CSW has 15 tasks, 3 of which originated the previous shift. The rest of the tasks, of equal clinical urgency, are in a different location and will take 3 h to complete.	*Task management [allocation]*
CDM12	CSW	CSW liaises with counterpart working at other end of the hospital site to respond to urgent tasks being inappropriately allocated by supernumerary coordinator.	*Task management [allocation]*
CDM13	Doctor [Registrar]	Registrar must swiftly plan and delegate care of a sick patient because required to attend and manage successive cardiac arrests. Other senior staff are unavailable.	*Emergency*
CDM14	Doctor [Registrar]	Registrar hands over care of an unclear case to another team, is called away to an emergency, and then another. Recalled to original patient, who has rapidly deteriorated.	*Emergency*
CDM15	Doctor [Registrar]	On-call doctor reviewing a patient with an unfamiliar condition, receives a call about post-op bleeding of an infant patient at another hospital 45 min' drive away.	*Task management [prioritisation]*
CDM16	Doctor [Registrar]	2 patients requiring specialist treatment cannot be moved because no beds are available. Doctor must either keep reviewing them or organise moving them.	*Task management [resources]*

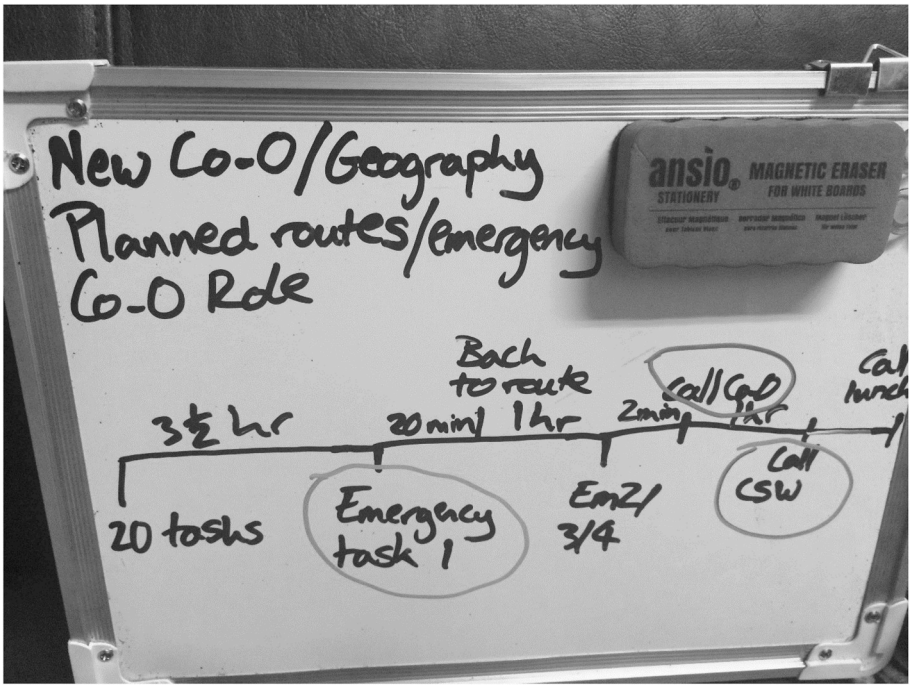

Fig. 2. Example of timeline constructed and decision points identified during interview [CDM12].

A3 whiteboard (e.g. Fig. 2). When this process was complete, researcher and participant reviewed the timeline and agreed on two or three key decision points within the situation (circled in Fig. 2).

The participant was then asked to think about each critical moment in more detail. A set of questions, presented in Table 1, were used by the researcher to guide this discussion, in order to clarify and interrogate the decision, and reveal the cognitive and affective factors at work in that moment. These questions included some final hypothetical alternatives about different actions possible under the circumstances, to elicit information about the significance of experience and training.

Table 3
Decision types (including key constraints and counts); summary of decision type; examples from transcripts.

Decision type	Summary	Examples
D1 - MANAGE WORKLOAD *What is my strategy for dealing with the present situation? How do I plan to meet multiple demands?* **Constraints: Build-up; Multitasking; Sharing workload** Coded in 13 sources (43 references)	• Decision of approach for tackling multiple tasks. • While 'Evaluate Tasks' involves comparison and prioritisation, managing workload is about situation in overview. • How tasks can be efficiently distributed among the clinicians working in an OoH team. • High volume of tasks due to build-up; tasks from previous shift, non-urgent requests or inability to move patients through system. • Often, only way to deal with workload is sharing with other clinicians. • Exchanges depend on roles: registrars delegate, coordinators (re)allocate, inexperienced junior doctors and CSWs negotiate.	' … I had to log onto a computer and try and get the jobs going again because, like, for neutropenic sepsis you only have an hour response time to treatment. If I left it for the full time of the cardiac arrest we'd have missed that window' (CDM1). 'I said well do you mind if I send these north corridor jobs … ? And she agreed to do it. I said look send to me if you get any south corridor jobs' (CDM12). 'It can go on for 5 min if there's beds available, and it can go on for most of the day if there's no beds available' (CDM16).
D2 - EVALUATE TASKS *What should I do now? What takes priority? What will I do afterwards?* **Constraints: Comparison with other tasks; Current Situation; Escalation** Coded in 12 sources (28 references)	• Decision based on comparison of incoming against existing tasks, organised into a hierarchy of urgency. • Placing of task in this hierarchy depends on information availability and interpretation. • Situational factors are described as having an impact on the 'threshold' for giving priority to a particular task; factors include clinical indicators, proximity to patient, nature of treatment, availability of appropriate staff, prior knowledge.	'So I allocated the work and looked at really what was urgent at that time that needed to go to doctors in other areas and what could wait until things had settled down, and the urgent patients had been seen' (CDM7). 'In my head is the fact that I'm with someone that I already think is sick, on one site, and the fact that the other patient's 45 min away' (CDM15).
D3 - ATTEND PATIENT *Do I need to attend the patient? Where is the patient? Is it safe to leave where I am now?* **Constraints: Patient needs; Presence; Staff capacity** Coded in 12 sources (25 references)	• Staff quickly determine where their presence will be most effective. • May choose to stay with a sick patient because they are concerned to keep them safe. • Can depend upon on particular clinical skills, treatment requirements and patient needs. • Also decide to attend/stay based on capacity of other staff at the time: offering support to colleagues, or undertaking tasks when no one else is available.	'It's very hard to leave that situation, somebody acutely unwell, particularly if the cardiologists are busy, as they usually are, so you end up doing a lot more. Like, I had to speak to family twice and make escalation decisions and plans on a patient who was alive and they couldn't get hold of his cardiologist and things, while my patient's sick somewhere else' (CDM13).
D4 - RESPOND TO ALERT *Do I respond? When do I need to respond?* **Constraints: Availability; Follow-up; Time window** Coded in 12 sources (23 references)	• Decision to respond to notification of urgent new task (automatic alert triggered by a high early warning score; bleep from a ward/coordinator for call back). • Alerts themselves are no more than a call to action; the response involves finding out what is going on and what is required. • Difficult to act until current task is under control or completed. • Strategies such as a grace period considered acceptable before a follow-up alert and/or response is expected. • Although there may be complaints from others the bottom-line justification is immediate patient safety and clinical priority. • Because alerts are associated with clinical emergencies, any limiting factors on ability to respond can be a cause of stress.	'I might get an escalation alert on the high EWS, and then I'll wait 10 min for the staff to contact me, because they should contact me, and then I will ring and say, you know, I notice you've escalated' (CDM4). 'So we have to do it, the bed manager or the site manager on call or whoever they are, they give you a phone call, it's not really negotiable. I think the last time I couldn't get to it because there were clinical emergencies which obviously take priority they called the on call consultant and complained' (CDM10).
D5 - HELP AND SUPPORT *Do I need help? Could I offer support?* **Constraints: Hospital at Night; Seniority; System capacity** Coded in 11 sources (37 references)	• Decision to request intervention or support when pressures on individual/system reach a level that additional actors are required. • Unmanageable build-up of tasks within a reasonable timeframe or clinical situation requires escalating to senior clinicians. • Important skill to recognise themselves when they need support; less experienced clinicians can take longer to realise they cannot manage alone; reticent to call on others. Senior roles (registrars, coordinators) rely on ability to direct others to initiate treatment. • Familiarity with OoH means participants know support mechanisms they can utilise; easier when there are pre-existing connections with senior colleagues, or established team relationships.	'The F2 will probably think about it, maybe don't want to be seen as a failure or not coping, and probably would take much longer to come to the conclusion … they're actually needing some help with their other tasks, or actually those other tasks can wait' (CDM4). 'When I was in respiratory I, I phoned up the co-ordinator at the time and asked them, could they just have a look through for the ones with lack of information and just give them a quick ring' (CDM9). 'As you get senior … you get more aware of when you need to seek that advice from someone else' (CDM14).
D6 - GATHER INFORMATION *Do I need to know more? What do I need to know? How do I find out?* **Constraints: Ascertain situation; Collaboration; Role requirements** Coded in 10 sources (18 references)	• Decision whether more knowledge is required in order to determine the correct course of action. • Sometimes staff take initiative to find out necessary details themselves; other times they work through details with colleagues. • When dividing staff or time resources across tasks, available resources and task requirements will determine the best fit under the circumstances. • If existing information about a task is insufficient, gleaning more through conversations can be time consuming.	'[I] came back to the office and was able to sit down with the co-ordinator, …and able to look at the screen and … set up the phone, …you've got all the information and it's easier to actually get through the tasks' (CDM9). '[S]ometimes if I get my alert on the phone and I'm thinking this patient doesn't quite sound right I will actually pick up the phone and just call and say what have you done so far, are you happy, do you want me to come across' (CDM10).

(*continued on next page*)

Table 3 (*continued*)

Decision type	Summary	Examples
	However, it is considered valuable in order to ensure quality of care. • For registrars/coordinators overseeing other staff, can be a matter of checking with clinicians to pre-empt potential problems.	
D7 - COMMUNICATE INFORMATION *What do I need to tell people? Who do I need to tell?* **Constraints: Clinical situation; Liaising; Workload issues** Coded in 9 sources (23 references)	• Decision whether to brief someone else, often because they intend to hand over task responsibility. Details passed to facilitate other people's decision-making and judgement. • Professional conventions/working practices govern procedures for distributing information. Escalation policy dictates more senior clinicians must be told about sick patients. • Sometimes negotiation with other teams of clinicians is necessary, to enlist their support or draw on their specialist knowledge. • When a patient is poorly, the priority is to impart salient clinical details for best treatment. • When managing a high volume of tasks, communication explains delay and confirms nothing has been forgotten or ignored.	'My information to the F1 was, I need you to go to this ward now to see this patient … who came in with this injury and the drain is filling fast …. I will send you on the information' (CDM5). 'I said I'm going to be busy on this side of the hospital …, can any of you take those three for South? If not they'll get done but we might need to ring the wards and explain that there's one of me, and they're in a priority list' (CDM11).
D8 - HAND OVER TASK *Can I pass task to someone else? Is it safe for me to step away now? Is there more I can do? Should I turn my attention elsewhere?* **Constraints: Requesting or requested; Safe hands; Task load** Coded in 9 sources (14 references)	• Decision to hand over task when staff they feel confident that they have done everything in their capacity for a patient. • Can leave them in the care of someone appropriately qualified. Depending on role, participants either delegate tasks (coordinators and registrars) or request that tasks are reallocated (inexperienced junior doctors, CSWs). • Under some circumstances clinicians deal with an uncomfortable task load by transferring some or all of it to other people.	'The ITU registrar followed quite shortly after; [the surgical registrar] was still there …. [T]here was plenty of support, so I felt I could leave' (CDM2). 'I feel bad for the F1 if they've got a lot handed over from me, because it also means that they might have a backlog and then it kind of perpetuates to the next day' (CDM3).
D9 - FOLLOW ROUTINE *Can I go back to what I was doing before? Will things proceeding normally from now on?* **Constraints: Nature of original plan; Safe practice; Shared patterns** Coded in 7 sources (15 references)	• Decide when challenging situation is resolved and it's appropriate to turn to non-urgent tasks. • Clinician may not deviate from established patterns despite emergency, provided safe practice is being followed. • Participants have developed techniques to accommodate their own and colleagues' personal needs within shift. • Be aware and fit with ways other clinicians' work; be seen to do so. • CSWs and coordinators develop more routinized working patterns than junior doctors, possibly due to more predictability and less variety in tasks.	'And as soon as they'd [the doctors] sorted these [urgent tasks] out then we went back to the geography, and I'd highlighted … jobs that they needed to do first' (CDM8). 'I would follow the logical route … of the tasks, unless there was an urgent one or a timed one, then I'd have to come off that route and go and do it and then come back to it' (CDM11).
D10 - ORGANISE STAFF *Who is best placed to deal with this? Who is available?* *What are their skills?* **Constraints: Available resources; Briefing; Responsiveness** Coded in 7 sources (18 references)	• Decision to implement strategy to resolve challenging situation relying on other clinicians. • Only applies to registrars and coordinators, who manage others within OoH care, rather than requesting 'Help and Support'. • Although systems in place for escalation, staff are flexible and responsive to circumstances. • Matching clinical needs to staff available; requires careful briefing about what treatment to instigate. • Staff reorganised in unusual ways compared with normal working.	'I called a doctor off the admission area. We have a vague awareness of admission work but we don't know sick patients, so that is an issue for us, …but I know by taking somebody off … I am leaving two people on there, so you're not leaving that area unsafe' (CDM8). 'So when she came down … she was a bit shocked that there were quite so many who had arrived. Then I just set out what I'd done and said, I've done these two, what we've got left is this, this, that and that …. [W]hat do you fancy seeing?' (CDM6).

2.4. Analysis

The interviews were transcribed and combined with the timelines for analysis, which was carried out in three iterative, deepening stages. First, the incidents described by clinicians were summarised and coded into identifiable situation types with role-specific contributors (see section 3.1). The second stage involved thematic analysis of the data. Primary coding identified specific decision-making instances within the incidents, combining these into general decision types. Secondary coding was carried out within each decision type to identify emergent themes common across participants and incidents (Corbin and Strauss, 2014; Robson and McCartan, 2016; Wong and Blandford, 2002). These sub-themes typically represented constraints on decision-making. At this stage the decision types and their constraints were examined separately and coded uniquely (see section 3.2). The third and final stage of analysis synthesised situation types, decision types and constraints to understand the structure of work within Hospital at Night teams. This allowed actual information flows to be mapped, in relation to the original expected model as shown in Fig. 1, and consistent coordination behaviours to be identified (see section 3.3).

The interviews and analyses were carried out by the same researcher. Another researcher coded the whole sample to check for interrater agreement of decision types and emergent themes. While no formal quantification of interrater reliability was performed, the two researchers collaborated after review to identify a consensual set of decisions (Campbell et al., 2013).

3. Results

3.1. Situation types and role-specific contributors

Table 2 summarises the incidents described by participants. These fell into two types – emergency siutations or task management.

Emergency situations are those urgent clinical tasks that arise unexpectedly in the course of patient care (e.g. cardiac arrest, rapid deterioration in a patient's health state). These incidents are described by

doctors and coordinators, but not CSWs. Although CSWs described dealing with clinically urgent tasks, the type of tasks they are asked to perform (e.g. taking blood samples) do not seem to pose task management challenges in the way that immediate responses to emergencies (e.g. cardiac arrest) impact upon doctors and coordinators. Because Hospital at Night coordinators are senior nurse clinicians they respond to cardiac arrest alongside doctors and cannot oversee other clinical resource allocation until the emergency is over (e.g. CDM2).

Task management situations were typically those where the major challenge was to allocate or organise people or tasks to meet clinical needs in an efficient manner. Some of these situations covered the prioritisation of tasks (i.e. the appropriate ordering of tasks) and are found across the clinical roles examined (e.g. CDM3 for a Doctor; CDM7 for a Coordinator). However, other workload pressures seem to be more particular to certain roles. Two of the registrars interviewed described situations in which the management of physical resources (e.g. beds available in the hospital – CDM10) contributed to challenges associated with their task management. This is apparently a source of tension for these individuals in positions of clinical seniority. Two of the CSWs interviewed described situations in which the allocation of tasks (i.e. the division and distribution of tasks between more than one person – CDM12) presents challenges. This is because they were allocated tasks that were geographically dispersed around the hospital site and could not therefore complete them efficiently. In this clinical support role, the participants have self-imposed expectations about optimal task length and routines for tackling tasks.

3.2. Decision types

All the decisions described by interview participants and included in the timelines of the incidents they recounted were coded. This process produced ten types into which all the decisions can be classified, presented in Table 3. The first column indicates the prevalence of the decision types within the interview data, gives illustrative examples of questions clinicians ask in reaching decisions and indicates the most prevalent constraints associated with decision types. The second column provides thumbnail descriptions of decision types. Findings of the thematic decision analysis are supported by excerpts of data in the third column. Decisions are presented in order of most common types in terms of counts of sources.

3.3. Information flows and coordination behaviours

Finally, analysis of situation types and decision types together supported an overall model of information flow and coordination. Fig. 3 overlays (in grey) roles and activities described in interviews on top of the best practice mapping for Hospital at Night depicted in Fig. 1. This shows the flow of information from nurses on the wards, through to coordinators, who are senior nurse clinicians. Coordinators are the conduit for information to pass to other resources in the Hospital at Night team, in cases where coordinators deem treatment cannot be provided on wards or by themselves. Clinical support workers (CSWs) receive information about set tasks that are their responsibility. Doctors and registrars receive information about clinical tasks based on coordinators' assessment of patient needs. The arrows show both the flow, and direction, of information associated with decision-making about clinical tasks. These illustrate that doctors and CSWs return as well as accept tasks they have been allocated by coordinators, and registrars delegate tasks to doctors.

As the information flows from the coordinator through to various clinical workers, different reflective decisions take place but, additionally, the coordinator engages in responsive, emergency orientated decisions. For example, a coordinating nurse will hear of a critical medical need to add to the coordination list, but decide that the urgency or limited availability of resources requires them to put coordination responsibilities on hold while they go and assist in an emergency situation (e.g. CDM3). Other roles engage in responsive decisions, primarily regarding emergencies and how this affects both the provision of care to the patient in the emergency situation, but also their availability for other potential tasks. For example, ascertaining that a patient's condition is not critical allows a registrar to entrust immediate care to more junior clinicians (e.g. CDM15). Registrars occupy a position of clinical responsibility and, therefore, their decisions have to account for immediate patient needs and also the wider care context within the system as a whole (e.g. CDM10).

The flow of information between clinicians gives rise to behaviours – allowing them to respond pre-emptively to patient needs, to augment their understanding of a clinical task, or to organise among themselves without recourse to the coordinator – which are summarised in Table 4 and discussed below. For example:

- Wards pass on additional tasks to clinicians in person when they are treating patients, and coordinators proactively contact or visit wards to reassure them and offer clinical help [pre-emption].
- Coordinators – and doctors and CSWs via coordinators - require clarification from wards about patient needs [information augmentation].
- Doctors and CSWs collaborate between themselves to organise tasks and task load [self-organisation].

These the three emergent behaviours can be overlaid on to expected Hospital at Night activities (Fig. 4).

Pre-emption refers to tasks being performed that might never make it to a formal task list. It therefore refers to proactive behaviours and actions rather than an anticipatory state of readiness. It is a behaviour that has also been observed occurring when Emergency Departments are under pressure (Back et al., 2017). The obvious example of pre-emption described in our interviews is when coordinators leave the desk in response to a clinical emergency or to go round wards to see if there are any clinical needs they can deal with. Such tasks may never make it into the task management data, therefore existing as 'invisible work' within the Hospital at Night system (Suchman, 1995), and therefore missing from behavioural analysis. Yet work of this nature forms a significant part of both the task demand experienced by the coordinator, and their availability to perform coordination.

Information augmentation refers to communication activities and information flows in addition to, and in support of, the information flow (i.e. task allocation) expressed within the Hospital at Night system. This information flow typically covers supplementary queries about task allocation, patient health state and help required, often (but not always) mediated through the coordinator (e.g. the doctor seeks clarification through the coordinator; the coordinator seeks additional information on patient status from the ward). Though it contains useful information for allocating tasks, this additional communication imposes additional task demands. For example, the lag between alerts arriving at coordinators and being sent out to care staff, or a lag in accepting a task, may not be due to inefficiencies or perceived low priority, but a need for staff to seek additional information to confirm the urgency of work and availability of resource. A response lag on the part of care staff often requires them to send additional information to confirm they are aware of the request.

Self-organisation refers to additional coordination going on after the formal allocation of tasks to clinical staff. This includes clinical support workers collaborating with each other to allocate tasks based on factors such as location, or ease of maintaining a routine. For doctors, several patients might remain concurrently under their immediate care and they will balance load between themselves and their colleagues until they feel confident they can handover each patient in turn. In terms of behavioural data, the constraints that lead to this self-organisation (load balancing, geography of the hospital) explain why care staff act in a manner that deviates from the tasks they are being presented with, and suggests additional optimisation constraints that need to be

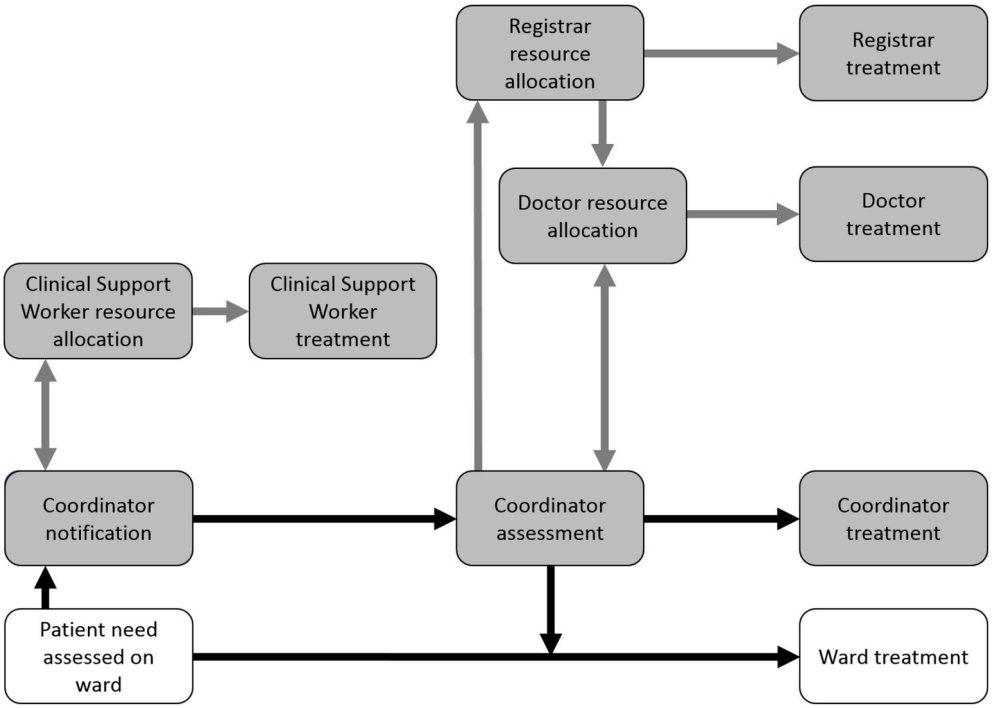

Fig. 3. Mapping Hospital at Night activities including information flows within the team.

Table 4
Summary of emergent behaviours within ooh activities.

Information Organisation	Goals	Socio-Technical 'System' Affordances
Pre-emption	- Maximise efficiency - Proactively control workload	- Clinician location within hospital - Coordinator oversight & clinical skill
Information augmentation	- Improve information accuracy & completeness - Provide reassurance - Correct system mistakes	- Bidirectional communication - Wanting to be 'Eyes on' with patient, to understand status for themselves
Self-organisation	- Adapt to local criteria & specifics of role - Delegate/share tasks - Second opinions	- Sending informal messages and calls - Using the native affordances of handheld mobile devices

reflected in OoH technology.

4. Discussion

The aim of the work was to understand coordination behaviours *during* OoH care. This complements existing knowledge of OoH handover (e.g. McQuillan et al., 2013) and supplements the interpretation of objective data such as through Wi-Fi positioning or task logs (Pinchin et al., 2014; Perez, Pinchin et al., 2016b).

A number of implications emerge from thematic analysis (presented in Fig. 3) of the decision types described by clinicians interviewed. First, there is no single decision that shapes coordination, but rather there are a series of decisions that must take place in order for coordination to take place. For the coordinator, this involves understanding the available resources (D10) and staff capacity (D3) that determine the limits of wider hospital and staff capacity (D5) within the current situation (D2). Also, these decisions are not just on the part of the designated coordinator role, but also shaped by the other roles that are being coordinated. There are additional role requirements and shared patterns shaping coordination across the whole Hospital at Night system. For example, CSWs needed to manage their coordination based on location and how they could group tasks (D9), rather than just on a task-by-task basis. This demonstrates that control and coordination is not linear but is dynamic and interdependent (Flach, 2012), in that allocation is contingent on how other people are already performing the tasks allocated to them. Analysis of decisions, and therefore the use of tools to support decision-making or analyses of observational data, cannot be pinned to one place or one point in time. It also demonstrates that the need for a shared view across roles needs to be maintained beyond handover (McQuilan et al., 2013) and across the whole period of OoH.

Second, information flow is two-way rather than just a simple allocation of tasks. This typically covers availability (D4), individual task load and assistance requested (D8). There is also briefing (D10) from the coordinator back to staff who are raising priority issues, to communicate the nature of the wider clinical situation (D7). This information flow demonstrates the need of the group as a whole to actively maintain the coordinator's awareness of clinicians' workload issues (Woods and Branlat, 2010). Communication is also information seeking to ascertain the situation (D6) and safe practice (D9) regarding specific patient needs (D3). Currently, electronic channels do not adequately support this exchange. There are even instances where a phone call alone is not enough and the coordinator feels the need to go to see a patient and be a physical presence on the ward(s), which involves both time away from coordination and, often, being drawn into actual clinical support. This reflects the needs for more detailed, often perceptual, information required for effective decision-making beyond what can be supported through technology alone (Hutton and Klein,

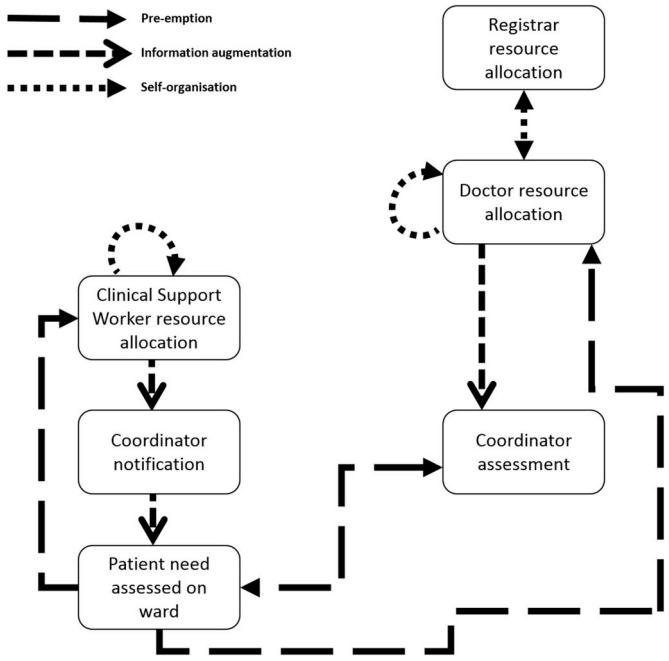

Fig. 4. Emergent behaviours at play in hospital at night teams and activities.

1999). It is possible that requirements analysis based on all communication would highlight at least some information that could be passed via an electronic system (e.g. alongside Early Warning Scores [EWS]), but the need to be 'eyes on', expressed by several participants, means there is always a role for face-to-face communications, and this needs to be supported and resourced.

The need for coordination highlights the issue of task demands. Frequently clinicians were involved in the management of parallel tasks that build-up, requiring multitasking (D1), comparison to prioritise and escalation to senior colleagues as appropriate (D2). One of the unexpected outcomes of the CDM interviews was how much time was spent by coordinators in active support of clinical tasks. Alternatively, registrars felt their clinical responsiveness (D10) was inhibited by the need to make coordination decisions about allocation of beds and progress of patients beyond their immediate care. Both of these illustrate that coordination is not neutral but comes with a cost (Clark and Wilkes-Gibbs, 1986; Hoffman and Woods, 2011): in the case of the coordinators, it is a cost they are not always able to meet, and for registrars as a cost that interferes with the requirements of clinical seniority (D5) and their responsibility to provide safe hands (D8). Processes are dynamic, continuous and exhibit simultaneity, which are key characteristics of complexity (Feltovich et al., 2004). It is also another dimension of interdependency (Flach, 2012), in that the coordinators themselves become part of the equation of which resources are available for care. It also highlights that task and behavioural data derived from sources such as responses to task logs, such as apparently unattended tasks (Royal College of Physicians, 2018), does not always reflect activity on the ground. The implication is that models of resourcing or workload needs to account not just for clinical tasks but also for time and effort spent by all parties (not just coordinators) engaged in the act of coordination. Also, models need to acknowledge the clinical time spent by the coordinator.

Finally, less experienced doctors (and the other clinicians working with them) commented that they lacked the expertise to identify the appropriate time window for a task and when to follow-up (D4), did not have confidence to ask others for additional resources, and could end up in a situation where they were overwhelmed. In this respect, and acknowledging the limitation of training as a simplistic solution for systemic problems, there is a place here for non-technical skills (Flin and Maran, 2004; Gordon et al., 2012, Kodate et al., 2012, Larkin et al., 2014.; Brown et al., 2015). This is most applicable for junior doctors to develop the knowledge of cues and confidence that allow more experienced staff to quickly identify that more resources are needed. This also potentially applies to other staff in how they make themselves amenable to being asked. The reported increase in willingness to ask for help as experience grows suggests positive cultural influence at work.

Other research into healthcare systems under pressure has argued that understanding and supporting system flexibility in response to goals should be considered alongside training in best practice working standards (Back et al., 2017). The overarching aim of this study was to capture factors that shape coordination decision making and would therefore help with the interpretation of OoH behavioural data. For example, one challenge was to understand gaps within task management data generated by the Hospital at Night system, such as when legacy tasks appear to go unattended (Royal College of Physicians, 2018). To that end, the results highlight three emergent behaviours that occur in parallel with the Hospital at Night system and shape how tasks are allocated and managed. These behaviours - pre-emption, information augmentation and self-organisation - are in no way 'failings' of OoH care but, instead, are adaptive ways that users manage the core functions of OoH care, including the Hospital at Night technology and processes, to best fit their current geographical, organisational and situational (i.e. current patient load) context and, therefore, maintain control (Hollnagel et al., 2006). All three are also examples of the kind of hidden or 'shadow' behaviours required for coordination found by Perry and Wears (2012), though they are purely procedural and communicative, rather than being based in any informal artefact.

There are a number of limitations with the current study. First, in the end, participant numbers from each role are small, though participants would often give their perspectives on other roles, not just their own. Nonetheless, building numbers is desirable, and the method has recently been applied with similar roles in a different health trust. These additional data will also help understand the applicability of these results across different OoH care regimes. This is important given that adaptations to Hospital at Night may be local to a given setting (Perry and Wears, 2012). A second limitation is that CDM enquires in relation to particularly memorable, mostly highly demanding, events. The risk is therefore that findings and models are built around atypical events. Anecdotal evidence from discussion both with participants and with clinicians in a project steering role is that the events presented by participants were fairly typical of OoH care.

5. Conclusion

The findings of this study provide an account of the complexity of OoH work and coordination processes among groups of clinicians working in the Hospital at Night system. This extends previous work to understand handover into OoH service (McQuillan et al., 2013) by considering the actual execution of OoH care, and therefore fills a critical gap in the human factors healthcare literature.

CDM interviews have been used to understand the complexity of decisions and information organisation behaviours OoH, which has developed from the implementation of Hospital at Night. Crucially we see that not all behaviours that make the system work are in fact captured by the technical aspects of the system (e.g. task logs). This is most obvious in the case of the coordinator, but all roles engage in supplemental activity to make the coordination system work. In many cases, this comes with its own workload that needs to be factored into any recording or policy of OoH management. Therefore, the reductive tendency (Feltovich et al., 2004) found in describing and designing cognitive systems is also applicable to the observation and analysis of OoH care. As illustrated in Fig. 3, it shows the limitations of relying on a purely linear model of task allocation (both for design, and for analysis of quantitative data) assumed in Fig. 1.

Future directions for this work could involve adaptions to the

system to acknowledge and facilitate bi-directional information flow. A particular gap is identified in when and how junior staff communicate that they need additional support. Also, technical and procedural means need to reflect how the care coordinator also remains actively involved in coordination even when they are also pulled into direct patient care. Any intervention to address these points could then be measured, not only through task management measures (Perez et al., 2016) or positioning data (Pinchin et al., 2014) but also through performance measures of care (McQuillan et al., 2013).

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