Interactional misalignment in the UK NHS111 healthcare telephone triage service

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Abstract

Background: A recent review of primary care serious incidents suggests that diagnosis and assessment problems, underpinned by communication failures, involving the UK telephone triage service, NHS111, may contribute to patient harm.

Methods: The present study utilised conversation analysis to address the lack of evaluative research examining the NHS111 system and in particular interactions between system components (e.g., call handler, computerized decision support system, patients/caller).

Results: Analysis of audio recorded call interactions revealed interactional misalignment across four mapped call phases (i.e., eliciting caller details, establishing reason for call, completing the Pathways assessment, and agreeing the outcome). This misalignment has the capacity to increase the risk of system failure, particularly in relation to assessment problems and issues related to the accurate transfer of care advice. Our analysis suggests that efforts to enhance the NHS111 system, similar telehealth services, and patient safety management more generally, should shift their focus from a limited set of individual components towards a system-specific interactionist perspective encompassing all elements.

Conclusions: Further evaluative research is required in order to build a comprehensive evidence-base concerning the multiple interacting factors influencing patient safety in the NHS111 system.

KEYWORDS: NHS111; computerized decision support; conversation analysis; patient harm; interactional misalignment

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1. Introduction

Telehealth services are an increasingly common facet of contemporary healthcare, with use rising steadily in recent years (Lopriore et al., 2017). Services available over the telephone include those typically offered in the more familiar context of primary care consultations, for example, triage, physical assessment, and treatment recommendations. The key difference between telehealth services and traditional consultations is the absence of physically co-present (face-to-face) patient-healthcare interaction. One of these services, telephone triage, is a process by which people with a healthcare problem are given advice or directed to another relevant service via telephone (Bunn et al., 2005). Telephone triage is used internationally, primarily as a strategy to reduce the increasing workload on primary and emergency care (Bunn et al., 2005; Murdoch et al., 2015; Salisbury et al., 2007; Turnbull et al., 2017). Despite the growing popularity of telephone triage systems, research evidence suggests that inherent communication problems between callers and healthcare professionals may compromise system functionality and, in some circumstances, increase the risk of negative patient outcomes (e.g., Murdoch et al., 2015; Rees et al., 2017; Turnbull et al., 2017).

The present study aims to address the need for a better understanding of latent system risks in the UK NHS111 urgent healthcare telephone triage service, a recommendation proposed by recent research (see Rees et al., 2017; Turnbull et al., 2017).

NHS111 was conceived as a means of providing a centralised entry point to the NHS in England to provide clinical assessment and direct callers to the most appropriate service for their needs (Department of Health, 2008; NHS England, 2013). Rolled out nationally in 2014, NHS 111 uses predominantly non-clinical staff to gather patient

symptom information using clinical questions generated by a Computer Decision Support System (CDSS) called '(NHS) Pathways'. The CDSS evaluates the symptom information and the assessment concludes with a 'disposition' that determines the clinical care needed and the time frame in which this is required.

A comprehensive analysis of primary care patient safety incident reports involving sick children, recorded on the National Reporting and Learning System for England and Wales over an eight-year period found that incidents implicating failures in diagnosis and assessment (including triage) were the most harmful to patients (Rees et al., 2017). Of the 659 incident reports related to diagnosis, assessment and referral, 60% were from NHS111. These types of incidents resulted in the most severe patient outcomes, including 10 deaths, 15 cases of severe harm, and 69 instances of moderate harm. The largest proportion of diagnosis and assessment incidents involved inadequate triaging (52%). In the context of telephone assessments, and specifically relating to NHS111, the study found that the contributory factors underlying these incidents were related to "protocolized" medicine. The authors describe incidents arising from non-clinically trained (NHS111) telephone health advisors choosing the wrong protocol on the computerized decision support system (CDSS), or not using the protocol correctly. Protocols themselves are described as inadequate in a number of analysed incident investigation reports in which, according to the investigators, health advisors (telephone operatives) failed to recognise the seriousness of a patient's condition. Rees et al. (2017, P.14) note that "in the event of staff failing to follow protocols, or the protocols failing to adequately assess the urgency of a child's condition, staff were criticized for not using critical thinking, despite not having any clinical training."

Of 177 communication-related incidents identified by Rees and colleagues, 33 cases (19%) were harmful, including two involving severe harm. Rees et al. (2017)

identified that the majority of communication failures arose during interactions with NHS111 (58%). Miscommunication was frequently implicated as a contributory factor in incidents involving diagnosis and assessment, with examples including ‘inadequate safety netting’, and ‘providing the wrong advice, or not clearly communicating the correct advice’.

Rees et al. (2017) conclude that there is a need for a robust evaluation of the effectiveness of NHS111, for children in particular. Alongside the conclusions and recommendations made by investigators in their serious incident reports relating to NHS111, Rees et al (2017) also implicate the Computer Decision Support Software (CDSS) and/or the poor situational awareness of the human telephone operator. In line with the suggestions of previous researchers (e.g., Graber et al., 2012; Singh et al., 2012), emphasis is placed on CDSS developers to improve the sensitivity and specificity of assessment algorithms for particular populations and provide alarm flags to alert users to the potential for error at a given point (e.g. to gather more detail about symptoms to avoid the use of the wrong triage protocol). Additional recommendations aim to address the so-called absence of ‘critical thinking’ on behalf of NHS111 call handlers (known as ‘Health Advisors’) described as a contributory factor in many telephone triaging incidents. Rees et al. (2017) label this as a lack of ‘situational awareness’, which they define as insensitivity to operations or failing to “know what is going on”. They suggest that health advisors (HAs) should engage in human factors training (about situational awareness) and be encouraged to recognise and act when the outcomes of CDSS protocols seem inappropriate. Together with improved CDSS protocols their study suggests that situational awareness enhancement may mitigate the risk of non-identification of sick children in need of care escalation.

While the first of these suggested solutions to improve clinical protocols and technological developments to CDSS is supported by systematic reviews (Kawamoto et al., 2005; Randell et al., 2007), the onus on the call handler to become more aware of, and act, when faced with potential risks does not consider the parameters and restrictions imposed by the design of the NHS111 system. Also, this conceptualisation of situational awareness as an individualistic cognitive phenomenon residing in a person's head is only appropriate if the socio-technical system under analysis can be usefully regarded as normative, closed loop and deterministic (Stanton et al., 2017). The NHS111 system does not possess these characteristics.

The broader introduction of new technology in a bid to aid (clinical) healthcare consultation is seemingly ill-founded, relying on certain philosophical and epistemological principles. First, it adopts a positivist perspective (Coiera, 2003; Kaplan, 1997) which implies a linear relationship between the system nodes, i.e., the healthcare worker, the technology, and the patient. This perspective assumes that the technology holds the knowledge that the 'user' (the healthcare worker) must access and transfer to the patient. Adopting this approach, much of the health informatics literature concludes that the use of technology in this way promotes rational, efficient, and safe consultations, with the prerequisite that the medical knowledge held by the technology is kept up to date (Coiera, 2003). Second, the systems assume communication is fundamentally a transactional process, where information can flow in a straightforward way between the knowledge holder and the user. From a design perspective, the structure of the social interaction that constitutes the call then becomes secondary to the information that is imparted through the call, or the standardised prompts that are used to elicit information from the caller.

The NHS111 system was designed according to the same positivist and transactional philosophies. The principal aim is to reduce human error and minimise risk

by standardising and monitoring triage and interactional practices, confining it to clear rules or decision sequences, informed by encoded expert knowledge (Turnbull et al., 2017). However, research studies using qualitative methods to study the operational reality of triage consultations, have questioned whether technology can successfully standardise patient-provider interactions. Ethnography has revealed that call handlers are not merely 'trained users' of triage technology (Turnbull et al., 2012) but are active managers of system risk (Turnbull et al., 2017). These researchers suggest that the technology (NHS Pathways), rather than controlling risk, can generate uncertainty via the Computer Decision Support System. Standardisation embedded in the software works on the premise that patients' symptoms of ill health can be efficiently elicited and aligned with the CDSS to produce a depiction that accurately reflects the reality of the patient experience. Studies of clinically trained nurses using CDSS have shown that often this is not the case. These studies show that when using the CDSS during telephone triage, they are constrained by the system, which requires them to reduce the patient's problem to one or more individual symptoms that fit the structure of the CDSS input strategy. This does not necessarily match the patient experience. A conflict arises between the CDSS as a 'fixed measuring instrument', standardised with the aim of providing a consistency across cases (Boyd and Heritage, 2006), and real-time interactional concerns created by patient and caller handler. Pooler (2010) describes the additional requirement to continually address this conflict as the 'hidden labour' of telephone triage. Murdoch et al. (2015) refer to the manifestation of this hidden labour for nurses and patients, as disruptions to 'interactional workability' (May et al., 2007). According to Pappas and Seale, (2010) telephone triage using CDSS is considered unfamiliar for both patients and nurses and is typified by vague boundaries, rules and communicative expectations.

Research suggests that during calls, nurses spontaneously tailor standardised CDSS scripts in order to overcome problems in interactional workability. They use their professional expertise and autonomy to manage the range of possible contingencies that can occur during telephone consultation, and after a short time, use knowledge of the CDSS to pre-empt the 'rules' and override standardisation (Greatbatch et al., 2005). The mitigation of risks associated with CDSS standardisation is significantly burdensome for clinical trained professionals (Greenhalgh et al., 2009; Murdoch et al., 2015), however, they possess the requisite status, experience and autonomy to take on this extension of their face-to-face responsibilities. Non-clinical call handlers working in the NHS111 service do not possess the same skills or experience, yet they still face interactional workability problems and have significant accountability for system risk (Turnbull et al., 2017). While they have some autonomy in the process of handling calls, which places the onus on them to manage risk, they do not have the 'protection' of clinical expertise.

There is a clear need for further research on the latent risks involved in NHS111 operations. Based on a review of serious incidents involving sick children, Rees et al. (2017) highlighted that NHS111 diagnosis and assessment problems underpinned by communication failures contributed to patient harm. Alongside recommendations to improve CDSS protocols, it was also suggested that non-clinical call handlers improve situational awareness (an individualistic cognitive construct) through training. Based on a review of the literature, including in-depth qualitative methods studies it is apparent that this recommendation does not consider the inherent complexity of context and the ambiguities of ambient uncertainty in the NHS111 system. Research suggests that standardisation imposed by the CDSS can result in interactional workability problems. Although the emphasis is on the NHS111 operative it is likely that this is a system generated problem resulting from the interaction between the patient, the call handler and

the CDSS. Without fully understanding the communicative practices within the NHS111 system it is unclear whether training interventions directed at one system actor will mitigate risk.

A number of studies have used fine-grained qualitative analysis approaches to assess interactional workability in systems involving clinically trained call handlers using CDSS for triage and patient helpline advice (Lopriore et al., 2017; Murdoch et al., 2017). Turnbull and colleagues (Turnbull et al., 2012; Turnbull et al., 2017) have also investigated the work of non-clinical call handlers. However, despite the claim that communication problems are rife (see Rees et al., 2017), no studies have explored interactional workability issues at NHS111, by investigating the interface between system actors; the CDSS, non-clinical NHS111 call handlers, and patients (and/or third-party callers).

The present study aims to fill this research gap. To do so, we apply the inductive, and qualitative method of conversation analysis (CA) to examine NHS111 interactions in detail (see Hutchby and Wooffitt, 2008; Wooffitt, 2005; Sacks, 1994). CA initially emerged within sociology, and has its roots in ethnomethodology, a radical social theory which conceptualises 'society' as formed bottom-up through the minutia of everyday human action and interaction (Heritage, 2009). CA therefore necessitates adopting a specific theoretical perspective on human interaction. Here, "interaction" is understood as pervasively action-oriented, dynamic, collaborative and bound to local context, with participants in that interaction both upholding and demonstrating the context-specific social norms associated with any given social circumstances (Heritage, 2005). Such a bottom-up and micro-focused theoretical position on interaction differs from the transactional perspectives which typify much work on human communication. As discussed above, a number of potential issues with the use of a CDSS relate to the arguably reductionist assumption that communication is a relatively simple, transactional and linear

process which can be reliably standardised by use of scripts or protocols. Conversely, decades of empirical CA research have demonstrated the rich layers of complex, nuanced and contextually-specific norms that constitute human interaction, which are in turn actively and variably attended to by speakers depending on the specifics of their moment-by-moment context (Antaki, 2011).

Given this theoretical perspective on human social organisation and action, it follows that CA is a qualitative method that avoids generalisations and instead involves detailed micro-analysis of exemplars of recordings of interactions. Analysts favour use of so-called "naturally occurring" data, which broadly refers to recordings of phenomena that would have occurred regardless of the involvement of a researcher (as opposed to, for example, laboratory-based interactions, or simulated/scripted conversation and/or roleplay) (see Sacks, 1994; Kiyimba et al, 2018). CA research then aims to identify sequential structures within those interactions that are demonstrated as meaningful by the participants in those interactions themselves. To provide a basic example, a turn by one participant can be considered to be a "question" if sequentially followed by an answer by another participant or, if an answer is absent, by an attempt by the first speaker to repair any misunderstanding. From this perspective, every turn taken in an interaction simultaneously reflects a speaker's understanding of the action of a previous turn, and projects for certain responses and/or constrains the following turns taken by others (Bilmes, 1992).

When applied to interactions in so-called "institutional" settings, CA has helpfully elucidated features of talk between professionals and clients that may have previously been overlooked. Amongst other applications, CA has been extensively used to examine healthcare interactions, including in primary care contexts (Heritage and Maynard, 2006). Such work has demonstrated the inevitable asymmetry of professional-client interaction, and indicated some of the tacit understandings and misunderstandings that can emerge in

communication contexts where one speaker has different communicative rights to the other. CA has also been used to examine communication underpinned by CDSS protocols. For example, Murdoch et al (2015) used a CA-based approach to examine nurse-led telephone triage interactions. Having mapped standard 'phases' in the triage calls, their analysis of the organisation of each phase demonstrated that nurses using CDSS must on one hand animate context-insensitive scripted questions to fit the interaction, whilst on the other reducing the verbally-presented patient presentation to a small number of key symptoms which fit with the CDSS system. These sometimes incongruous demands could result in *misalignment* at moments of uncertainty, characterised by instances within a call where the patient and nurse were, to an extent, talking at crossed purposes or pursuing different interactional agendas. As the authors note, such misalignment could "result in healthcare professionals unwittingly encouraging a reduced understanding of patient concern or perspectives […] lack of uptake of advice, poor adherence and reduced help-seeking behaviours" (p46). Given the elevated levels of clinical risk potentially present in NHS111 calls and their outcomes, it becomes a priority to identify how similar issues may play out through use of this system.

Following Murdoch et al. (2015), our objectives are as follows:

1) To identify common points within the NHS111 call protocol where the resultant interactions appear vulnerable to misalignment.

2) To explore the consequences of this misalignment for call outcome, in reference specifically to the clinical assessment and therefore the risk of system failure.

2. Methodology

2.1. Design and analysis approach

We applied a qualitative approach based on principles of conversation analysis (CA) to a cross-sectional corpus of routinely-recorded NHS111 telephone conversations.

2.2. Data collection and management

The study, in fitting with CA's commitment to naturally-occurring data, used anonymised voice recordings of NHS111 calls, with an offline version of the triage tool (Pathways version 10.0.1) available to researchers to aid understanding of the system. Data were extracted by a regional provider of the NHS111 service, from recordings archived on the Avaya telephone system and Adastra platform which hosts the NHS Pathways triage record. The NHS111 provider collected the required data, implemented anonymisation, and supplied materials securely (via an NHS password protected email account) and directly to the research team. Appropriate ethical permissions were sought by the provider (via NHS research governance procedures) and the researchers (via Leeds Beckett research ethics processes) prior to study commencement.

A striated sample of calls was used in this study. The data provided to the research team by the NHS111 provider were as follows:

1. All serious incidents from the 2 years prior to data collection (from 1st March 2014 to 29th Feb 2016) with associated pathways assessments, event lists, and reports. A serious incident, or an incident requiring investigation, is defined as an incident that occurred in relation to NHS-funded services and care resulting in unexpected or avoidable death, harm or injury to patient, carer, staff or visitor (NHS England).

2. Of all other calls received from December 1st 2015 to January 31st 2016 (2 months) 10 calls across each of the following time points (40 in total). These were

purposively sampled by the provider to generate variation in the Health Advisor answering the call, the call duration, and its outcome:

a) 'In-hours' weekday (Mon 0800 – 1830; Tues 0800 – 1830; Wed 0800 – 1830; Thurs 0800 – 1830; Fri 0800 - 1830)

b) Out-of-hours weekday (Mon 1831 – Tues 0759; Tues 1831 – Wed 0759; Wed 1831 – Thurs 0759; Thurs 1831 – Fri 0759)

c) Out-of-hours weekend day (Sat-Sun 0800 – 1830)

d) Out-of-hours weekend night (Fri 1831 – Sat 0759; Sat 1831 – Sun 0759; Sun 1831 – Mon 0759)

2.3. Analytic procedure

CA is a resource intensive methodology, which typically requires extensive transcription and detailed analysis of large datasets. Given this, an expedited and iterative approach was applied in this study to enable a broad examination of the call corpus prior to detailed CA analysis of a subsection of calls. This approach enabled us to map the overall structure of NHS111 calls, whilst creating collections of fragments of call recordings that were demonstrative of the key analytic themes.

The research team first conducted a detailed listening exercise consisting of an initial sample of five calls. The aim of this step was to produce an initial map of call structure, which could serve as a framework to guide subsequent sampling and analysis. From this framework, a template (a "critical listening summary"; see Branney et al., 2012) was designed through which to guide a first pass through the data. While listening to an audio recording of the case, the researchers used the critical listening summary to summarise what occurred, providing illustrative quotes and notes (See Appendix 1 for the

critical listening summary template). Two of the team with significant experience of qualitative research (TM and PB) piloted the framework with 8 calls randomly selected from the main corpus and subsequently ascertained reliability through detailed cross-comparison of notes. The remainder of the corpus was then subjected to critical listening in order to build a collection of examples of particular interactional, sequential phenomena across the calls.

Calls were then considered against one another in detail, underpinned by examination using the CA approach, in a cross-case analysis. The researchers read all of the critical listening summaries and used these to direct detailed transcription and analysis of sections of calls. These were compared in close turn-by-turn detail, drawing on the CA perspective, in order to map the variation and consequences of key interactional phenomena common across the dataset.

3. Findings and discussion

The initial stages of the above process generated a prototypical map consisting of four phases for NHS111 calls, which is illustrated below as figure 1. This structure is significantly constrained by the Pathways system; as discussed in the introduction, modern telehealth protocols frequently rely on standardization to reduce risk. In this case, Health Advisors are required to move through the specific phases documented on this diagram and are provided scripts for the statements and questions that open each phase and serve to transition between them. These scripted utterances and the call structure more broadly are intuitive to the call handler, because each is dictated and constrained by the required order of data entry into the Pathways system which the call handler uses while interacting with the caller. Conversely, callers interface exclusively with the call handler rather than the Pathways system, and therefore must rely on the interactional behaviours of the call handler to identify transitions between call phases and ascertain the outcomes required of

each phase. However, the Pathways script provides little explicit signposting to callers about the structure of the calls, transitions between phases, the outcomes required from each phase, or the role of the Pathways system in the interaction.

[Insert figure 1 about here]

As will be discussed below, a frequent feature of analysed calls was a 'lack of fit' between (a) callers' interactional behaviours, and (b) the outcomes required in the corresponding call phase as pursued by the Health Advisors. This lack of alignment between caller and call handler emerged both as a function of the overall call structure, but also because of issues in relation to the interactional behaviours of the call handlers, most notably in relation to the semi-standardised utterances used within the Pathways assessment. Such misalignment had different consequences in different calls, but sometimes generated subsequent issues in relation to data flow between caller and call handler, within and across call phases. For example, during the final call phase such misalignment may lead to the non-transfer or misunderstanding of important procedural or medical advice (e.g. actions to be taken in light of current or worsening symptoms). Additionally, across all call phases data flow issues could be seen to influence the outcome generated by Pathways, the principal function of the system. In other words, problems with misalignment between callers and call handlers directly (but in a complex manner) impacted upon the call outcome. These issues, therefore add significantly to system failure risk.

In our analysis we identified that misalignment occurred within and across the call phases:

<u>Call phase 1 – Eliciting caller details</u>

Call phase 1 is the opening of an NHS111 call. Within the Pathways system, the principle objective in this phase appears to be transactional: it is at this point in the call that caller details (including location) are confirmed. Accordingly, all calls began with an immediate transition by the call handler, following a greeting, into caller details elicitation phase which is primarily constituted by open, information-soliciting questions. Given the organisation of the Pathways system, it is intuitive for the call handler that they should move straight into the first call phase in this way, and operationally, this is of clear importance. However, such a call structure overlooks the typical social function and organisation of everyday call openings. In previous conversation analysis work on telephone services, it has been consistently demonstrated that openings can impact upon subsequent co-operation between participant and be predictive of interactional outcome (see Leydon et al, 2013).

There are two notable features of the NHS111 call opening. First, there is an absence of 'typical' reciprocal greetings that are normative in social interaction. Second, the call handler's first question is also not normative: in the vast majority of telephone calls, callers provide a reason for the call very early in the interaction (Schegloff, 1986). This includes during telephone consultations with doctors, where patients will disclose a medical query or problem within the first few turns of the call once the identity of both parties is established (Hewitt et al, 2010). However, during an NHS111 call, we noted that the caller is not positioned to provide their reason for contacting the service until the second call phase, which in reality occurs some minutes into the call. This frequently led to callers providing their reason for the call during phase 1, at which point the call handler and Pathways system were unable to receive it. Extract 1 provides an example. Here, the caller (C) discloses their reasons for contacting NHS111 to the Health Advisor (HA) very early into the call (lines 9 onwards):

Extract 1 (case 71934)

1	HA	Evening, you're through to the NHS 111 service,
2		you're speaking to <name>, a health advisor.
3		Can I start by taking a contact telephone number, please?
4	C	<Phone number>
5	HA	Thank you and confirm [recording cuts] -
6	C	Yeah.
7	HA	Thank you, are you calling for yourself or somebody else?
8	C	No, I'm callin - I'm calling for my partner,
9		**the ambulance come out to him last night and, um,**
10		**because he's on morphine they said he's having a withdrawal.**
		(10 lines of further explanation about problem cut)
21	HA	OK. Have you tried ringing the ambulance?
22	C	No, not yet I haven't, I don't know who to ring.

Whilst the caller's disclosure *interactionally* fits the prior closed question by the call handler, it is misaligned with the Pathways-dictated call structure. In this instance, the long and emotive early disclosure by the caller leads to a derailing of call phase 1 (see HA's response in line 21) and generates data flow problems when finally transitioning into call phase 2. Hence, the ill-fittedness between the structure of openings of NHS111 calls and normative social conventions around how telephone conversations are organised becomes a dynamic factor adding to the risk of system failure. This feature of the NHS111 call distinguishes it from other healthcare telesystems that have been examined by CA. For instance, Lopriore et al. (2017) describe an Australian system with similar objectives to NHS111 that begins with a socially normative sequence, which includes the caller being prompted to provide an opening reason for contacting the services.

Call phase 2 – Establishing reason for the call

Call phase 2, as noted on figure 1, is of importance as it is the point at which the caller is provided with the opportunity to explain their reason for contacting NHS111. The discussion that takes place within this phase enables the call handler to initiate the Pathways assessment and tacitly agree its focus. As in phase 1, this is structured as if transactional: call handlers typically initiated the transition from call phase 1 to phase 2

using a general, non-specific and open-ended question form such as "*can I just take a brief reason for the call please?"*, to which callers are required to provide an answer that ultimately can initiate assessment. Once again however, whilst this may make sense operationally, from an interactional perspective it is noteworthy that such questions provide very little constraint or direction to callers about what kinds of "reasons for calls" might fit the NHS111 call structure and the Pathways system. Callers are positioned to provide an extremely broad range of answers which, whilst *interactionally* fitting the transition turn, may fail to provide appropriate information for initiation of a Pathways assessment. The call handler is therefore placed in a position of individual responsibility to convert a (possibly misaligned) reason for calling into a 'problem' that fits the system. This conversion plays out through interaction, and hence, interactional factors again become a significant dynamic factor in system failure risk. Consider extract 2, where a parent has contacted NHS111 about symptoms demonstrated by their child. This reflects a straightforward call, where phase 2 was resolved in a relatively short duration. Here, the caller spontaneously provides a reason for calling that presents acute medical symptomatology, and the positive responses of the handler suggest that this fits the Pathways system. For clarity, sections of both caller (C) and call handler (HA) turns that are specifically related to acute presentation have been emboldened:

Extract 2 (case 77141)

1	HA	Lovely, OK, how can I help?
2	**C**	**Um, he's woken up with a really bad ear...ache**
3		**and I gave him the maximum dose of Calpol...**
4		**so 10ml an hour ago but it's done nothing,**
5		**and he seems really distressed.** Um, he's been poorly the
6		last 3 days, he's had diarrhoea,
7		tummy bug but he's been absolutely fine in himself,
8		um, he's been drinking lots of water and up until,
9		um...tonight, he's been eating dried toast and stuff
10		but I - I think I'm - I've sort of made a decision that
11		actually he probably just needs to just stick to water now.
12	HA	Okay
13	C	The bug's just not going, but...

14	**HA**	**OK, right, but at the moment it's the earache that's causing**
15		**you the most concern, is it?**
16	C	Yeah.
17	HA	OK, what I need to do then is go through an assessment
18		with you, OK?

Despite this call being relatively straightforward, note that even here C discloses a reason for calling between lines 2 and 11, only the first part of which (lines 2-5) relates to acute symptomatology. Accordingly, in lines 14-15 HA can be seen to repackage the caller's reason for calling into an acute problem. This is delivered as a closed question, enabling the caller to agree or disagree subsequently with this glossing. Following agreement, the call handler then transitions into the Pathways assessment in lines 17-18.

In contrast, the longest instances of call phase 2 were where the initial presented reason for contacting NHS111 required more extensive reformulation on the part of the call handler. Examples of calls that appeared complex (based on the call handler's behaviour) included medical issues not relating to acute symptomatology or the emergence of a new condition; complex situations encapsulating social and/or wellbeing issues in addition to potential medical factors; and calls where the reason for the individual calling was unclear, or inconsistent across the interaction. For instance, in extract 3 the caller's initial reason for contacting the service (a faulty nebuliser) is not accepted immediately by HA (line 3), who after some discussion ultimately focuses on the elements of the caller's account that could be packaged as acute symptoms (breathing difficulties: see emboldened text):

Extract 3 (case 26938)

1	HA	How can I help? What's the reason for the call today?
2	C	Well because my nebuliser's packed up
3	HA	Right
4	C	And er, well, I haven't got one to use, look,
5		I've got my inhaler and he's got a lot of goods for me,
6		I use them four times a day, you see 'cos of my COPD and I've
7		got it very bad. I've been in bed for nearly a year,
8		can't do anything, **I can hardly walk because my**
9		**breathing's so bad.**

10	HA	Right. O.K. Right. Have you not been in touch …
11		who supplies this? Is it your gp surgery that supplied it?
12	C	Is it my gp is it?
13	HA	I don't know. Is that who supplies your nebuliser?
14	C	Well, not before. It was the hospital who supplied it.
15		It was really bad, so I got another one.
16	HA	Oh O.K. Right. Right. O.K.
17		**And how long have you been breathless like this?**
18	C	Oh I've been breathless, I'm always breathless my love but
19		I'm, I've been more breathless (inaudible 2 words) these last
20		two days than I have for a while.
21	HA	O.K. Bear with me a second … O.K.
22		**And you're really breathless all the time, aren't you?**
23	C	Yes, Yes.
24	**HA**	**Right. O.K. Have you been bleeding at all from anywhere**
25		**in the last half an hour?**
26	C	Have I been what, darlin'?

Conversationally, C's answer in line 2 above fits the prior question. However, HA's responses indicate that it does not fit the requirements of this call phase, meaning that an elongated sequence follows. First, in lines 8-9 the caller makes some reference to a potential acute medical condition, although this appears to be deployed as a justification for calling (i.e. reinforcing to HA why a broken nebuliser represents a 'problem'), rather than being packaged as a reporting of symptoms in their own right (see Heritage and Robinson, 2006). This leads HA to first discuss the nebuliser, before ambiguously shifting to breathing difficulties (lines 16-17), and then commencing a Pathways assessment without transition (line 24). Across this sequence, agreement is not ratified between the caller and call handler about what should be assessed. The call ultimately unfolds into a complex, extended call based around assessment of breathing difficulties and, ultimately, an ambulance call out. However, the caller appears not to have contacted the system about breathing difficulties in the first instance, and it was the flow of social interaction that led to these being foregrounded.

Finally, we noted a particularly significant specific risk associated with misalignments between caller and system in this phase. These arise because the very open and non-specific question produced by the call handler at the beginning of this call phase

could be interpreted as a general "opener" to a subsequent clinical assessment (see Heritage and Robinson, 2006), when in actuality it is pivotal to the direction of subsequent assessment. In this case, a caller may reasonably hold back certain pieces of critical information in favour of providing a conversationally fitted and overly broad answer to the question. This appears to have potentially been a factor in one Serious Incident (SI) that we examined. Here, a third-party caller did not disclose a critically relevant pre-existing health condition on the part of the patient:

Extract 4 (case 41904)

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1 HA   Could you give me a brief reason for the call please.
2 C    Okay she's come home from school and she's obviously found like that
3      she has no energy and felt sick, and ever since she's like nearly
4      almost constantly been sick all the time erm she hasn't had nothing to
5      eat and every time she has water she brings it back up erm and now
6      she's saying she can't balance properly and erm her vision keeps going
7      blurry?
8 HA   ok so she came home from school no energy [and
9 C                                               [yeah
10     and feeling sick (.) oh bad belly sorry
11 HA  anything she's could have had to bring this on?
12 C   erm I asked her if she's had anything at school and she said no so I
13     haven't got a clue to be honest
```

What above appears generic and non-serious symptoms were, in this case, indicative of acute medical emergency given the third party's existing health condition. On examining the whole call, it became clear that the crucial point of the interaction where a disclosure of this was required was during call phase 2, as at no point during the subsequent Pathways assessment were they asked for this. It may seem surprising that the caller did not spontaneously disclose such critical information. However, as noted above, it was *interactionally* appropriate for the caller to omit this if treating this question (with its here-and-now focus on "reasons for calling") as an opener to a subsequent detailed assessment.

In this phase then, it has been demonstrated that the standardized prompts used by the call handlers appear to open an interactional space where callers can respond in a manner that does not fit the system requirements of the phase. The opening question of the phase is pivotal in this process. This finding strongly indicates that modelling standardized questions as merely transactional overlooks dynamically emerging factors that emerge from the norms of social interaction rather than the system per se. An additional important factor is that the first line of NHS111 call handlers (HAs) are not clinicians and are therefore trained to closely follow CDSS prompts. In Murdoch et al's (2015) study of a nurse-led telehealth system, clinicians were shown to demonstrate discretion when potentially dissonant outcomes emerged from the diagnostic system that they were using; here however, the call handler is not positioned to do so, which arguably elevates the risk of system failure in these circumstances.

Call phase 3 – Completing the Pathways assessment

Call phase 3 comprises the Pathways assessment process. Therefore, its structure is both variable (depending on the selected pathway), but also strongly constrained by the system. Following call phase 2, the call handler transitions into the remainder of the Pathways assessment process using a semi-standardised form of words such as "*I'm going to ask you a series of questions. Some of them might not seem relevant but will enable me to complete a thorough assessment today and get you the appropriate help [for the patient]*". The Pathways assessment then proceeds through a series of closed polar (yes/no/unsure) questions, which are presented on the screen to the call handler. The early questions in call phase 3 relate to assessments of potentially urgent or life threatening conditions, and become increasingly more specific as the assessment continues.

Call phase 3 varied significantly in length across the cases we examined. Some of this variance reflected differences between assessment pathways. However, we also identified a dynamic interactional factor contributing to the unfolding of phase 3. This was the extent to which caller's answers were congruent with the polar yes/no/unsure responses ideally required by the Pathways system. Extract 5 illustrates a well aligned call where the caller primarily responds to prior questions with polar yes/no answers.

Extract 5 (call 17437)

1	HA	O.K. And in the last 30 minutes has he been bleeding from anywhere?
2	C	No.
3	HA	O.K. and just to confirm you said he's got these cold-like symptoms,
4		a cough and he's breathless at the moment.
5	C	Yeah.
6	HA	O.K. Now is he struggling desperately for every breath, like he's
7		fighting for his life?
8	C	No.
9	HA	O.K. And is he limp, floppy and/or unresponsive at all, like a rag
10		doll?
11	C	No.
12	HA	And if you put your hand on the skin of his chest,
13		does he feel a normal temperature?
14	C	No, **he is hot, he is hot.**
15	HA	And at the moment, has he got any rapid swelling of his lips,
16		face or tongue?

This call was characterised by a relatively short and repetitive, question-answer based call phase 3. However, the caller does in one instance provide *more* than a polar answer in line 14. Such "over-answering" reflects a social norm: there are a range of circumstances where, following a polar yes/no question, speakers may clarify or qualify their response, or respond in such a way that presents them as a knowledgeable answerer (Heritage and Raymond, 2012). Whilst in the above example this appears to be without consequence, there were several instances in the dataset where callers' (interactionally appropriate) over-answering appeared to influence the direction of the call, such as in extract 6. Here, in lines 3-4, the caller responds to a polar yes/no question with a description of abdominal pain, which indirectly references this moving into their chest:

Extract 6 (call 35791)

1	HA	And does the pain go away after passing wind or
2		opening the bowels?
3	C	It sort of circulates around my bowels and then that's
4		where the - the pain sort of **goes up my chest** and...
5	**HA**	**So have you got pain in your chest then?**
6	C	Yeah. It keeps happening every - every so often.
7		Like every 20 minutes or half an hour or something
8		like that.
9	**HA**	**You experience some chest pains, yeah?**
10	C	Yep.
11	HA	OK...and have you ever been diagnosed with heart attack?
12	C	No, not a full heart attack, no.
13	**HA**	**No, have you got the pain right now in your chest?**
14	C	Yeah it's - it's a little minor at the moment,
15		it usually...
16	**HA**	**But you've got some, yeah?**
17	C	Comes and goes, yeah.

(six lines of discussion of pain omitted)

24	**HA**	**Right, and is it in your chest?**
25	C	It's...at the moment it's in my stomach -

Whilst chest pain is not the 'main' piece of information presented in this turn, HA turns this into the primary topic of discussion. A factor in them doing so is that 'chest pains' is flagged by Pathways as a priority for assessment. As Murdoch et al (2015) illustrated in relation to a different telehealth system, in these circumstances topic flow becomes dictated by the system rather than the interaction, and consequently C's subsequent agreement with a series of questions about chest pain (lines 5-24) ultimately resulted in ambulance dispatch, despite indication from the caller that they are not currently experiencing this symptom (line 25). Without making judgements about the clinical appropriateness of this outcome, it remains the case that an assessment for chest pains only became *interactionally* relevant because of the extended and unboundaried nature of C's over-answering of questions. Moreover, C's subtle and equivocal disagreements with HA's questions about chest pain between lines 13-17, whilst conversationally typical (Pomerantz, 1984), serve to contribute to a reification of "chest pain" as being the presenting problem due to the polar responses required by Pathways. In other words,

whilst polar questions have been built into this system to simplify the process of assessment, their inclusion is based on a transactional view of interaction which assumes that callers will behave in a manner that is outside of typical socio-interactional norms.

Call phase 4 – Agreeing the outcome

Call phase 4 is the final stage of the call, which involves: (a) communication of outcome, (b) provision of both interim care advice and instructions to be followed in case of a worsening condition, and (c) the closing of the call. At times in call phase 4 caller and call handler appeared aligned with one another but *collectively misaligned* with the requirements of this call phase. Previous CA work has indicated that ends of calls typically play out over a number of turns in routinized ways (Schegloff and Sacks, 1973). Standard features of such call closings include: (a) increase in pace of the professional's speech, (b) less frequent and shorter minimal turns from the caller, and (c) use of so-called "closing questions", those being turns that do not project for answers but instead serve to mark the forthcoming end of an interaction (for example, "are there any more issues you wish to discuss today?": see Heritage et al, 2007). We found evidence of all of these closing features occurring in call phase 4 immediately following communication of the call outcome, despite the fact that the call is not technically over at this point. This suggests that both callers and call handlers may not treat the advice-giving part of this call phase as a genuine communication of meaningful information, but rather a marking of the end of the interaction. Extract 7 illustrates such a pattern. Here, following the call handler's (HA) communication of the disposition, a large amount of advice is provided to the caller. HA's turns are relatively long, with the caller providing minimal response turns. Moreover, the pace of HA's talk speeds up noticeably during this sequence. Hence, both participants in this call appear to treat this as a closing sequence, and there are no clear indications from the caller that they are actively receiving the provided advice.

Extract 7 (call 26813)

HA O.K. Well, from what you've told us we would advise for you to attend an emergency treatment centre today, O.K., sometime in the next hour.
C Right. Yeah
HA We would advise that someone else take you
C Right. O.K.
HA And also take just a list of any current medications you're on, or any medical records that you have for yourself, to the hospital with you
C O.K.
HA Also just take a mobile phone just in case you require any medical assistance on the way. O.K.?
C O.K. Thank you

(six lines cut of discussion about location of hospital)

HA Yeah. O.K. If you are getting hot and feverish I think you should be having plenty of fluids, O.K., little and often is best
C O.K.
HA And just wear light clothing so don't (inaudible 1 word) wrapping yourself up to (inaudible 1 word) any fever
C Yeah
HA On the other hand, when you do get hot, don't try cooling yourself down too quickly with any cold sponging or fanning 'cos if you cool down too quickly it might make you shiver which'll make your temperature go up again. Alright?
C Yeah
HA A couple of things which are probably self-explanatory but just to get your friend to look out for. Obviously, if you become very (inaudible 1 word), unresponsive or start having a fit, or you become severely ill with any new marks that look like bruising or bleeding under the skin then of course dial 999 for an ambulance.
C O.K.
HA If you've not already taken some (inaudible few words) like you have been, take some Paracetamol of Ibuprofen, both can be used to help with any pain and reduce a fever but follow the instructions on the pack and ask a pharmacist.
C Yeah

Above, HA segments their advice across multiple turns, and append some turns with question forms (e.g. "okay?" and "alright?"; see lines 12 and 29) which project for a limited response from the caller. In other calls, advice was sometimes provided without even these features. The risk inherent in these instances is that callers are not meaningfully processing the information that is provided, because they are orienting to this part of the call as a build up to call termination. Moreover, in some cases, clear ambivalence and/or concern expressed by the caller in relation to the perceived appropriateness of the outcome

was glossed over by the call handler as part of these relatively rapid call-ending sequences. The following case illustrates this issue:

Extract 8 (call 75440)

1 HA Um, y'know, in regards to, um, to the dental practice, there isn't
2 actually an emergency dentist within your area.
3 C Right, well –
4 HA So it is the case that he will have to go to the emergency
5 department.
6 C What in er –
7 HA He'll have to go down to A&E.
8 C Where in (name of hospital)?
9 HA Yeah, your local emergency department, he'll have to attend.
10 C Yeah, well – they're not gonna do nothing, they're just gonna give
11 him painkillers, aren't they.
12 HA But then, if he needs pain relief – and also they'll look at the
13 swelling, if the swelling's reaching the eye.
14 C Right.

In extract 8 above, a third-party caller is informed during discussion of the advice that they should take a patient with severe toothache to an emergency treatment centre for pain relief. The caller, however, had suggested earlier that a positive call outcome would have been referral to an emergency dentist. The caller's response in lines 10-11 presents a negative evaluation of the call outcome. Whilst indirect, this kind of 'gentle' disagreement is socially normative (Pomerantz, 1984), and therefore conversationally fitting at this point in the interaction; however, in the context of HA apparently treating this advice as part of a call closing, its indirectness also enables it to be glossed over, as happens in the following lines.

4. Conclusion, implications and future research

The present study sought to apply conversation analysis to examine NHS111 call interactions in an attempt to build a more complete understanding of latent system risks in the UK urgent healthcare telephone triage service. Our findings support those of previous quantitative and qualitative studies. In line with the work of qualitative researchers (see Lopriore et al., 2017; Murdoch et al., 2015; Turnbull et al, 2012; 2017) in similar telephone

service settings, our conversation analysis revealed interactional workability issues. Our results suggest that communication misalignment instances have the capacity to increase the risk of system failure and in certain circumstances lead to negative outcomes such as those identified by Rees et al., (2017) in their review of serious incidents involving sick children. The review authors' classification of these outcomes as diagnosis and assessment problems is also supported by our work in that we propose that interactional misalignment can result in an inappropriate call outcome. However, our results also show that misalignment can lead to other negative outcomes beyond diagnosis and assessment problems. Our analysis of call stage 4 interactions revealed that misalignment has the potential for key information to be lost towards the end of a call. While the consequences of this are generally not immediate, and not easily quantifiable due to a lack of data about what happens after seemingly non-serious calls, there is the potential for this information flow problem to impact on whether the patient/caller follows the advice provided. In cases where worsening symptom advice is not effectively communicated or misunderstood, and worsening occurs, there is an increased risk of negative patient outcomes (including loss of life).

Our results build on existing findings (i.e., Rees et al., 2017), in that we found communication issues in the NHS111 system can lead to diagnosis and assessment problems and other negative outcomes, for all patients, not just sick children. We also extend knowledge in this field because our deeper analysis of actual communicative interactions showed that previous recommendations for system improvement, on their own, will not have a positive impact. Rees et al (2017) suggested that separate work needs to be conducted to improve CDSS protocols and at the same time improve 'situational awareness' training for Health Advisors. Alongside the qualitative findings of Lopriore et al., (2017), Murdoch et al., (2017) and Turnbull et al, (2012; 2017), our analysis adds to

existing evidence which suggests that efforts to improve individual units of the NHS111 system in isolation, without considering how they interact, will not reduce the risks associated with interactional misalignment.

While it may be possible for us to provide tentative recommendations for system improvements with respect to each call phase, we are mindful of the limitations of the current study imposed by the preliminary scope. Also, because our data analysis was conducted in 2016 and we are aware that the system (mainly the CDSS) has since been iteratively updated we have been reluctant to provide specific practical recommendations. However, NHS Digital, the CDSS developers, are utilising our findings to inform plans to redesign aspects of Pathways technology in order to reduce the risks associated with interactional misalignment. One area of focus is on improving the capability of the system to capture key information expressed by a caller in an initial call phase so it is not lost and can be utilised at a later point to help drive the assessment.

The broader implication of our work is that efforts to enhance the NHS111 system or similar telehealth systems used across the world, and patient safety management practices more generally, should shift the current focus away from a limited set of individual components (e.g., for NHS111 the call handler and CDSS) towards a system-specific interactionist perspective encompassing all elements. For example, current retrospective methods of serious incident analysis use generic contributory factor frameworks (e.g., the National Patient Safety Agency contributory factors framework) that lack evidence-based support and are utilised across healthcare services, the majority of which involve face-to-face interactions. Although more recent frameworks (e.g., the Yorkshire Contributory Factors Framework, Lawton et al., 2012) have utilised domain-specific research in an attempt to incorporate multiple system factors at multiple system levels they cannot be easily applied to the unique NHS111 system. For instance, while

'patient factors' are included in some of these frameworks, the patient is depicted as merely a receiver of care and as such is considered a passive system user. As our study shows, in the NHS111 system the patient and/or third-party caller is/are an important active component. In light of the limits of existing investigation tools it is not surprising that serious incident investigators and reviewers (i.e. Rees et al., 2017) have implicated the separate contribution of the other key components, i.e., the CDSS, and the Health Advisors.

Further evaluative research is required in order to build a comprehensive evidence-base concerning the multiple interacting factors influencing patient safety risk in the NHS111 system. The present study provides a foundation for this work and demonstrates that conversation analysis is a useful research tool in this setting. CA's scope of application within healthcare has increased substantially over recent decades and has resulted in significant innovations in practice. Where its strengths are particularly evident in the present study is around its capacity to model, at a systems level, interactional outcomes as multi-party and multi-factorial. As with other applied CA work (e.g. Heritage et al, 2007), it may lend itself to practical application within training contexts for new or existing protocol-led health services.

NHS111 and similar telehealth systems involve complex sociotechnical interactions between a particular set of components, and as such, evaluation studies aimed at understanding these relationships should consider a wide range of interdisciplinary research methods. For example, an approach used in the field of ergonomics to aid the evaluation of systems involving complex 'distributed cognition' across human and non-human system components is Distributed Situational Awareness (DSA; Stanton et al., 2006; see Stanton, 2016 for an overview). A number of methods have been developed to assess DSA in a variety of domains including the evaluation of road user behaviour,

aviation accident investigation, and submarine control rooms. Using the present study as a foundation, future evaluations of protocol-led healthcare, such as the NHS111 telehealth system should consider the application of interactionist approaches such as conversation analysis, the DSA approach, and other non-linear perspectives.

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References

Antaki, C., 2011. Applied Conversation Analysis: Intervention and Change in Institutional Talk, Palgrave Advances in Language and Linguistics. Palgrave Macmillan UK.

Bilmes, J., 1992, Mishearings. In G. Watson and R.M. Seiler (Eds.), Text in Context: Contributions to Ethnomethodology. Sage, London (pp. 97-112).

Bunn, F., Byrne, G., Kendall, S., 2005. The effects of telephone consultation and triage on healthcare use and patient satisfaction: A systematic review. Br. J. Gen. Pract. 55, 956-961. https://doi.org/10.1002/14651858.CD004180.pub2

Boyd, E., Heritage, J., 2006. Taking the history: questioning during comprehensive history-taking. In: Heritage, J., Maynard, D.W. (Eds.), Communication in Medical Care: Interaction between Primary Care Physicians and Patients. Cambridge University Press, Cambridge.

Branney, P., Witty, K., Bagnall, A.-M., South, J., White, A., 2012. 'Straight to the GP; that would be where I would go': An analysis of male frequent attenders' constructions of their decisions to use or not use health-care services in the UK. Psychol. Health 27, 865–880. https://doi.org/10.1080/08870446.2011.636443

Coiera, E., 2003. Guide to Health Informatics, Medical Information and the Internet, second ed. Oxford University Press, Oxford.

Cresswell KM, Panesar SS, Salvilla SA, Carson-Stevens A, Larizgoitia I, Donaldson LJ, et al., 2013. Global research priorities to better understand the burden of iatrogenic harm in primary care: an international Delphi exercise. PLoS Med. 10(11):e1001554. doi: 10.1371/journal.pmed.1001554

Department of Health. (2008). NHS next stage review. Our vision for primary and community care. London: Department of Health.

Graber ML, Kissam S, Payne VL, Meyer AND, Sorensen A, Lenfestey N, et al., 2012. Cognitive interventions to reduce diagnostic error: a narrative review. BMJ Qual Saf. 21(7):535–57. doi: 10.1136/ bmjqs-2011-000149

Greatbatch, D., Hanlon, G., Goode, J., O'Cathain, A., Strangleman, T., Luff, D., 2005. Telephone triage, expert systems and clinical expertise. Sociol. Health & Illn. 27 (6), 802-830.

Greenhalgh, T., Potts, H., Wong, G., Bark, P., Swinglehurst, D., 2009. Tensions and paradoxes in electronic patient record research: a systematic literature review using the meta-narrative method. Milbank Q. 87, 729-788

Hepburn, A., Wilkinson, S., Butler, C.W., 2014. Intervening with Conversation Analysis in Telephone Helpline Services: Strategies to Improve Effectiveness. Res. Lang. Soc. Interact. 47, 239–254. https://doi.org/10.1080/08351813.2014.925661

Heritage, J., 2005. Conversation Analysis and Institutional Talk. Handb. Lang. Soc. Interact. https://doi.org/10.1207/S15327973RLSI321&2_9

Heritage, J., 2009. Conversation Analysis as Social Theory. In B.S. Turner, The New Blackwell Companion to Social Theory. Wiley-Blackwell, Chichester.

Heritage, J., & Maynard, D. W. (Eds.). (2006). *Communication in medical care: Interaction between primary care physicians and patients* (Vol. 20). Cambridge University Press.

Heritage, J., Robinson, J.D., 2006. The Structure of Patients' Presenting Concerns: Physicians' Opening Questions. Health Commun. 19, 89–102. https://doi.org/10.1207/s15327027hc1902_1

Heritage, J., Robinson, J.D., Elliott, M.N., Beckett, M., Wilkes, M., 2007. Reducing Patients' Unmet Concerns in Primary Care: The Difference One Word Can Make. J. Gen. Intern. Med. 22, 1429–1433. https://doi.org/10.1007/s11606-007-0279-0

Hewitt, H., Gafaranga, J., McKinstry, B., 2010. Comparison of face-to-face and telephone consultations in primary care: qualitative analysis. Br. J. Gen. Pract. 60, e201–e212. https://doi.org/10.3399/bjgp10X501831

Hutchby, I. and Wooffitt, R., 1998, Conversation Analysis: Principles, Practices and Applications. Polity Press, Cambridge.

Jatoba, A., Burns, C.M., Vidal, M.C.R., Carvalho, P.V.R., 2016. Designing for Risk Assessment Systems for Patient Triage in Primary Health Care: A Literature Review. JMIR Hum. Factors 3, e21. https://doi.org/10.2196/humanfactors.5083

Kaplan, B., 1997. Addressing organizational issues into the evaluation of medical systems. J. Am. Med. Inform. Assoc. 4, 94-101.

Kawamoto, K., Houlihan, C.A., Balas, E.A., Lobach, D.F., 2005. Improving clinical practice using clinical decision support systems: a systematic review of trials to identify features critical to success. BMJ 330, 765. https://doi.org/10.1136/bmj.38398.500764.8F

Kiyimba, N., Lester, J.N. and O'Reilly, M., 2018. *Using naturally occurring data in qualitative health research: A practical guide*. Springer.

Lawton, R., McEachan, R.R.C., Giles, S.J., Sirriyeh, R., Watt, I.S., Wright, J., 2012. Development of an evidence-based framework of factors contributing to patient safety incidents in hospital settings: a systematic review. BMJ Qual. Saf. 21, 369–380. https://doi.org/10.1136/bmjqs-2011-000443

Leydon, G.M., Ekberg, K., Drew, P., 2013. "How can I help?" Nurse call openings on a cancer helpline and implications for call progressivity. Patient Educ. Couns. 92, 23–30. https://doi.org/10.1016/j.pec.2013.02.007

Lopriore, S., LeCouteur, A., Ekberg, S., Ekberg, K., 2017. Delivering healthcare at a distance: Exploring the organisation of calls to a health helpline. Int. J. Med. Inform. 104, 45–55. https://doi.org/10.1016/j.ijmedinf.2017.05.001

May, C., Finch, T., Mair, F., Ballini, L., Dowrick, C., Eccles, M., Gask, L., MacFarlane, A., Murray, E., Rapley, T., Rogers, A., Treweek, S., Wallace, P., Anderson, G., Burns, J., Heaven, B., 2007. Understanding the implementation of complex interventions in health care: the normalization process model. BMC Health Serv. Res. 7, 148. https://doi.org/10.1186/1472-6963-7-148

Murdoch, J., Barnes, R., Pooler, J., Lattimer, V., Fletcher, E., Campbell, J.L., 2015. The impact of using computer decision-support software in primary care nurse-led telephone triage: Interactional dilemmas and conversational consequences. Soc. Sci. Med. 126, 36–47. https://doi.org/10.1016/j.socscimed.2014.12.013

NHS England. (2013). High quality care for all, now and for future generations: Transforming urgent and emergency care services in England - Urgent and Emergency Care Review. End of phase 1 report. Leeds: NHS England.

Pappas, Y., Seale, C., 2010. The physical examination in telecardiology and tele-vascular consultations: a study using conversation analysis. Patient Educ. Couns. 81, 113-11

Pomerantz, A., 1984. Agreeing and disagreeing with assessments: some features of preferred and dispreferred turn shapes. In J.M. Atkinson & J. Heritage (Eds.), Structures of Social Action pp. 57- 101. Cambridge: Cambridge University Press.

Pooler, J., 2010. Technology and Talk in Calls to NHS Direct. PhD. Loughborough University.

Randell, R., Mitchell, N., Dowding, D., Cullum, N., Thompson, C., 2007. Effects of computerized decision support systems on nursing performance and patient outcomes: a systematic review. J. Health Serv. Res. Policy 12, 242–251. https://doi.org/10.1258/135581907782101543

Rees, P., Edwards, A., Powell, C., Hibbert, P., Williams, H., Makeham, M., Carter, B., Luff, D., Parry, G., Avery, A., Sheikh, A., Donaldson, L., Carson-Stevens, A., 2017. Patient Safety Incidents Involving Sick Children in Primary Care in England and Wales: A Mixed Methods Analysis. PLoS Med. 14, 1–23. https://doi.org/10.1371/journal.pmed.1002217

Sacks, H., 1994, *Lectures on Conversation* (Oxford: Blackwell).

Salisbury, C., Montgomery, A.A., Simons, L., et al., 2007. Impact of advanced access on access, workload, and continuity: controlled before-and-after and simulated-patient study. Br. J. Gen. Pract. 57, 608-614.

Schegloff, E.A., 1986. The routine as achievement. Hum. Stud. 9, 111–151. https://doi.org/10.1007/BF00148124

Schegloff, E.A., Sacks, H., 1973. Opening up Closings. Semiotica 8 (4), 289-327. https://doi.org/10.1515/semi.1973.8.4.289

Singh H, Graber ML, Kissam SM, Sorensen AV, Lenfestey NF, Tant EM, et al., 2012. System-related interventions to reduce diagnostic errors: a narrative review. BMJ Qual Saf. 21(2):160–70. doi: 10. 1136/bmjqs-2011-000150

Stanton, N.A., 2016. Distributed situation awareness. Theor. Issues Ergon. Sci. 17, 1–7. https://doi.org/10.1080/1463922X.2015.1106615

Stanton, N. A., Salmon, P. M., Walker, G. H., Salas, E., & Hancock, P. A. 2017. State-of-science: situation awareness in individuals, teams and systems, Ergonomics, 60:4, 449-466, DOI: 10.1080/00140139.2017.1278796

Stanton, N.A., Stewart, R., Harris, D., Houghton, R.J., Baber, C., McMaster, R., Salmon, P., Hoyle, G., Walker, G., Young, M.S., Linsell, M., Dymott, R., Green, D., 2006. Distributed situation awareness in dynamic systems: theoretical development and application of an ergonomics methodology. Ergonomics 49, 1288–1311. https://doi.org/10.1080/00140130600612762

Stokoe, E., 2014. The Conversation Analytic Role-play Method (CARM): A Method for Training Communication Skills as an Alternative to Simulated Role-play. Res. Lang. Soc. Interact. 47, 255–265. https://doi.org/10.1080/08351813.2014.925663

Turnbull, J., Prichard, J., Halford, S., Pope, C., Salisbury, C., 2012. Reconfiguring the emergency and urgent care workforce: Mixed methods study of skills and the everyday work of non-clinical call-handlers in the NHS. J. Health Serv. Res. Policy 17, 233–240. https://doi.org/10.1258/jhsrp.2012.011141

Turnbull, J., Prichard, J., Pope, C., Brook, S., Rowsell, A., 2017. Risk work in NHS 111: the everyday work of managing risk in telephone assessment using a computer decision support system. Heal. Risk Soc. 19, 189–208. https://doi.org/10.1080/13698575.2017.1324946

Wooffitt, R., 2005, *Conversation Analysis and Discourse Analysis: A Comparative and Critical Introduction*. Sage, London.

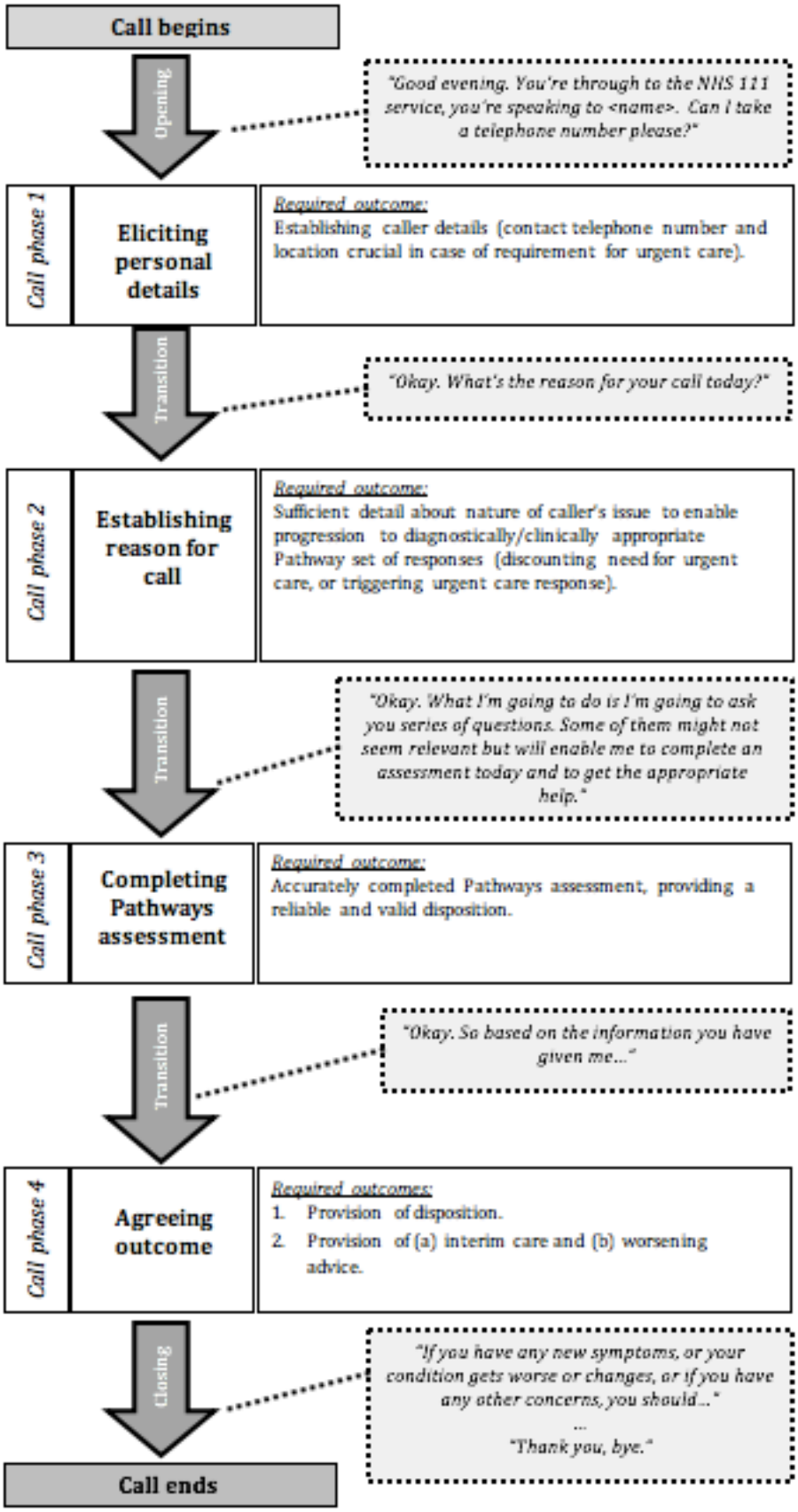

Figure 1. *Schematic of the four-phase invariant macro-structure of an NHS111 call*

Appendix A. Critical Listening Summary Template

Call ID	
Researcher - First listen	
Researcher - Second listen (if relevant)	
Researcher - Dual coded	
Call group	

1. Summary of the story of the call (including metadata)		
2. What is the problem today		
	Question	
	Answer	
	Transition	
3. Closing disposition		
	Giving the disposition	
	Receipt	
	Follow-on	
	Conclusion	