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[Qualitative Protocol]

Healthcare stakeholders' perceptions and experiences of factors affecting the implementation of critical care telemedicine (CCT): qualitative evidence synthesis

Andreas Xyrichis[1], Nicola J Mackintosh[2], Marius Terblanche[3], Suzanne Bench[4], Julia Philippou[1], Jane Sandall[5]

[1]Florence Nightingale Faculty of Nursing, Midwifery & Palliative Care, King's College London, London, UK. [2]SAPPHIRE, Department of Health Sciences, College of Medicine, Biological Sciences and Psychology, University of Leicester, Leicester, UK. [3]Critical Care Medicine/ Division of Health and Social Care Research, Guys and St Thomas NHS Foundation Trust/ Kings College London, London, UK. [4]School of Health and Social Care, London South Bank University, London, UK. [5]Department of Women and Children's Health, School of Life Course Science, Faculty of Life Sciences & Medicine, King's College London, London, UK

Contact address: Andreas Xyrichis, Florence Nightingale Faculty of Nursing, Midwifery & Palliative Care, King's College London, London, UK. andreas.xyrichis@kcl.ac.uk.

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ABSTRACT

This is a protocol for a Cochrane Review (Qualitative). The objectives are as follows:

- To identify, appraise and synthesise qualitative research evidence on healthcare stakeholders' perceptions and experiences of factors affecting the implementation of CCT.

- To identify hypotheses, for subsequent consideration and assessment in effectiveness reviews, about factors that are more likely to ensure successful implementation of CCT.

BACKGROUND

The context of critical care

International interest in the benefits and implementation of telemedicine in a variety of settings and for different conditions is growing fast, as evidenced by the recently published Cochrane intervention review (Flodgren 2016) and Cochrane qualitative evidence synthesis protocol (Odendaal 2015). This is especially the case in the care of critically ill patients. The burden of critical illness is higher than generally appreciated and is expected to increase as a result of global population ageing (Adhikari 2010; Vincent 2014). Consequently, critical care services in major hospitals are stretched, while smaller hospitals and rural areas have limited access to relevant expertise (Wunsch 2008). In addition, critical care is challenged by inconsistent application of evidence-based guide-

lines, variation in staffing levels and clinical outcomes, higher rates of medication errors and adverse drug events (Pronovost 2004; Rothchild 2005); all of which are accentuated by the unpredictable nature of patient conditions, the urgent nature of many admissions to critical care and the need for out of hours decision making. In the context of this review, we define critical care as the concentration of healthcare staff and equipment in a distinct area of the hospital in order to care for patients whose conditions are life-threatening and who need constant and close monitoring and support.

Critical care telemedicine

Telemedicine has been broadly defined by the World Health Organization (WHO) as: "the delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities" (WHO 2010:9). Critical care telemedicine (CCT) in particular enables a team of critical care doctors and nurses to provide 24-hour remote support to clinicians utilising audio-visual communication and computer systems. In 2014, it was estimated that 8% of total intensive care unit (ICU) beds in the USA were covered by CCT, with an average growth rate of 8% per year (Khan 2014). CCT offers minute-by-minute monitoring and recording of vital organ function, making use of electronic records and remote surveillance in order to facilitate early detection and response to physiological deterioration. In addition, the integration of decision-support tools and early warning systems supports adherence to clinical guidelines, which can level out variances in quality of care. Further advantages of CCT for stakeholders include additional support for junior staff, with patients and families feeling looked after. Consequently, CCT has potential to improve clinical outcomes beyond the confines of the ICU for people who may benefit from critical care expertise but are not based in specialist units; for example, they may be at an emergency department, generic ICU or medical/surgical ward. This is possible by extending the availability and reach of critical care expertise through a 'hub and spoke' model, and in this way act as an added safety net to ward-based and non-specialist bedside providers.

The hub and spoke model of CCT is used in the context of multi-location delivery of critical care services. A remotely-based team of senior and experienced critical care clinicians - called the 'hub' - is networked via audio-visual communication and telemonitoring systems with a number of bedside terminals, clinicians and patients. The hub acts as a single point of contact for critical care advice and support, while through seamless extensions - called 'spokes' - hands-on patient care is provided across multiple locations. In a wider role, the 'hub' can also take on co-ordinating responsibilities including patient flow through ICUs, brokering admission and discharge of patients; as well as quality, risk and performance management through early warning capabilities, rounding tools to monitor at-risk patients, inbuilt clinical decision support and prompts regarding adherence to best practice. In summary, CCT includes the following functionality: client to provider telemedicine; client health records; provider to provider telemedicine; provider-based decision support; laboratory and diagnostics management; data collection, management and use.

CCT is designed as a *continuous* form of clinical support to *bedside practice*, enabling clinical oversight and interactions between providers. In this way, it is distinct from other telemedicine models that mainly offer an interface for *sporadic* consultation between providers and patients in remote locations, or between generalist and specialist clinicians. Critical care patients' condition can be unstable, deteriorate unexpectedly and quite rapidly; requiring close monitoring and prompt reaction by a multidisciplinary team of expert clinicians, there and then. As a consequence, critical care services tend to have increased organisational autonomy, resources and staffing levels compared to other areas of the hospital. These unique features of critical care practice can influence professionals' perceptions, experience and utilisation of CCT; all of which can affect successful implementation.

Implementation of critical care telemedicine

The implementation of new technologies in healthcare settings is surrounded by multiple challenges. Reports on failure of widely accepted and seemingly diffused health technologies to become embedded in daily practice is common place in the literature, even where these have support by both clinicians and politicians (May 2000). To understand where implementation of such technologies fail, a strong theoretical foundation to guide evaluation of such programmes is needed. Use of implementation theory can help generate explanatory models and hypotheses about factors influencing implementation of health technologies, leading to the identification of approaches more likely to result in successful implementation.

For the purpose of the current review, the Consolidated Framework for Implementation Research (CFIR) (Damschroder 2009) will be used to theoretically conceptualise the included studies and guide the data analysis. CFIR is a 'meta-theoretical' model, made up of constructs generated out of a synthesis of existing theories; one of its strengths and unique features is that it does not depict rigid interrelationships, specific ecological levels, or specific hypotheses. This allows for theory development guided by exploratory questions such as what works, where and why across different contexts. The CFIR has been used successfully in recent reviews of eHealth and found to offer great theoretical and explanatory capabilities (Ross 2016).

CFIR is composed of five key constructs, each made up of different factors that affect the implementation of innovations into practice

(see Appendix 1). In summary, the five key constructs of the CFIR are: I. Intervention characteristics, II. Inner and III. Outer Settings, IV. Characteristics of individuals, and V. the Process of implementation. The first construct, ***Intervention characteristics*** , refers to features of the intervention including its source, evidence base, advantage over other interventions, the extent of its adaptability, 'trialability' and complexity; as well as its quality and cost. The second and third constructs, ***Inner and Outer Settings*** , relate to the internal and external environment in which implementation occurs. For example, the inner setting is about features of the structural, political and cultural organisation contexts through which the implementation process takes place; while the outer setting relates to the economic, political and social context within which the organisation resides. The fourth construct refers to the ***Characteristics of the Individuals*** who engage with the intervention or the implementation process. Individuals' knowledge and beliefs of the intervention, their self-efficacy, personal attributes and identification with the organisation play a key part to the success or failure of the implementation process. The final construct relates to the ***Implementation process*** itself, which includes elements of planning, engaging with leaders, champions and change agents, carrying out the implementation plan and evaluating the process and experience.

Operationalising the CFIR as an organising framework in the context of this qualitative evidence synthesis allows for a theoretically informed approach to data extraction, analysis and synthesis; helps with the interpretation of results; and strengthens the theoretical transferability and comparability of conclusions. At the same time, it allows for testing of the CFIR and consequent elaboration in the context of telemedicine in general, and CCT in particular.

Why it is important to do this review

Cochrane reviews (Currell 2010; Flodgren 2016) on the use of telemedicine indicate that answering questions of its efficacy requires attention to the contextual features of its application, including participants and settings. Effectiveness reviews of CCT in particular, report a great degree of variability in effectiveness (e.g. Young 2011), likely related to challenges with successful implementation (Thomas 2009). For example, Wilcox 2012 concluded that "the impact of telemedicine likely depends on characteristics of the environment in which it is deployed, including ICU organisation"; however, existing quantitative studies report limited contextual details. Currently, adoption of CCT appears haphazard and unplanned, and decision making about this lies hidden; this risks patient safety, quality of care and resource waste. Before such complex interventions are to be further developed and implemented, a more complete understanding of the factors that influence successful implementation is necessary (Glenton 2013). These include the perceptions, experiences and values of relevant stakeholders, as well as usability and applicability in different contexts.

It is therefore important to complement existing effectiveness reviews on CCT with a qualitative evidence synthesis that enables understanding of the factors affecting successful implementation, as well as illuminate the unintended consequences, acceptability and feasibility of CCT. This is especially important given that, despite lack of conclusive evidence, there has been a rapid uptake of CCT in North America; and considering that the 24/7 hub and spoke model of CCT may have reach beyond critical care - Critical Care Outreach and Emergency Departments for example - and in this way has great potential to transform the provision, quality and safety of acute care across hospital settings in the future.

This qualitative evidence synthesis addresses a subset of the Flodgren 2016 effectiveness review on interactive telemedicine by looking at CCT in particular; it will complement the Flodgren 2016 review by providing an added layer of knowledge that can enable a more nuanced understanding of the factors influencing implementation of CCT. It also complements the Cochrane review protocol for a qualitative evidence synthesis on experiences of mHealth technologies in primary health care (Odendaal 2015), since critical care represents the acute far end of the health system and the opposite pole to primary care. In addition, CCT is distinct as an application from the traditional models of mHealth - which rely on *mobile* technology - used in primary care, since it utilises a hub and spoke model to provide a 24/7, continuous form of clinical support to bedside practice rather than just being an interface for sporadic communication between patients and providers.

OBJECTIVES

- To identify, appraise and synthesise qualitative research evidence on healthcare stakeholders' perceptions and experiences of factors affecting the implementation of CCT.

- To identify hypotheses, for subsequent consideration and assessment in effectiveness reviews, about factors that are more likely to ensure successful implementation of CCT.

METHODS

Criteria for choosing studies

Type of studies

We will include empirical studies that use qualitative designs and methods for data collection and analysis. These will include, for example, ethnographic studies utilising participant observation or

phenomenological studies using interviews. We will consider studies utilising mixed designs where the qualitative component and findings can be discerned; we will also consider qualitative process evaluations as well as formative studies used to inform the design of CCT where the previous statement applies. We will include studies regardless of whether these were linked to effectiveness studies of CCT. We will exclude studies that use qualitative data collection methods but perform quantitative data analysis (e.g. using descriptive statistics).

Type of participants

We will consider all relevant stakeholders with a part to play in the implementation of CCT. These will include the following.

- All kinds of critical care workers (i.e. professionals, paraprofessionals and lay health workers) who make use of telemedicine to support or provide care to patients and/or family members. Critical care workers are the main users of CCT and/or are the ones whose daily work is influenced at various degrees by the introduction of CCT. Their views regarding acceptance, resistance to. or rejection of CCT are likely to be a contributing factor to implementation success or failure.

- Any other individuals or groups involved in the commissioning, evaluation, design and implementation of CCT. These individuals or groups could include administrative staff, information technology staff, managerial and supervisory staff, and industry partners who may or may not be based in a critical care facility, but must be involved in the utilisation or implementation of CCT. We will also include participants identified as technical staff who develop and maintain the CCT architecture used, since it is their logic and understanding of critical care services that underpins the final product at the point of use.

- Critical care patients and family members who have been the consumers or been involved in the development of CCT. As the recipients of care mediated via CCT, their views are likely to hold insight to factors influencing successful implementation.

Setting

We will include studies of telemedicine programmes implemented in critical care services, irrespective of specialisation (e.g. general, cardiothoracic, liver), or country. In the context of this review, we define critical care as the concentration of healthcare staff and equipment in a distinct area of the hospital in order to care for patients whose conditions are life-threatening and who need constant and close monitoring and support. Critical care services provide intensive, 24-hour monitoring and support of threatened or failing vital functions in patients who have illnesses with the potential to endanger life.

Phenomena of interest

The review will focus on healthcare stakeholders' perceptions and experiences of factors affecting the implementation of CCT; studies that look at either the initiation or ongoing delivery of CCT will be considered. In this review, CCT consists of the following combination:

- laboratory and diagnostics management, and client health records including the continuous electronic recording of patients' vital signs at the bedside linked to a computer system enabling display of real-time data;
- provider-based decision support, in the form of clinical decision-making algorithms and electronic alerts; and
- provider/client to provider telemedicine, utilising a remotely located team of critical care specialists, including doctors and nurses, who monitor the patients.

The presence of all three features is required to identify an intervention as CCT. We will not consider CCT applications that exclude clinical decision making as in some forms of plain remote screening.

Search methods for the identification of studies

Electronic searches

A combination of the following databases will be used to identify primary research studies for inclusion.

- MEDLINE, OvidSP
- Embase, OvidSP
- CINAHL, EbscoHost
- Social Science Citation Index, Web of Science

The MEDLINE search strategy is given in Appendix 2; additional search strategies will be developed for each database following the Cochrane Qualitative Research Methods Group's guidelines (Booth 2011). No date or language limits will be imposed.
Related reviews will be sought through PDQ-Evidence (www.pdq-evidence.org), the reference lists of which will be scanned for relevant studies.

Other sources

We will search the reference lists of related reviews and all included studies. We will use GoogleScholar to search for citing references to the included studies. We will search for Grey literature through 'The Grey Literature Report' (www.greylit.org) and 'OpenGrey' (www.opengrey.eu).

Data collection and analysis

Selection of studies

Two review authors will independently screen the corpus of identified literature for relevant studies using a predetermined tool based on the SPIDER framework (Cooke 2012, Appendix 3). Following title and abstract review, irrelevant citations will be excluded. We will retrieve potentially relevant papers in full and assess them for eligibility. Disagreements between the two review authors will be resolved through discussion, or by involving a third member of the team. Where necessary, we will contact study authors for clarification or additional information.

Translation of studies

Relevant studies published in a language other than English will be translated following the approach proposed by Downe 2017. In the first instance, the abstract of potentially relevant studies will be translated using an open source platform (Google Translate). Should the translated abstract indicate relevance, or is inadequate to judge this, we will approach members from our multilingual networks to help with the transliteration (Regmi 2010) of the full text using an approach known as 'elegant free translation' (Birbili 2000). Specifically, transliteration refers to a process that can be used when undertaking qualitative research in different languages and involves the translation of meaning from a text without this necessarily being a word-for-word process. This can be achieved through an elegant free translation whereby only the key themes, quotes and a description of the context is transcribed. We acknowledge that an element of precision and meaning may be lost through this process, but agree with Downe 2017 that this is a pragmatic solution to the complexity and resource demands associated with the full translation of qualitative research studies. We will utilise this approach when making decisions about inclusion and in extracting and synthesising data.

Purposive sampling of included studies

In the event that more than 50 eligible articles are identified, we will utilise a purposive sampling approach to attain the broadest possible variation of studies. We are not aware of any clear guidance about the optimal maximum number of studies, but based on previous Cochrane qualitative evidence syntheses (e.g. Glenton 2013), we will use 50 as a cut-off. In addition, we will take note of any issues or challenges tied to study numbers when analysing the data and writing up the full review to inform future work and methodological developments in qualitative evidence synthesis. Sampling will pay attention to: type of participants, kind of ICU and richness of data. First, we will seek to include studies that represent the widest possible variation of stakeholders; we expect most studies to include critical care workers as participants, so in the first instance we will sample studies involving non-clinical staff including patients and family members. Second, we will sample studies undertaken in specialist units, such as cardiothoracic or liver, in addition to general ICUs. Third, we will assess the richness of data in the remaining studies by adapting the approach developed by Ames 2017. In particular, we will create a 1 to 5 scale where: 1 will correspond to available data being limited or thin (i.e. from open-ended survey questions); 3 will correspond to an average, peer-reviewed, qualitative article in a mainstream health journal; and 5 will correspond to very rich data (i.e. from an ethnographic study). We will then sample all articles that score 3 or higher in terms of richness of data.

Data extraction, management and synthesis

We will extract key features of the included papers using a predetermined table (Appendix 4) to include: author(s), year, country, hospital type, ICU model and staffing, CCT system and vendor, study design, data collection and participants. We will also extract data on stakeholders' perceptions and experiences of factors affecting the implementation of CCT; this will include authors' interpretations as well as actual data in the form of quotes or fieldnote extracts. We will consider data presented in either the results or discussion sections of the articles.

Data synthesis will draw from the CFIR framework (Appendix 1) to examine the available evidence on factors affecting the implementation of CCT. As noted in the Background, the CFIR is a 'meta-theoretical' model, made up of five constructs: I. Intervention characteristics, II. Inner and III. Outer Settings, IV. Characteristics of individuals, and V. the Process of implementation. CFIR will inform but not restrict data synthesis, with additional themes not captured by CFIR used to challenge and add to previously held assumptions. This approach will lead to a more refined theory of implementation in the context of CCT, building on and extending the propositions of CFIR, thus strengthening the theoretical generalisability of the review findings.

We will follow the Best-fit framework approach (Carroll 2013), since this allows examination of the 'fittingness' of an existing framework as well as its consequent elaboration as necessary. This approach consists of four main analysis stages: First, we will code data from the included studies against the CFIR framework. Second, themes not accounted for by CFIR will be noted, coded and classified under a separate construct. Third, following a consensus approach, additional constructs will be used to supplement or adapt the CFIR; if consequently the framework changes substantially, the papers will be re-coded based on the new framework. Fourth, we will revisit the data to explore relationships between themes and constructs in order to develop explanations for the findings.

Reviewer reflexivity

We will maintain a reflexive stance throughout the stages of the review process, from study selection to data synthesis. Progress will be discussed regularly among the team and decisions made explored critically. As a review team, we all have clinical backgrounds: in nursing (AX, NM, SB, JP), medicine (MT) and midwifery (JS). In addition, three review authors have received advanced training in implementation science (NM, SB, JS) and are well versed in relevant theory. NM, AX, MT and JS have been part of a project examining the implementation of CCT at a UK site, but SB and JP are independent of that research. Based on our collective and individual experiences (as clinicians, academics and researchers), we anticipate the findings of our review to reveal a combination of organisational, professional and individual factors influencing the implementation of CCT. We will as a team remain mindful of our presuppositions and support each other to minimise the risk of these skewing our analysis or the interpretation of our findings. As the lead author, AX will keep a reflexive journal throughout the review process in which to document and reflect on progress and decisions made.

Appraisal of the methodological limitations of included studies

Two review authors will independently apply a predetermined set of quality criteria to each of the included studies; these criteria are based on the Critical Appraisal Skills Programme (CASP) quality assessment tool for qualitative studies (CASP 2013, Appendix 5). All eligible studies irrespective of quality will be considered. In case of disagreement between the two review authors, a third member of the team will be invited to adjudicate.

Assessment of confidence in the review findings

We will utilise the GRADE-Confidence in the Evidence from Reviews of Qualitative research (GRADE-CERQual) approach to summarise our confidence in the review findings (Lewin 2015). CERQual assesses confidence in the evidence based on the following four key components.

- **Methodological limitations of included studies**: The extent to which there are concerns about the design or conduct of the primary studies that contributed evidence to an individual review finding.
- **Coherence of the review finding**: An assessment of how clear and cogent the fit is between the data from the primary studies and a review finding that synthesises that data. By "cogent" we mean well supported or compelling.
- **Adequacy of the data contributing to a review finding:** An overall determination of the degree of richness and quantity of data supporting a review finding.
- **Relevance of the included studies to the review question**: The extent to which the body of evidence from the primary studies supporting a review finding is applicable to the context (perspective or population, phenomenon of interest, setting) specified in the review question.

After assessing each of the four components, we will make a judgment about the overall confidence in each review finding. Confidence will be judged as high, moderate, low or very low. All findings will start as 'high confidence' and will then be graded down if there are important concerns regarding any of the CERQual components. The starting point of 'high confidence' reflects a view that each review finding should be seen as a reasonable representation of the phenomenon of interest unless there are factors that would weaken this assumption.

As a final step, we will prepare an evidence profile for each finding as well as 'Summary of qualitative findings' tables. This is similar to the 'Summary of findings' tables used in Cochrane intervention reviews and summarises the key findings, our confidence in the evidence for each finding, and an explanation of the assessment of confidence.

Supplementing Cochrane effectiveness reviews

Findings will be used to complement and contextualise a subset of the conclusions of the Flodgren 2016 Cochrane intervention review on interactive telemedicine by looking at CCT in particular. In addition, findings will complement those of Odendaal 2015's Cochrane qualitative evidence synthesis protocol on experiences of mHealth technologies in primary health care. The refined CFIR framework developed through this review will be used to explore the appropriateness of linking the review findings with conclusions and outcomes drawn by Flodgren 2016. In particular, using CFIR as a starting point, we will deploy a logic model approach (see Glenton 2013) to develop a logical flow of theoretical connections/hypotheses through which implementation factors could affect CCT effectiveness and outcomes. At least two review authors will work together to develop this. This logic model could allow identification of specific combinations of factors that could lead to the results described in the Flodgren 2016 review. This could help explain variability in effectiveness of CCT, identify factors that need to be considered in future trials and inform the development of future CCT interventions and evaluations.

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* *Indicates the major publication for the study*

APPENDICES

Appendix 1. CFIR Table of Constructs

Topic/Description	Short Description
I. INTERVENTION CHARACTERISTICS	
A - Intervention Source	Perception of key stakeholders about whether the intervention is externally or internally developed
B - Evidence Strength & Quality	Stakeholders' perceptions of the quality and validity of evidence supporting the belief that the intervention will have desired outcomes
C - Relative advantage	Stakeholders' perception of the advantage of implementing the intervention versus an alternative solution
D - Adaptability	The degree to which an intervention can be adapted, tailored, refined, or reinvented to meet local needs
E - Trialability	The ability to test the intervention on a small scale in the organization, and to be able to reverse course (undo implementation) if warranted
F - Complexity	Perceived difficulty of implementation, reflected by duration, scope, radicalness, disruptiveness, centrality, and intricacy and number of steps re-

(*Continued*)

	quired to implement
G - Design Quality and Packaging	Perceived excellence in how the intervention is bundled, presented, and assembled
H - Cost	Costs of the intervention and costs associated with implementing that intervention including investment, supply, and opportunity costs
II. OUTER SETTING	
A - Patient Needs & Resources	The extent to which patient needs, as well as barriers and facilitators to meet those needs are accurately known and prioritized by the organization
B - Cosmopolitanism	The degree to which an organization is networked with other external organizations
C - Peer Pressure	Mimetic or competitive pressure to implement an intervention; typically because most or other key peer or competing organizations have already implemented or in a bid for a competitive edge
D - External Policy & Incentives	A broad construct that includes external strategies to spread interventions including policy and regulations (governmental or other central entity), external mandates, recommendations and guidelines, pay-for-performance, collaboratives, and public or benchmark reporting
III. INNER SETTING	
A - Structural Characteristics	The social architecture, age, maturity, and size of an organization
B - Networks & Communications	The nature and quality of webs of social networks and the nature and quality of formal and informal communications within an organization
C - Culture	Norms, values, and basic assumptions of a given organization
D - Implementation Climate	The absorptive capacity for change, shared receptivity of involved individuals to an intervention and the extent to which use of that intervention will be rewarded, supported, and expected within their organization
1 - Tension for Change	The degree to which stakeholders perceive the current situation as intolerable or needing change
2 - Compatibility	The degree of tangible fit between meaning and values attached to the intervention by involved individuals, how those align with individuals' own norms, values, and perceived risks and needs, and how the intervention fits with existing workflows and systems
3 - Relative Priority	Individuals' shared perception of the importance of the implementation within the organization

(*Continued*)

4 - Organizational Incentives & Rewards	Extrinsic incentives such as goal-sharing awards, performance reviews, promotions, and raises in salary and less tangible incentives such as increased stature or respect
5 - Goals and Feedback	The degree to which goals are clearly communicated, acted upon, and fed back to staff and alignment of that feedback with goals
6 - Learning Climate	A climate in which: a) leaders express their own fallibility and need for team members' assistance and input; b) team members feel that they are essential, valued, and knowledgeable partners in the change process; c) individuals feel psychologically safe to try new methods; and d) there is sufficient time and space for reflective thinking and evaluation
E - Readiness for Implementation	Tangible and immediate indicators of organizational commitment to its decision to implement an intervention
1 - Leadership Engagement	Commitment, involvement, and accountability of leaders and managers with the implementation
2 - Available Resources	The level of resources dedicated for implementation and on-going operations including money, training, education, physical space, and time
3 - Access to knowledge and information	Ease of access to digestible information and knowledge about the intervention and how to incorporate it into work tasks
IV. CHARACTERISTICS OF INDIVIDUALS	
A - Knowledge & Beliefs about the Intervention	Individuals' attitudes toward and value placed on the intervention as well as familiarity with facts, truths, and principles related to the intervention
B - Self-efficacy	Individual belief in their own capabilities to execute courses of action to achieve implementation goals
C - Individual Stage of Change	Characterization of the phase an individual is in, as he or she progresses toward skilled, enthusiastic, and sustained use of the intervention
D - Individual Identification with Organization	A broad construct related to how individuals perceive the organization and their relationship and degree of commitment with that organization
E - Other Personal Attributes	A broad construct to include other personal traits such as tolerance of ambiguity, intellectual ability, motivation, values, competence, capacity, and learning style
V. PROCESS	
A - Planning	The degree to which a scheme or method of behavior and tasks for implementing an intervention are developed in advance and the quality of those schemes or methods

(*Continued*)

B - Engaging	Attracting and involving appropriate individuals in the implementation and use of the intervention through a combined strategy of social marketing, education, role modeling, training, and other similar activities
1 - Opinion Leaders	Individuals in an organization who have formal or informal influence on the attitudes and beliefs of their colleagues with respect to implementing the intervention
2 - Formally appointed internal implementation leaders	Individuals from within the organization who have been formally appointed with responsibility for implementing an intervention as coordinator, project manager, team leader, or other similar role
3 - Champions	Individuals who dedicate themselves to supporting, marketing, and 'driving through' an implementation, overcoming indifference or resistance that the intervention may provoke in an organization
4 - External Change Agents	Individuals who are affiliated with an outside entity who formally influence or facilitate intervention decisions in a desirable direction
C - Executing	Carrying out or accomplishing the implementation according to plan
D - Reflecting & Evaluating	Quantitative and qualitative feedback about the progress and quality of implementation accompanied with regular personal and team debriefing about progress and experience

Appendix 2. MEDLINE search strategy

Database(s): **Ovid MEDLINE(R)** 1946 to March Week 5 2017
Search Strategy:

#	Searches	Results
1	exp Telemedicine/	21370
2	exp Telenursing/	170
3	telemedicine.ti,ab,kw.	7564
4	tele medicine.mp.	64
5	telehealth.mp.	2277
6	tele health.mp.	65
7	telecare.mp.	534

(*Continued*)

8	tele care.mp.	20
9	telemonitoring.mp.	862
10	tele monitoring.mp.	73
11	Medical Informatics Applications/	2288
12	medical informatics application?.mp.	2333
13	electronic health.mp.	15524
14	electronic care.mp.	41
15	ehealth.mp.	1167
16	e health.mp.	1458
17	((patient? adj1 monitor*) and (device? or tele* or electronic*)) .ti,ab,kw	982
18	decision support.mp.	27779
19	electronic alert?.mp.	127
20	(hub and spoke?).mp.	267
21	(remote support or remote surveillance or remote monitoring or remote counseling or remote counselling).ti,ab,kw	1096
22	Computer Communication Networks/	13312
23	Telecommunications/	4706
24	or/1-23	83059
25	exp Intensive Care Units/	68435
26	Critical care/	45548
27	Intensive Care, Neonatal/	5000
28	critical care.mp.	55943
29	intensive care.mp.	126308
30	intensive therap*.mp.	4778

(*Continued*)

31	intensive treatment?.mp.	4375
32	ICU?.mp.	37316
33	ITU?.mp.	692
34	(critical* ill* or sever* ill* or serious* ill* or at risk patient? or trauma patient?).ti,ab,kw	61356
35	or/25-34	215340
36	24 and 35	2715
37	eICU?.mp.	59
38	tele ICU?.mp.	97
39	tele IC?.mp.	94
40	teleIC?.mp.	4
41	or/37-40	156
42	36 or 41	2756
43	Qualitative Research/	33278
44	interview:.mp.	285735
45	experience:.mp.	779981
46	qualitative.tw.	140651
47	or/43-46	1099074
48	42 and 47	407

Appendix 3. Screening tool

Sample	• All kinds of critical care workers (i.e. professionals, paraprofessionals and lay health workers) who make use of telemedicine to support or provide care to patients and/or family members. • Any other individuals or groups involved in the commissioning, evaluation, design and implementation of CCT. These individuals or groups could include administrative staff, information technology staff, managerial and supervisory staff, technical staff and industry partners who may or may not be based in a critical care facility but must be involved in the utilisation or implementation of CCT. • Critical care patients and family members who have been the consumers or been involved in the development of CCT.
Phenomenon of **I**nterest	• Healthcare stakeholders' perceptions and experiences of factors affecting the implementation - either initiation or implementation - of CCT. • CCT consists of the following combination: • ○ continuous electronic recording of patients' vital signs at the bedside, linked to a computer system enabling display of real-time data; • ○ use of clinical decision-making algorithms and electronic alerts; and • ○ a remotely located team of critical care specialists including doctors and nurses, available 24/7. • Do not consider CCT applications that exclude clinical decision making as in some forms of plain remote screening.
Design	• All empirical studies that use qualitative designs and methods for data collection and analysis. These will include, for example, • ○ ethnographic studies utilising participant observation; or, • ○ phenomenological studies using interviews. • Studies utilising mixed designs to be considered only where the qualitative component and findings can be discerned; qualitative process evaluations to be considered where the previous statement applies. • Studies to be considered for inclusion regardless of whether these were linked to effectiveness studies of CCT. • Studies that use qualitative data collection methods but perform quantitative data analysis (e.g. using descriptive statistics) to be excluded.
Evaluation	• Experiences and perceptions
Research type	• Qualitative

Appendix 4. Study characteristics extraction table

Author/ Date	Country	Type of hospital	ICU model and staffing	CCT system & Vendor	Study Design	Data collection	Participants
e.g. Xyrichis 2016	*e.g. UK*	*e.g. Teaching*	*e.g. Closed, 1:1 nurse to patient ratio*	*e.g. Phillips VISICU*	*e.g. Ethnography*	*e.g. Non-participant observation*	*e.g. ICU doctors and nurses*

Appendix 5. Quality assessment tool

No.	Question posed
1.	Was there a **clear statement of the aims** of the research?
2.	Is a qualitative **methodology appropriate**?
3.	Was the research **design appropriate** to address the aims of the research?
4.	Was the **recruitment strategy** appropriate to the aims of the research?
5.	Was the **data collected** in a way that addressed the research issue?
6.	Has the **relationship between researcher and participants** been adequately considered?
7.	Have **ethical issues** been taken into consideration?
8.	Was the **data analysis** sufficiently rigorous?
9.	Is there a clear **statement of findings**?
10.	How **valuable** is the research?

Appendix 6. GRADE CERQual

Component	Definition
Methodological limitations	The extent to which there are problems in the design or conduct of the primary studies that contributed evidence to a review finding
Relevance	The extent to which the body of evidence from the primary studies supporting a review finding is applicable to the context (perspective or population, phenomenon of interest, setting) specified in the review question
Coherence	The extent to which the review finding is well grounded in data from the contributing primary studies and provides a convincing explanation for the patterns found in these data
Adequacy of data	An overall determination of the degree of richness and quantity of data supporting a review finding

Appendix 7. CERQual Evidence Profile

Objective of QES: To identify, appraise and synthesise qualitative research evidence on healthcare stakeholders' perceptions and experiences of factors affecting the implementation of CCT							
Summary of Finding	Studies contributing to the finding	Methodological limitations	Relevance	Coherence	Adequacy	Overall assessment of confidence	Explanation of judgement

CONTRIBUTIONS OF AUTHORS

Andreas Xyrichis led the development of the protocol. The review was conceptualised by Nicola Mackintosh, Jane Sandall, Marius Terblanche and Andreas Xyrichis. Andreas Xyrichis drafted the first version of this protocol. Nicola Mackintosh, Jane Sandall, Marius Terblanche, Suzanne Bench and Julia Philippou reviewed and commented on all drafts of this protocol.

DECLARATIONS OF INTEREST

Andreas Xyrichis: none known.

Nicola Mackintosh: none known.

Marius Terblanche: none known.

Suzanne Bench: none known.

Julia Philippou: none known.

Jane Sandall: none known.

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