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Digital mediation of candidacy in maternity care: managing boundaries between physiology and pathology

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Abstract

This paper brings together scholarship across sociology, media and communication, and human computer interaction to explore the intersection of digital health and the maternity care system. We draw on data (including interviews, focus groups, observations, and analyses of digital media content) from 19 studies involving over 400 women to explore women's experiences of using different forms of digital support such as the Internet, mobile technologies (apps and text messaging), social media, and remote monitoring devices in their reproductive journeys. We use a best fit approach to analysis, mapping our findings to the candidacy framework and notions of trajectory work to understand how women engage in digital health practices to negotiate boundaries between physiology and pathology and to enter dialogue with maternity services during conception, pregnancy and the postnatal period. We propose an integrated revised conceptual framework which explicates intersections between digital and care practices, and micro-level negotiations between women and professionals in the maternal health context. Our revised framework retains the dimensions of candidacy, but it introduces a precursor to the identification of candidacy in the form of 'understanding normality'. It identifies distinct forms of digital work (e.g. information work, navigation work, machine work) which operate across the candidacy dimensions that women (and partners at times) engage in to negotiate legitimacy when entering into encounters with the maternity care system. Operating conditions (norms around expert motherhood; neoliberal discourses around health optimisation, risk and responsibilisation) provide a broader macro-level context, influencing the micro-level dialogic processes between women and healthcare professionals. Our synthesis highlights digital mediation as a useful filter to understand care systems, distribution of lay/professional responsibilities, relational practices and the (dis)enablement of candidacy.

Research highlights

- How do digital resources mediate eligibility distinctions for maternity services?
- We synthesised qualitative data from 19 studies (> 400 women) using a best fit approach
- Women utilise digital technologies to interact with maternal healthcare
- Learning what constitutes normality is important for negotiating candidacy
- Digital work is a useful filter to understand negotiations of care

Keywords

Narrative review, digital health, maternity care, maternal health, uncertainty, risk, maternity, lay-professional

1 Introduction

Online health information exists in many forms, both formal (e.g. governmental, healthcare providers and charities) and informal (e.g. social media) (Marcu et al., 2018). Actively seeking health information has become part of the general populations' role (Kivits, 2004) and 'norm of conduct' (Rose, 1999) in order to stay healthy. The Internet also enable users to find informational and emotional support on health concerns, and to make sense of symptoms and use search engines to aid self-diagnosis (Marcu et al., 2018; Maslen & Lupton, 2018; Oh & Worrall, 2013).

In addition to online health information, the advent of new digital media and mobile ubiquitous computing devices has also enabled blended use of a range of digital media and resources such as websites, blogs, forums or online health support groups, podcasts, social media (YouTube, Facebook, Twitter and Instagram), enabling new ways of 'doing health' (Kivits, 2013; Maslen & Lupton, 2019; Wang et al., 2012). These new digital media technologies facilitate active engagement by users, giving them the opportunity to share health experiences and knowledge and create and upload content such as status updates, audio-visual material, comments and personal data (Beer & Burrows, 2010; Maslen & Lupton, 2019). Part of this move towards 'prosumption', combining aspects of consumption and production (Beer & Burrows, 2010), includes the introduction of apps, platforms and websites that enable users to measure and record their bodily activities and habits. These practices are often referred to as self-tracking and form part of the 'quantified self-movement' (Bode & Kristensen, 2016; Lupton, 2015; Owens & Cribb, 2017).

Scholarship from digital sociology and media and communication studies, science and technology studies and sociology of health and illness, have been interrogating these digital practices over the last decade. Sociological studies of health information highlight how Internet use enables the emergence of new forms of lay expertise and destabilisation of traditional public-professional relationships (Ziebland, 2004). Sociological analysis of digital technologies explicate how people understand their bodies through numbers rather than embodied sensation, conferring a form of 'algorithmic subjectivity' to the process of 'doing health' (Lupton, 2015). Science and technology (STS) and human computer interaction (HCI) studies have shown the expressive value of data (Piras & Zanutto, 2014; Weiner et al., 2017), the complexities of patient and caregiver care work enacted through data (Burgess et al., 2019; Hogan & Palmer, 2005; Kaziunas et al., 2017), and the physical and emotional costs of data tracking (Kaziunas et al., 2018; Weiner et al., 2020). STS and HCI research has also highlighted how digital affordances support the interactions between clinicians and patients as well as the redistribution of care tasks, agency and responsibilities (Oudshoorn, 2008; Piras & Zanutto, 2010).

A large part of this scholarship has concentrated on the technologies themselves or individualised digital practices *outside* the medical setting (Brown et al., 2019; Thomas & Lupton, 2016; Weiner et al., 2017; Weiner et al., 2020). While digital health resources can be seen to offer a distinct 'space' to clinical encounters and consultations, increasingly they can be considered an integral part of contemporary health and care infrastructures and the conventions of self-care work that sustain them (Weiner et al., 2017). This narrative synthesis focuses on those social, professional and institutional factors that shape and modify intersections between digital self-care and professional healthcare practices (Andersen et al., 2011; DiMaggio et al., 2001; Stevenson et al., 2019).

We take as our focus the maternal health system, accounting for the current global attention directed at risk management and digital self-care before, during and after pregnancy to reduce maternal/perinatal morbidity and mortality (UN, 2014; WHO, 2016). Pregnancy and birth is a normal physiological process. However, emergencies such as pre-eclampsia and reduced foetal movements

can develop rapidly and unexpectedly, requiring prompt recognition and clinical management (Flenady et al., 2016). Digital resources are increasingly being harnessed to inform women about 'red flags' and early warning signs of perinatal complications and appropriate help seeking (Tommy's charity, 2017). The attraction of digital technologies is that these tools are imbued with the promise of what has been termed 'technology-enablement' (Koteyko et al., 2015), facilitating self-empowerment, decision making and access to healthcare (Tamrat & Kachnowski, 2012).

This paper takes as its focus the negotiation of boundaries between what requires self-help as distinct from professional help, and associated transition points around risk and normality during conception, pregnancy and birth. We look across the maternity journey to see how digital resources mediate for women (and partners) distinctions of eligibility for medical treatment and care, and shape their negotiations and encounters with maternity services. Our synthesis brings together a sociological and HCI lens on digital health practices (Blandford et al., 2018), and uses two existing conceptual models, the candidacy framework (Dixon-Woods et al., 2006) and Corbin and Strauss' notion of trajectory work (Strauss et al., 1997), as a starting point to identify a priori themes (Carroll et al., 2011).

2 Conceptual framework

The aim of our narrative synthesis is to explore interactions between digital health, women (and partners) and maternity care. The sociological construct candidacy 'describes the ways in which people's eligibility for medical attention and intervention is jointly negotiated between individuals and health services' (Dixon-Woods et al., 2006 p.7). Whilst the process is acknowledged to be dynamic and cyclical, seven dimensions (identification of candidacy; navigation of services; permeability of services; appearances at services; adjudications by professionals; offers of and resistance to services; and operating conditions) are identified in the process of negotiating candidacy that equate to a journey into and through healthcare services. It has provided a useful framework to highlight how healthcare users in primary care and secondary care co-ordinate aspects of candidacy through fragmented boundaries and the moral character imposed on help seeking which has made people highly sensitive to the demands on professional time (Hudson et al., 2016; Llanwarne et al., 2017). Importantly, the framework draws attention to the organisation of healthcare, and intersections between social interactions and the structural patterning of health services. There has been relatively little empirical testing of candidacy in relation to women's journeys through maternity care. The dynamic aspect of candidacy foregrounds the socially constructed nature of help seeking as women consider whether they are a candidate for particular illnesses or conditions and interventions or services during their maternity journeys. Given the space between physiology and pathology 'is as much socially constructed as identifiable as an objective transition between the normal and abnormal' (Davis-Floyd, 2003), the construct offers promise in understanding (mis)alignments between women, staff and professional services. We explore candidacy's utility as a means of articulating the multiplicity of ways that digital can add to the constituting, defining and negotiating process as women enter into dialogue with the maternity healthcare system.

We additionally draw on Corbin and Strauss' notion of patient and caregiver's 'work' in healthcare settings i.e. 'what tasks, who does them, how, where, the consequences, the problems involved' (Corbin & Strauss, 1991 p.224). Corbin and Strauss highlight two basic lines of work either in the 'service of trajectory or everyday life management' and each of them contains different sub-types of work (Corbin & Strauss, 1991 p.224). While there has been great attention to examine the self-care work done by patients and caregivers in the context of illness trajectory (illness-related work) for several conditions (Burgess et al., 2019; McCoy, 2009; Timmermans & Freidin, 2007; Yin et al., 2020), there has been limited attention on women's pregnancy and birth trajectories (Wiener et al., 1979).

We explore the concept of digitally-mediated care work as women and partners utilise digital technologies to *interact with* the complex, often fragmented healthcare infrastructure (Gui & Chen, 2019; Strauss et al., 1997). Integrating the notion of 'work' into candidacy offers potential to shed light on the hidden level work that goes on in terms of self-monitoring, self-diagnosing and checking up on health professionals and care delivery, and usefully foregrounds the repertoires and resources women and partners draw on to inform these processes.

3 Methods

3.1 Study design

Our research question was: 'How do women use digital resources to help navigate the space between 'the normal' and 'the abnormal', and negotiate legitimacy when entering into dialogue with the healthcare system? Our review was configurative and interpretive, aiming to build on concepts and theories (Thomas et al., 2012). We chose a deductive 'best fit' framework to aid analysis, providing a scaffold against which our findings could be mapped (Carroll et al., 2011).

3.2 Study scope

We focused on qualitative studies as they enable exploration of different perspectives and the creation of theoretical models and possible explanations (Snilstveit et al., 2012). We included studies that used methods such as ethnography, interviews, focus group discussions, design workshops and text analysis. Feasibility and usability studies were excluded.

3.3 Search strategy

The searches covered the period from 1st Jan 2000-2018. We used expertise within the team to identify relevant literature from different disciplinary fields, searching the following databases: MEDLINE, Ovid, CINAHL, EbscoHost, Global Health, Ovid, Science Citation Index and Social Sciences Citation Index, ISI Web of Science, HCI Bibliography. Specific journals such as Health Informatics Journal, Journal of Biomedical and Health Informatics, Journal of Medical Informatics and JMIR were also accessed. Details of our searches are provided in Appendix 1.

3.4 Sampling strategy

We developed an organic process for sampling that fitted with the exploratory and theory testing nature of our review (Dixon-Woods et al., 2006). We used sampling techniques based on primary qualitative research, such as purposive sampling, maximum variation and snowballing to identify the sample, as others have done (Dixon-Woods et al., 2006; Perry et al., 2020). This process benefited from the multidisciplinary nature of our review team (sociology, media and communication studies, human-computer interaction) (Lupton, 2015). Our sampling strategy was designed to be purposive rather than exhaustive. Our final list aimed to provide sufficient conceptual insights across disciplinary fields to generate new understandings about the role digital resources play as women navigate boundaries between home and the clinic, and between constructs of 'normal' and 'abnormal' in maternal health.

For our inclusion and exclusion criteria see Table 1. We purposively worked *across* reproductive events and boundaries associated with pregnancy and birth (Latimer & Thomas, 2017), including conception, pregnancy, birth and the post-natal period. We also purposively included multiple forms and functionalities of digital e.g. Internet, mobile technologies (apps and text messaging), social media, and remote monitoring devices to keep our focus broad. To keep the review manageable we focused on boundary distinctions around physiology and pathology. Our focus was on the dialogic relationship

as women engaged with (or resisted) and navigated the maternity care infrastructure. We use the term 'maternity care' as inclusive of women's reproductive journeys through fertility clinics, antenatal and postnatal clinics and hospital care.

3.5 Data extraction and quality appraisal

Following the initial search, duplicates were removed and title/abstracts were screened. All four authors independently assessed the full texts of the remaining papers. Discrepancies were discussed and resolved among the four reviewers.

The team assessed the selected papers using a set of prompts to help us focus attention on the range of dimensions of qualitative research that require appraisal (Dixon-Woods et al., 2004). Checklist approaches to quality appraisal tend to prioritise the technical aspects of the research, so we assessed papers on the basis of the contribution of each research paper to the topic under question (Morse, 2021). All studies that fulfilled the relevance criteria were included, as a robust case has now been made for not excluding qualitative data studies from evidence synthesis on the basis of quality appraisal (Dixon-Woods et al., 2004; Thomas & Harden, 2008). We devised a data extraction framework to identify each paper's research aim, methodological approach, type of population and reproductive health risk, reference to type of digital technology, women's experiences, consequences and implications of using digital technology, conceptual models used and theory generation (see Table 2). Data extraction was led by (x) and cross checked by other team members.

3.6 Best fit approach to analysis

Data extracts, analytic themes and discussion of the data used in the source papers were considered as data. Analysis was deductive and augmentative (Carroll et al., 2011), building on the candidacy framework and pregnancy and birth trajectory work. Each of the authors separately analysed the qualitative evidence and independently coded Using NVIVO. We mapped themes against: (a) the pre-existing dimensions within the candidacy framework (Dixon-Woods et al., 2006); and (b) forms of digital work required to navigate the space between 'the normal' and 'the abnormal' and negotiations around legitimacy in encountering maternity services (Strauss et al., 1997). We shared findings and discussed coding differences and inconsistencies, and identified data we felt did not fit the conceptual framework. This iterative process continued until a priori themes were supported by the data and we were confident of the explanatory value and validity of our revised conceptual model (see Table 3).

3.7 Search results

Nineteen papers were included in the review (see figure 1). The papers predominantly included high income settings including Australia, Canada, New Zealand, UK, United States, Denmark, Germany and Sweden. Two papers were based in low and middle income (LMIC) settings, North India (Kazakos et al., 2016) and Kenya (Perrier et al., 2015). This imbalance could be linked to disciplinary and methodological differences in study design. Research involving digital technologies in LMIC settings often focuses on pilot testing, measuring usability and feasibility potential or effectiveness of new medical technologies to enable access to information.

Our sample included 625 women, 12 partners and 32 couples. There was also a mix across the papers in terms of a focus on: those with healthy pregnancies; those categorized as high risk where risk functioned as a social condition of compromised health status e.g. fetal congenital anomaly (Carlsson et al., 2016; Carlsson et al., 2017; Kett et al., 2017), diabetes (Aarhus et al., 2009), pre-eclampsia (Grönvall & Verdezoto, 2013; Harris et al., 2014), preterm labour (Goetz et al., 2017); and more generalized concerns (e.g. Johnson, 2015; Lupton, 2017). The digital resources included in the 19 papers were varied and included discussion boards and online forums (Johnson, 2015; Lupton, 2017;

Sherman & Greenfield, 2013), radio shows (Kazakos et al., 2016), SMS (Perrier et al., 2015), Internet search, blogs and websites (Carlsson et al., 2016; Carlsson et al., 2017; Harris et al., 2014; Johnson, 2015; Kett et al., 2017; Lagan et al., 2011; Petrovska et al., 2017; Peyton et al., 2014; Porter & Bhattacharya, 2008); social media (Lupton, 2016, 2017; Ruppel et al., 2017; Carlsson et al., 2016; Carlsson et al., 2017; Goetz et al., 2017; Grönvall & Verdezoto, 2013; Harris et al., 2014; Johnson, 2015; Kazakos et al., 2016; Kett et al., 2017; Lagan et al., 2011; Lingetun et al., 2017; Lupton, 2016, 2017; Perrier et al., 2015; Petrovska et al., 2017; Peyton et al., 2014), apps (Goetz et al., 2017; Lupton, 2017; Peyton et al., 2014), and self-monitoring devices (Aarhus et al., 2009; Grönvall & Verdezoto, 2013). Reproductive events included conception (Porter & Bhattacharya, 2008; Ruppel et al., 2017); pregnancy and birth (Carlsson et al., 2016; Carlsson et al., 2017; Goetz et al., 2017; Grönvall & Verdezoto, 2013; Harris et al., 2014; Johnson, 2015; Kazakos et al., 2016; Kett et al., 2017; Lagan et al., 2011; Lingetun et al., 2017; Lupton, 2016, 2017; Perrier et al., 2015; Petrovska et al., 2017; Peyton et al., 2014; Ruppel et al., 2017; Sherman & Greenfield, 2013); and the postnatal period (Johnson, 2015; Lupton, 2016, 2017; Sherman & Greenfield, 2013).

Recruitment methods varied across the dataset including via hospital settings (e.g. Goetz et al., 2017), market research company (e.g. Lupton, 2016) and targeting specific populations (e.g. Ruppel et al., 2017). The most common data collection methods used in the papers included semi-structured interviews (n=6) and mixed methods (including analyses of discussion boards and blogs, interviews and surveys) (n=6). Studies used focus groups (n=4), survey using free text responses (1) and a field trial including interviews, observations, questionnaires, log data and audio recordings (n=1). Studies also included analysis of 600 discussion groups/threads and 13 blogs.

4 Results

Our findings highlight the significance of trajectory work for asserting candidacy in maternity care. We found that (1) different types of digital work were undertaken as part of this process of asserting candidacy; and (2) data from our sample of papers did not completely align to the original seven candidacy dimensions; we created an additional dimension (understanding normality) and merged others (navigation, permeability and appearances at services; adjudications and offers and resistance).

4.1 Understanding normality

Identification of candidacy in previous studies has related to the process by which patients and parents recognise symptoms as indicative of a medical problem that needs professional attention or treatment. We noted that for our population, navigating normality was a precursor to identifying candidacy as women were required to make sense of bodily changes in pregnancy in order to distinguish pathological from normal physiological changes.

Part of the work women and partners' engaged in to accomplish this understanding involved online information retrieval as part of their routine care practices during conception, pregnancy and post birth (Goetz et al., 2017; Lagan et al., 2011; Lupton, 2016; Peyton et al., 2014; Porter & Bhattacharya, 2008). Many women used the Internet for work, entertainment, wedding planning, studying, shopping, *"...so why wouldn't I think of using it for pregnancy information?*" (Lagan et al., 2011 p.39).

Navigational work was required to access, make sense of and manage both online and paper based information. '*Today* [in the antenatal clinic] *they gave me a whole bag of* [medical] *pamphlets and flyers and...didn't explain or go over them with me... and now I have to go home and try to go through them, while I have a kid running around*....' (Peyton et al., 2014 p581). Whilst the Internet was already a familiar source of information for many participants, additional validation work was required to check the reliability and consistency of Internet information by comparing websites, sources and

cross-checking information (Goetz et al., 2017; Lagan et al., 2011). Searches also exposed women to risk awareness of *potential* health complications (Peyton et al., 2014); *'problems that you may never encounter in your pregnancy*' (Lagan et al., 2011 p.342).

Apps, remote monitoring devices and social media platforms provided women with additional levels of interactivity and personalisation, networking and the ability to track and evaluate themselves against norms (Lupton, 2016; Peyton et al., 2014). This type of embodied work enables perceptions of what constitutes health (as distinct from illness) in the context of reproductive events. Women were able to view images and read descriptions of how the foetus was changing and growing. Individual interpretative work was required as Apps collected data and presented this back to women, displacing responsibility on to the individual user for the interpretation. *'What I have also noticed in those apps: if you are asked...to say how you feel...that's always just a matter of interpretation, for example what "good" really means to you'* (Goetz et al., 2017 p.7).

Images of the foetus, however, could be uploaded to social media as part of a larger social repository (Lupton, 2016). Quantification provided benchmarks to measure against, enabling women to co-construct boundaries around normality. '*Usually women want to share experiences, make comparisons. Just like: "Well, the doctor has told me recently that my baby weighs about 2.5 kg in the ultrasound measurement. Is this actually normal?*'" (Goetz et al., 2017 p.6). Online discussions provided reassurance (Lupton 2016) and features such as adding comments or visualizing health parameters supported interpretation and reflection (Goetz et al., 2017; Lupton, 2016). Individual digital sense making was also located within wider social infrastructures of interactivity: '*But* [apps] *definitely cannot replace a private conversation - for me, this is still extremely important*' (Goetz et al., 2017 p.7).

4.2 Assertion and identification of candidacy

Digital spaces enabled collective diagnostic work, helping mediate understandings as to whether symptoms warranted candidacy (Johnson, 2015; Lagan et al., 2011; Lupton, 2017; Ruppel et al., 2017). The accessibility and immediacy of these digital spaces enabled engagement. '*If you have a weird pain or, you know, you have cramp in your legs at three a.m. you can get on your phone straight away'* (Lupton, 2017 p.4). One woman who feared her wife was miscarrying wrote on a discussion board, *'My wife is 13 weeks 2 days pregnant and has been getting cramping on her lower left side since about 4 pm. [I] was just wondering what it could be. Online [it] just says rest*' (Ruppel et al., 2017 p.21).

Message boards helped shape women's understandings of their mothering responsibilities, enabling them to 'test' if concerns could be resolved safely outside the clinic (Sherman & Greenfield, 2013). Anxieties could be shared, enabling collective discussions around candidacy and what constituted a waste of medical time in a safe anonymous digital space (Johnson, 2015; Lagan et al., 2011; Lupton, 2016; Sherman & Greenfield, 2013). '*I also found the anonymity good, especially when I was looking for the answer to a question that I felt 'too silly' to ask my midwife* ' (Lagan et al., 2011 p.340). Online platforms enabled women to seek affirmation that the symptoms they or their newborns were experiencing required professional help. *'Yeah, one time* [the baby*] had a bit of a rash on her chin. I took a photo, uploaded it, asked the ladies what they thought and they all wrote back with, with their thoughts and advice*' (Johnson, 2015 p.242). 'How-to-videos' about diagnosing medical conditions in their children were also accessible via YouTube, a user generated video-sharing site (Lupton, 2017).

While clinical evidence-based guidance and experiential data supported women in their decision-making, online exchanges in some cases contributed to misinformation, with the potential to negatively affect candidacy. Ruppel's study highlighted the gendered and discriminatory nature of maternity healthcare practices which dissuaded LGBQ women from discussing fertility and conception

concerns with healthcare professionals (Ruppel et al., 2017). Similarly while Sherman's study of teen pregnancy message boards found that only a small minority of posts contained unsound medical advice, this advice was continually accessible to other members increasing the risk of misinformation spreading beyond just the intended recipient (Sherman & Greenfield, 2013).

4.3 Navigation, permeability and appearances at services

Navigation relates to women's knowledge of services in terms of how and when to make contact in relation to identified candidacy and their ability to mobilise the necessary resources to seek care, whereas permeability relates to the ease with which women can access services. The articulation (or coordination) work that women undertake to assert their candidacy in interactions with a healthcare professional falls within appearances at services. We bring together these dimensions to consider how the structuring of professional maternity services interacts with digital resources to meet women's health information needs regarding access to care (both routinely and for potential emergencies).

In high income settings, the level of face to face professional contact (in particular the timing and length of consultations) was often reported to be insufficient for meeting women's health needs (Carlsson et al., 2017; Goetz et al., 2017; Lagan et al., 2011; Peyton et al., 2014). Women turned to the Internet, valuing the immediacy of access to information from a wide variety of sources in contrast to the bounded nature of antenatal care (Lupton, 2016). Some women expressed a desire for maternity services to extend their services beyond bounded face to face consultations in the clinic to forms of online professional support (Lupton, 2016). *'There should be a chat room, where a doctor is available or other medical staff. So, one could ask...Specific questions...and you might even get a response from a professional'* (Goetz et al., 2017 p.7).

Rather than acting as a means of uncertainty absorption, on-line information retrieval at times generated more uncertainties and reliance on professionals for reassurance (Harris et al., 2014). Women and partners described periods of anxious waiting between diagnostic tests and follow-up hospital appointments (Carlsson et al., 2016; Carlsson et al., 2017; Kett et al., 2017; Lagan et al., 2011). The bounded nature of services meant that women and family members had to 'hold onto' anxieties until opportunities were available to discuss them with healthcare professionals (Carlsson et al., 2016). *'At 30 weeks an ultrasound came back with the possibility of a lesion on my baby's lung. [..] I panicked and went to the Internet to research on my own. All I found were horror stories and worst-case scenarios (death rates, etc.) involving what "could" have been seen on my baby. [..] I was an emotional wreck for 4 days waiting for my appointment with the obstetrician'* (Lagan et al., 2011 p.342).

In low and middle income settings, digital resources offered the potential to expand service delivery beyond the physical constraints of the clinic. In Kenya, pregnant women often had to wait for several hours at the clinic to see a nurse, which discouraged them from attending their antenatal clinic visits and decreased the amount of professional advice and support received during their pregnancy (Perrier et al., 2015). Perrier reported on a hybrid SMS system which sent pregnant women timely tailored information and connected them directly to a nurse who was able to respond to their questions or concerns. In Kazakos study, a community-led radio show was used in recognition that low levels of Internet connectivity and challenges due to socioeconomic circumstances (e.g. lack of skills, low levels of literacy) limit the use of Web 2.0 tools in resource-limited settings (Kazakos et al., 2016). While both projects reported limits to the level of participatory engagement, for some women these digital resources provided access to professional care, enabling women to assert candidacy. '*Listener Female 1 – "Madam this one thing that I wanted to ask was, about the trouble in breathing, I feel so suffocated." Host ASHA Naraingarh – "Ok. Dr. Savi is with us, she will talk to you, you can ask her about this and what should be done about it?*' (Kazakos et al., 2016 p.350).

4.4 Adjudications and offers of/resistance to services

We merged adjudications, which refers to the judgments and decisions made by professionals which enable or prevent progression of candidacy, with the professional offers of care made by maternity services and women's resistance to these offers.

Women's information work *outside* the clinic shaped the local production of candidacy (Carlsson et al., 2017; Porter & Bhattacharya, 2008). The nature of health risks meant at times it was difficult for medical authorities to provide definitive predictions and solutions, creating an information vacuum, which sat at odds with the plethora of information online. Dorothea, expecting a child with anomaly in the kidney and urinary tract posted on a discussion board '*I don't feel like we've gotten very much information at all and it hasn't really been able to tell us what's actually going to happen [...) We also haven't been given a rundown at all of the examinations they're going to do when she comes'* (Carlsson et al., 2017 p.57). Online information provided a benchmark for women to measure professional services against. One of the female participants attending a fertility clinic reported '*He* [*the doctor*] *never gave us nothing to go away with. He never said, "Do this and do that." I would have got more information going home and going onto the Internet or reading books*." (Porter & Bhattacharya, 2008 p.569).

Digital resources, however, also provided opportunities for some women to actively engage with and prepare for clinic visits (Goetz et al., 2017). Digital preparation was enacted as a way to enable a beneficial health encounter. '*I found that if I researched a topic, and THEN approached my doctor, I got a more "honest" answer*' (Goetz et al., 2017 p.8).

Professionally endorsed home monitoring systems facilitated the bridging of boundaries between women's self-care practices at home and monitoring practices in the clinic regarding conditions such as diabetes and pre-eclampsia (Aarhus et al., 2009; Grönvall & Verdezoto, 2013). In Gronvall's study of pre-eclampsia, women engaged in machine work (work relating to operating machines that are used for self-monitoring), checking and sending vital sign data to the hospital, which facilitated a feeling of security for women which extended to partners. '*I can feel the child and so... I know now what to react on. [..] [My partner] 'can see these values... and see that everything is ok'* (Grönvall & Verdezoto, 2013 p.592). Access to this data also enabled the extension of responsibilisation practices for fetal health to include partners (Grönvall & Verdezoto, 2013).

Countervailing forms of support to the clinic provided legitimacy for women to avoid use of services or choose not to follow professional guidance (Johnson, 2015; Kett et al., 2017; Lagan et al., 2011; Lingetun et al., 2017; Petrovska et al., 2017). *'The big advantage getting health information from the Internet is that you have ready access to women who have experienced pregnancy and the range of complications, not just health professionals who have studied them*' (Lagan et al., 2011 p.341). Online parenting forums provided 'surreptitious support', enabling women to buttress a view that conflicted with or substituted the medical advice offered or not offered by doctors (Johnson, 2015).

Women also described forms of resistance work related to risk categorisation. In Lingetun's study, women used blogs as a medium to validate and justify their perspectives, to counter feeling singled out and labelled as a risk pregnancy because of their weight. *'Last time at the antenatal care clinic I had gained 4 kilos in total and that made my midwife concerned, because I shouldn't gain weight at all. Not when you're as fat as I am. But when I look at myself in the mirror and in pictures, I'm not sure I agree. Am I really severely overweight?*" (Lingetun et al., 2017 p.68). Whilst women reported attending antenatal appointments, they noted that relationships with midwives were strained and they dismissed gestational weight gain guidance.

4.5 Operating conditions

The last candidacy dimension refers to the operating conditions i.e. the contextual factors that exert influence on women's access to care and the interactions between women and staff. The ideals of professionalised motherhood provided a backdrop to women's assertion of candidacy (Johnson, 2015; Lupton, 2016, 2017). Women discussed the role of pregnancy information Apps in helping them become knowledgeable and responsible parents. '[..] *every day I would look at the app. What stage am I on? What I should be doing? What I should be eating, what should I be looking to avoid? So it was a life saver for me*' (Lupton, 2017 p.6).

Imperatives of responsibilisation appeared linked into discourses of health optimisation and motherhood/parenthood. The majority of women in Goetz's study wanted an App to be implemented in routine pregnancy care in order to help them *detect and prevent* serious pregnancy conditions already at an early stage (Goetz et al., 2017). As one woman noted of her peers - *'It would be important that patients were more informed...Because I have the feeling that many pregnant women, especially the less educated, just know too little about their pregnancies*' (Goetz et al., 2017 p.6).

Online forums and chat rooms provided a shared digital space for women to discuss medical concerns, and draw on medical advice, practical knowhow, personal experience and peer-based knowledge. The Internet enabled access to the experiences of mothers who have traditionally sat outside the norm such as disabled mothers and same-sex mothers (Johnson, 2015; Ruppel et al., 2017). Internet blogs provided a way to recraft and legitimise identities for those women who felt clinical assessments and professional guidance around risk (e.g. around obesity) are discriminatory (Lingetun et al., 2017). However, forums, chat rooms and message boards were noted to have a self-regulatory function, policing and moralising behaviour and practices (Sherman & Greenfield, 2013).

Complex connections between provider response and individual responsibilisation practices were also evident. Healthcare professionals' formal and informal digital caring roles, and distinctions between system level and woman-centred approaches had a mediating influence on women's preparedness to share details of their self-care work, concerns and decisions (Goetz et al., 2017; Grönvall & Verdezoto, 2013; Johnson, 2015; Kazakos et al., 2016; Lingetun et al., 2017; Perrier et al., 2015; Petrovska et al., 2017)

5 Discussion

This narrative synthesis utilised a deductive 'best fit' framework, drawing on the synthetic construct of candidacy and notions of patient and caregiver's 'work' to aid analysis. Through mapping our findings to these existing scaffolds and interrogating gaps and overlaps, we were able to develop a new integrated conceptual framework (Table 3). Our framework retains the dimensional nature of candidacy, but it incorporates an additional dimension (understanding normality) and brings together others (navigation, permeability and appearances at health services; and adjudications and offers of/resistance to services). It identifies distinct forms of digital work which operate across the dimensions that women (and partners at times) engage in to negotiate legitimacy when entering into encounters with the maternity care system. Our findings suggest that assertion of candidacy needs to be understood more as a dynamic and iterative than a linear process, and that the operating conditions provide a broader macro-level context, influencing the micro-level processes (digital work involved in asserting candidacy).

Our analysis brings a theoretical lens to build on existing research on on mediation of transition points, negotiation processes and women's contribution to escalation of care for potential obstetric emergencies (Eri et al., 2009; Mackintosh et al., 2017). The maternity care infrastructure imposes

structural constraints on women and professionals because of time, space and resource limitations (Gui & Chen, 2019) and brings attention to all the hidden work required to maintain care infrastructures (Weiner & Will 2018). Our narrative synthesis has highlighted how women utilise digital technologies to *interact with* the complex, often fragmented maternal healthcare infrastructure (Bagalkot et al., 2020; Gui & Chen, 2019). 'The complex, messy, and unevenly distributed nature of infrastructure requires that individuals be in continuous negotiation with it' (Erickson & Jarrahi, 2016). Our findings make explicit forms of labour that occur outside formal settings of maternity care, that require ongoing articulation of trajectory and everyday work (Corbin & Strauss, 1991 p.224). While aspects of digital work are collective and visible, other forms of work are private, responsibility for which lies with individuals, isolated from each other (Gui & Chen, 2019). Rendering this form of hidden labour visible, enables 'infrastructural inversion' (Bowker et al., 1994) and casts a light on responsibilisation practices.

Candidacy as a construct was originally applied to healthcare access for marginalised communities, including those with specific conditions e.g. asthma (Hudson et al., 2016). Its application has been usefully broadened to different settings e.g. primary care (Llanwarne et al., 2017) and illnesses (Macdonald et al., 2016) to highlight how categories and context influence notions of candidacy, access and experiences of care. Our review extends application of this construct to the relatively diffuse and broad ranging topics of reproduction and digital. Our findings demonstrate the model's utility in foregrounding moral dimensions, and dialogic and recursive processes of digitally mediated care, as women enter into encounters with the maternity care system.

Our use of the candidacy framework focuses attention on operating conditions that help shape women's maternity journeys as continuous negotiations of care. Public health information locates responsibility for health optimisation, self-diagnosis, and self-care in the domestic sphere, while positioning women as in need of scientific and medical advice and support (Faircloth & Murray, 2015; Lee, 2008). Enactment of good mothering is linked to women's ability to navigate the interface between physiology and pathology (Ogle et al., 2011). Media texts function as a form of public pedagogy across a broad network of institutions (Giroux, 2004). Surveillance associated with health imperatives circulates relationally and affectively as a form of public pedagogy (Rich, 2011). We see how lay health imperatives align with, extend or juxtapose maternal healthcare infrastructures forming a multiplicity of surveillant assemblages (Haggerty & Ericson, 2000).

Our review builds on the candidacy theory, articulating the significance of normality as a construct distinct from abnormality. Our studies indicate that learning what constitutes normality forms an important part of pregnancy and mothering. In order to identify candidacy and need for professional services, women first need to understand and experience normality and navigate its boundaries. This is linked to wider societal perceptions around 'responsible use' of finite health resources, notions of deservedness, and the work that is required by users to establish a moral case for access (Chase et al., 2017).

Normality is constructed through an *absence* of risk (Scamell & Alaszewski, 2012). Normality is 'the subject that is not one' (Butler, 1999 p.2). Digital technologies perform as part of maternal discourse and practice, shaping pregnancy and mothering operating conditions. As women become drawn into monitoring practices, the very process of self-monitoring 'simultaneously confirms and disturbs' normality (Scamell & Alaszewski, 2012). Through the practice of negotiating affects and emotions (through reassurances, new anxieties and uncertainties), digital technologies extend, align with or contradict wider practices of care in the clinic (Swallow & Hillman, 2019).

Our review adds to previous research highlighting how digital infrastructures can complement, or even enhance, traditional professionalised forms of care (Piras & Miele, 2019). Images of the foetus can be

uploaded to social media to become part of a larger social repository enabling visualisation and providing reassurance in a similar way to the ultrasound (Thomas et al., 2017). As Heal notes 'the social is facilitated by the screens through which we interact with each other. It engenders an additional sense of confidence, safety and removal from the social situation or interaction. It enables us to be less burdened by expectations of others' (Heal, 2018).

The findings also foreground the importance of digital social spaces e.g. Internet blogs (Lingetun et al., 2017) for women given the poor fit of some professional services. It is important for us as digital researchers to create rich fine grained understandings when intimate mothering publics (Johnson, 2015) work to complement and supplement services i.e. to allow for private discussions to aid assertion of candidacy, and when this work becomes detrimental. Further research is needed to explore how maternal subjects 'patch together their own approach to advice, knowledge and support' allowing for self-reflexivity as women shift between 'conventional medical advice and the patient role, and new, alternative or renegotiated forms of advice' (Johnson, 2015). Our review highlights how experiential data enabled women's decision making and shaped their expectations and use of services.

Our narrative synthesis draws on Strauss' trajectory work (Strauss et al., 1997) explicating the different types of digital-related work (e.g., machine work, body work, information work, emotion work and resistance work) women and family members engage with in order to manage, shape and experience transitions and dialogues with healthcare (Chen, 2011). Novel elements such as resistance work complement previous work in this area (Strauss et al., 1997). Digital work intersects with the 'negotiative contexts' (p267) and 'temporal ordering' (p277) of pregnancy trajectories, usefully drawing attention to the temporal and relational aspects of trajectory work that must be planned for and coordinated among the different types of care work (Corbin & Strauss, 1991 p.224). Our review also highlights the dynamic and ongoing nature of diagnostic work, which involves social, embodied and material interactions (Büscher et al. 2010).

In terms of bringing candidacy and trajectory work together, these theoretical frames enabled us to surface relationships between different aspects of the social and the technological. The candidacy framework draws attention to dialogic processes, legitimacies and structural pathways, whereas trajectory work foregrounds the division of labour underpinning digital work to mediate journeys and interactions through information and communication technologies. Our conceptual framework highlights maternity care as a longitudinal distributed process involving 'micro-level negotiations' between women, partners (at times), and professionals in the home and within 'local/organizational (meso) and national/political (macro) contexts' (Mackenzie et al., 2013 p.820).

We call for further research to explore how different features of digital work together as a 'patchwork', enabling shifts between biomedical and experiential authority, and allowing for self-reflexivity for those implicated in conception, pregnancy and birth, and postnatal trajectories. Opportunities to include partners and staff in these research studies would add value. Further research could usefully explore partners' roles in the different dimensions of asserting candidacy, and whether specific forms of digital work extend responsibilisation practices beyond women to include partners and family members.

Digitally mediated care reflects the dynamic relationship between expert systems and social orders (Knorr Cetina, 2007). Our synthesis highlights digital mediation as a useful filter to understand care systems, distribution of lay/professional responsibilities, relational practices and the (dis)enablement of candidacy. Provider response shapes women's responsibilisation practices, and contributes to cultural shifts in norms around risk and safety, and self-care conduct (Rose, 1999). Further dialogic based research is needed to understand how professionals engage with formal and informal ways of digital care and how lay-professional responsibilities and jurisdictions are negotiated at local level.

This could usefully include greater understanding of how diagnosis is enacted as a distributive and collective process, which objects of diagnostic work are privileged and accepted, and who has the authority and legitimacy to diagnose.

An important methodological consideration is the absence of ethnographic observations or interactional analysis in the source literature. Several of the studies analysed discussion boards and blogs, drawing on netnography (Bowler, 2010), which adapts use of ethnographic methods to the study of cultures and communities online. The lack of traditional ethnographic observational or interactional data may be linked to bounded aspects of maternity care (e.g. privacy around birth), as well as difficulties identifying points in care journeys where digital work is visible.

In terms of applicability of our analytical insights to other populations and care settings, it is important to acknowledge those characteristics that are specific to maternity. Two or more lives need to be considered at any one time with the maternity population and care of a pregnant woman and her baby/babies extends over a relatively long period, with multidisciplinary input for complex cases, compared to short episodes of care which tend to occur in other areas of the health service. For the majority of the population, pregnancy and birth is a normal physiological process. However, emergencies can develop rapidly and unexpectedly, and women are often drawn into navigating the 'grey space' between physiology and pathology. Lastly, digital use within the maternity population is likely to reflect its relatively young age (European Commission, 2020).

5.1 Methodological limitations

Our review was deliberately broad. We purposively included multiple forms and functionalities of digital which limited detailed insights into distinct features of each. We worked with empirical papers with varied aims and objectives. Some papers focused explicitly on the role of digital, whilst others only referenced digital within the wider context of information or help seeking. This mix we believe was important for us to understand intersections with care practices. However, we acknowledge the risk of decontextualizing data associated with our approach. The multidisciplinary nature of our review team helped address this limitation, enabling us to surface and question ontologies and understandings of digital health technologies.

We chose a best fit deductive approach to analysis which brings with it the 'risk of shoehorning data into categories' (Perry et al., 2020 p.10). This was mitigated by each author independently coding the data, regular team discussions and by the organic development of the revised conceptual framework. We adopted a purposive rather than exhaustive sampling strategy. If we had drawn on a broader literature, our conceptual model may have looked different. Further testing is required to interrogate and to build on the revised framework, and to investigate how it can be applied and adapted for understanding candidacy through the maternity journey in different socio-cultural health contexts.

Syntheses of qualitative data have economic and social benefits in terms of saving time and money, and research burden (Rotstein & Laupacis, 2004). Using a best-fit approach is augmentative and deductive, building on existing conceptual frameworks, which can contribute to theory development and testing (Carroll et al., 2011). Our approach enabled us to bring together scholarship across sociology, media and communication, and human computer interaction. However, our analysis was limited to what was reported and discussed within each of the papers. Qualitative secondary analysis involving re-use of qualitative data held in archives and institutional repositories increasingly offers opportunities for data sharing and transparency (Bishop & Kuula-Luumi, 2017). Although there are ethical challenges associated with repurposing data, secondary analyses are becoming more accepted within the mainstream of social science methods (Hughes & Tarrant, 2019).

5.2 Conclusion

Our narrative synthesis has generated a revised conceptual framework which explicates intersections between digital and care practices, and micro-level negotiations between women and professionals in the maternal health context. Our revised framework retains the dimensional nature of candidacy, but it introduces a precursor to the identification of candidacy in the form of 'understanding normality'. It identifies distinct forms of digital work which operate across the candidacy dimensions that women (and partners at times) engage in to negotiate legitimacy when entering into encounters with the maternity care system. Operating conditions provide a broader macro-level context, influencing the micro-level dialogic processes between women and healthcare professionals. Our framework offers opportunity for research post COVID-19 in terms of analysis how care systems and infrastructures, distribution of lay/professional responsibilities and relational practices have been reconfigured in line with greater visibility of the role of digital in healthcare.

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Digital mediation of candidacy in maternity care: managing boundaries between physiology and pathology

Table 1: Inclusion and exclusion criteria

	Participants	Reproductive events	Focus	Digital technologies	Study types
Included	Women, partners	Conception, pregnancy, birth and the post-natal period	Boundary distinctions between normality and abnormality, Dialogic relationship as women engaged with (or resisted) and navigated the maternity care infrastructure	Multiple forms and functionalities of digital e.g., Internet, mobile technologies (apps and text messaging), social media, and remote monitoring devices	Qualitative, Evaluation (technology-in-use)
Excluded	Healthcare professionals		General reproductive self-care, health education		Quantitative, feasibility and usability studies, extended abstracts, posters and other reviews

Table 2: Characteristics of studies

ID	Study	Country	Study aims	Participants/Target population	Study design, data collection and analysis	Form of 'digital'
1	Lupton (2017)	Australia	To explore women's experiences of using digital media for pregnancy and parenting	36 pregnant women/ women with young children	• Focus groups • Constant comparative analysis	Mobile apps, social media, online forums, tracking apps
2	Kett et al. (2017)	USA	To describe pregnant women's experiences who had been referred to foetal centres for the evaluation of foetal congenital anomalies	11 pregnant women with foetal congenital anomalies	• Semi-structured telephone interviews • Thematic networks analysis	Internet
3	Porter and Bhattacharya (2008)	Scotland	To examine couples' perceptions of the information available from various sources in the context of achieved pregnancy or continuing treatment	25 couples trying to conceive	• Interviews • Thematic analysis/ Grounded theory	Internet
4	Ruppel et al. (2017)	USA	To understand patterns in seeking and sharing online health information for LBQ women attempting conception	400 discussions in Facebook groups involving LBQ women trying to conceive	• Content analysis of discussion boards	Facebook groups
5	Petrovska et al. (2017)	Global*	To examine the views and experiences of women who sought a vaginal breech birth	204 women who had planned a vaginal breech birth at or close to full term in the past 7 years	• Qualitative survey • Inductive thematic analysis	Internet and social media websites
6	Aarhus et al. (2009)	Denmark	To explore the development of supportive healthcare technology for diabetic, pregnant women using participatory design methods	3 pregnant women with type 1 diabetes	• Ethnographic field studies, qualitative interviews, idea and concept generation workshops	Web-based tool

7	Johnson (2015)	Australia	To explore how first-time mothers use offline and online information and support in their transition to motherhood	12 pregnant women transitioning to first-time motherhood	• Semi-structured interviews conducted during pregnancy and in the postnatal period • Analysis based on concepts of frontstage, and backstage of motherhood	Online support sources
8	Lingetun et al. (2017)	Sweden	To describe what pregnant women who present themselves as overweight or obese write about their pregnancy in their blogs	13 Internet blogs from pregnant women	• Inductive thematic analysis used to analyse the texts in the blogs	Internet blogs
9	Lagan et al. (2011)	Global*	To understand Internet use in pregnancy and its role in relation to decision-making	92 women during pregnancy or the postnatal period	• Focus groups • Analysis based on a theoretical model of information seeking	Internet
10	Peyton et al. (2014)	USA	To understand pregnant women's health needs in order to design a targeted health management application	Over 20 women during pregnancy or the postnatal period	• Focus groups and semi-structured interviews • Inductive constant comparative method	Internet, social network, mobile apps, digital devices
11	Sherman and Greenfield (2013)	USA	To investigate the role of Internet-mediated communication in providing social support for teenage population	200 chat forum threads from pregnant and post-natal teenager mothers	• Analysis of posts within message boards highlighting instances of emotional, informational, and instrumental support	Online message boards
12	Harris et al. (2014)	UK	To investigate the potential psychological benefits, harms and acceptability of providing pregnant women with an antenatal screening test for pre-eclampsia.	15 pregnant women	• Cross-sectional semi-structured interviews • Common-sense model of self-regulation	Online information about pre-eclampsia

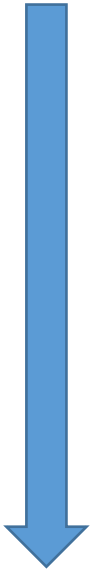
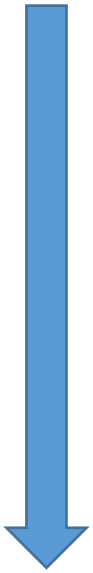
13	Goetz et al. (2017)	Germany	To examine the perceptions and expectations of mobile and web-based patient-engagement pregnancy applications	30 pregnant women (low- to medium-risk)	• Semi-structured interviews • Thematic analysis	Mobile and web apps and authors' own app
14	Lupton (2016)	Australia	To investigate how women use the diverse range of digital media and assess their usefulness and credibility	36 women who were pregnant or had given birth in previous 3 years	• Focus groups • Thematic analysis	General digital and social media use
15	Perrier et al. (2015)	Kenya	To understanding how low-income women use a hybrid computer-human SMS system to engage in health related communication	100 pregnant women	• In-depth analysis of SMS conversation	Hybrid computer-human SMS system
16	Grönvall and Verdezoto (2013)	Denmark	To understand home-based health monitoring practices and how women integrated measurements into their daily lives	6 pregnant women with severe pre-eclampsia or with premature rupture of the membranes	• Semi-structured interviews • Socio-technical conceptual framework	Home-based healthcare technology, wearable and non-wearable sensors, off-the-shelf and a tele-monitoring system
17	Carlsson et al. (2017)	Sweden	To understand the processes that expectant parents experience when they are faced with a prenatal diagnosis of a congenital anomaly in their unborn child	10 pregnant women experiencing a pre-natal anomaly	• Cross-sectional study of message boards. • Grounded theory	Internet
18	Carlsson et al. (2016)	Sweden	To explore the need for information and what information was actually received following a prenatal diagnosis of a congenital heart defect	14 pregnant women and 12 partners whose baby had a prenatal diagnosis of congenital heart defect	• Semi-structured interviews • Content analysis	Internet

19	Kazakos et al. (2016)	North India	To understand the user experience of a technology response system	31 listeners during pregnancy and the postnatal period (20 for pregnancy	• Field trial (interviews, observations, demographic questionnaires, audio recordings, log data • Inductive thematic analysis	Real-time interactive voice response (IVR) system

*Australia, Canada, New Zealand, UK, USA, South Africa, Germany, other

**Australia, Canada, New Zealand, UK, USA

Table 3: Integrated conceptual framework: digital mediation of candidacy

Candidacy dimension	Implications of digital for mediating candidacy	Types of digital work	Operating conditions
Understanding normality	Digital enables (and disables) understandings, interpretations and explanations of maternal and fetal bodies (Reference papers: ID 3, 9, 10, 13, 14)	Navigation work; information work; interpretative work; embodied and body work; diagnostic work; identity work; machine work; resistance work	Expert motherhood; neoliberal discourses around health optimisation and risk; responsibilisation (Reference papers: ID 1, 4, 5, 7, 8, 11, 13,14, 15, 16, 19)
Assertion and identification of candidacy	Digital interacts with the assessment of the significance of bodily sensations; it facilitates diagnosis as a *social* process (as distinct from a professional process) (Reference papers: ID 1, 4, 7, 9, 11)		
Navigation, permeability and appearances at services	Accessibility, immediacy of digital acts to *extend*, *supplement*, or *increase demand for* the clinic; digital is implicated in dialogic processes / social contracts and expectations of services (Reference papers: ID 2, 9, 10, 12, 13, 14, 15, 17, 18, 19)		
Adjudications/offers and resistance	Digital enables new self-governing practices in line with, as a challenge to, or as separate to medical practices; enables multiplicity of practices, peer based knowledge to sit alongside expert professional knowledge (Reference papers: ID 2, 3, 5, 6, 7, 8, 9, 13, 16, 17)		

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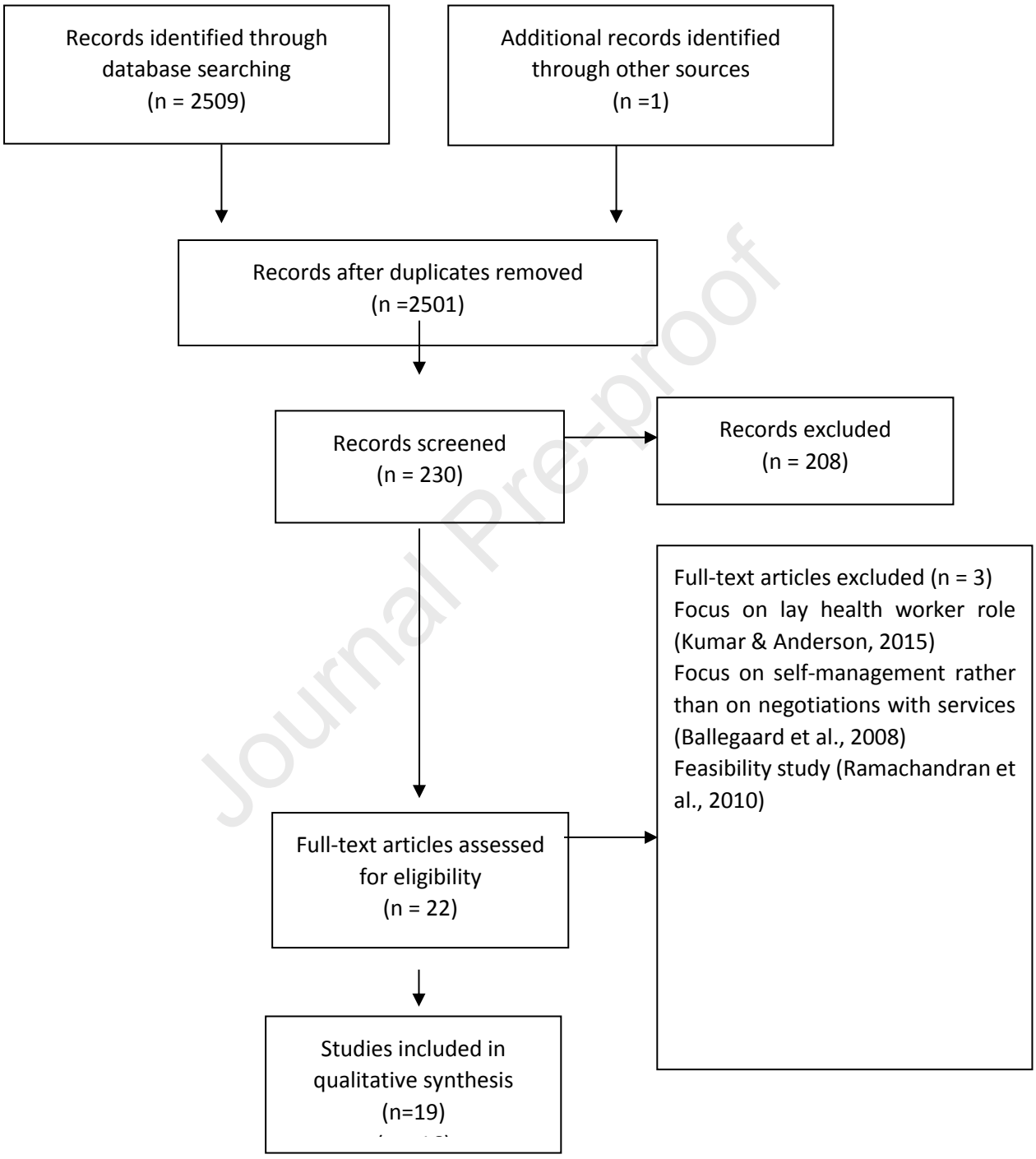

Figure 1: Flow diagram (PRISMA)