<table>
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<tr>
<th><strong>Title</strong></th>
<th>Critical care nurses' experiences of providing care for adults in a highly technological environment: A qualitative evidence synthesis</th>
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<tr>
<td><strong>Author(s)</strong></td>
<td>Crilly, Geraldine; Dowling, Maura; Delaunois, Isabelle; Flavin, Mary; Biesty, Linda</td>
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ABSTRACT

Aims: To synthesise the available body of qualitative evidence relating to nurses’ perceptions and experiences of care provision in adult critical care environments.

Methods: The study adhered to ENTREQ (Confidence in Evidence of Reviews of Qualitative Research) guidelines. A systematic search of the literature in nine databases was undertaken: CINAHL, Web of Science, Medline, Embase, PsycINFO, Campbell Collaboration, Proquest A & I, DART, Lenus. Blind screening to select relevant studies was undertaken and each selected study was assessed for quality using the Critical Appraisal Skills Programme framework (CASP). Guided by Thomas and Harden’s three-stage approach to thematic analysis, line-by-line coding of participants’ verbatim accounts and the researchers’ interpretations in the selected studies’ findings was undertaken and then organised into higher order analytical themes. Confidence in the findings were reviewed using GRADE-CERQual.

Results: Twelve studies reported in thirteen papers, including 122 nurses were selected in the final sample for synthesis. Three analytical themes were identified: 1) sometimes machines get all the attention 2) with experience the patient becomes the focus, and 3) technology can’t save everybody.

Conclusions. Providing care for adult patients in a highly technological environment is challenging particularly for novice nurses, who face the potential of technology drawing all their attention. Experienced critical care nurses learn to keep technology in abeyance and deliver person-centred care within the bounds of a technological environment.

Relevance to clinical practice. The review supports Locsin’s theory of technological competence and highlights that providing care in critical care requires nurses to actively balance attention for the person while managing machines. Experienced nurses achieve this balance and can offer support to novice nurses. Critical care nurse orientation programmes should be underpinned by a holistic approach which addresses the dualism of technology and care.

Keywords. Critical care, evidence synthesis, intensive care, nursing, qualitative.

What does this article contribute to the wider global clinical community?

- Technology is essential to critical care nursing but can also interfere with care.
Novice critical care nurses can feel overwhelmed and can place disproportionate emphasis on technology and can lose sight of the patient. The experienced critical care nurse learns how to see the patient first and keep technology in abeyance.

Introduction

Technology is a complex phenomenon due to its many assorted roles and functions in healthcare (Stayt et al., 2015). While it is an inherent aspect of nursing care (Sandalowski, 1999), competing perspectives abound in the literature where technology in nursing is on the one hand embraced but on another ostracised (Barnard, 2016; Zang et al., 2014). It is argued that new technologies will have the greatest impact on nurses and the way nurses care for patients (Huston, 2013). While the expanding merger of technology and nursing care poses many challenges (Archibald and Barnard, 2018), technology in healthcare has also resulted in many positive changes for nurses and patients (Kritz, 2019). Examples include robotic telehealth systems allowing nurses to monitor patients at risk of falling and digital signs with vital patient information such as allergies on each patient’s door that can be updated instantly as needed (Kritz, 2019), to scanners using wireless technology that can detect tissue damage beneath the skin (Harrington, 2017).

Initially, a scoping search was undertaken to help guide the focus of this qualitative evidence synthesis (Flemming et al., 2019). The scoping search revealed a number of qualitative studies presenting nurses’ struggle with finding a balance when caring in a highly technological environment (Da Silva and Ferreira, 2013; Price, 2013; McGrath, 2008; Bagherian et al., 2017).
While critical care nurses embrace the positive aspects of technology on their care provision (Bagherian et al., 2017), it can be difficult for nurses to maintain their focus of attention on the patient, whilst competing elements within the technological environment draws on their attention (Price, 2013). Over time however, nurses achieve a balance between the care required and the intrusiveness of technology in the unnatural environment of critical care (Almerud et al., 2008; Mc Grath 2008).

The above studies highlighted both positive and negative influencing factors of technology on caring in adult critical care settings, but a comprehensive and synthesis view of the phenomenon is lacking. Thus the rationale for this qualitative evidence synthesis was to synthesise the available evidence on this topic. Qualitative evidence synthesis can expose deep layers of meaning, acceptance and understanding of those issues that are most important to patients, health professionals and other stakeholders (Booth, 2016). The subsequent evidence synthesis presents themes across time and geographical distance which serve to inform practice and education in critical care nursing.

**Aims and Methods**

The aim of this QES was to synthesise all available qualitative evidence on how nurses in adult critical care settings experience care delivery while using technology.

This review was guided by the approach to qualitative evidence synthesis outlined by Thomas and Harden (2008). We followed the ENTREQ Statement “Enhancing transparency in reporting the synthesis of qualitative research” (Tong et al., 2012). Qualitative evidence of critical nurses in paediatric settings was not included because
of the difference in these settings in terms of parent involvement in care (Graham et al., 2009; Denis-Larocque et al., 2017). Moreover, adult critical care nurses often have more assigned patients and greater patient turnover (Shively et al., 2011).

Search Strategy.
A systematic search strategy was employed by the first and third authors according to PRISMA guidelines (Moher et al., 2009). The SPICE framework (Setting, Perspective, Intervention, Comparison, Evaluation) (Booth and Brice, 2004) was used to formulate the review question, identify key-words, develop the inclusion-exclusion criteria and inform the search strategy (Table 1). No date limit was applied in order to capture the complete body of qualitative literature. In order to achieve a balance between sensitivity and specificity in the search results (Hopp and Rittenmyer 2015) the early initial search strategy was subject to iterative testing. An initial search of CINAHL was followed by eight other individual database searches, Web of Science, Medline, Embase, PsycINFO, Campbell Collaboration, Proquest A & I, DART, Lenus. Each search was repeated a number of times, developing on retrievals and gaps from the prior search. The database searches were supplemented by ‘hand-searching’ of the reference list of included studies, and a ‘berry-picking’ approach after the database searches (Barroso et al., 2003). Grey literature (theses, conference proceedings, Google Scholar) were also searched. To enhance rigour, the searches were undertaken by a specialist librarian and the search was peer reviewed by another specialist librarian as recommended by McGowan et al. (2016). The database searches identified 1721 candidate articles.
**Screening and study selection.**

Blind screening of title and abstract was undertaken by the first and fourth authors in the online screening software Covidence© (Covidence.org, 2017) using the following inclusion criteria:

1. Nurses providing care in critical care/intensive care settings for adult patients ≥18 years of age;
2. Qualitative studies to include mixed methods, ethnography, phenomenology, grounded theory, lived experience, narrative analysis, generic qualitative;

Disagreements between the first and fourth authors on included studies for full screening were resolved by reaching consensus through discussion with the second and final authors. Full text screening was then undertaken on 77 papers by the first and final authors (Figure 1). The screening processes resulted in the inclusion of 12 studies (reported in 13 papers) exploring nurses’ experiences of providing care in critical care/intensive care settings for adult patients (Figure 1, Table 2).

**Quality assessment**

Quality appraisal of each study in the review was undertaken by the first and second authors and guided by the Critical Appraisal Skills Programme framework (CASP, 2017) (Table 3).

**Data extraction and thematic analysis.**

Thomas and Harden’s (2008) three-stage approach to thematic analysis guided our synthesis. The included papers were read in full and initial codes were generated from each study’s findings (i.e. verbatim accounts from study participants and the
researchers’ interpretations) by the first author. In keeping with precedent set in other QES studies (as noted in Thomas and Harden (2008)), we considered that the findings of the included studies were quotations from the participants and also the researchers’ interpretations. Noyes and Lewin (2011) deem this to be a more inclusive approach to data extraction in that it provides valuable qualitative evidence that may have otherwise been missed if the original paper has been restricted in the number of direct quotes included.

Line-by-line coding of each study’s findings was examined repeatedly and compared against data and codes from the other studies. Existing codes were clarified and new codes were added. The second stage of synthesis included grouping related codes into logical descriptive themes. In the third stage, these descriptive themes were used to address the review question itself. These concepts were further organised into the final three higher order analytical themes, which were validated by the second and last authors.

Finally, we used the GRADE-CERQual (Confidence in Evidence of Reviews of Qualitative Research) assessment to reach conclusions on our confidence in our review findings. GRADE-CERQual allows a judgement to be reached regarding the confidence in each individual review finding (Lewin et al., 2015; Lewin et al., 2018 a, b) (Table 4). This assessment was undertaken by the first, second and last authors.

Results

Sample sizes across the included studies ranged from 8 to 22, with a total of 122 nurses from eight different countries.
Three higher order themes were identified across the studies 1) Sometimes machines get all the attention, 2) With experience the patient becomes the focus, and 3) Technology can’t save everybody.

**Sometimes machines get all the attention**

Critical care nurses face daily challenges in caring in an environment pervaded by contradictions and tensions regarding technology and care. Novice nurses experience fear and stress when developing their technological competence and “it’s very easy to lose sight of the patient, the emphasis of priority can be lost” (Alasad, 2002, p. 410).

Technology and caring are viewed as inseparable (Price, 2013; Tunlind et al., 2015; Wikstrom et al., 2007). Caring involves giving “so much care to the patient with the computer” (Almerud et al., 2008, p. 134), and “…looking at them from the baseline, by looking at the gases, and… at the patient overall” (Crocker and Timmons, 2009, p.57). Technology was also the means by which the critical care nurse remains almost constantly present at the bedside (Almerud et al., 2008; da Silva and Ferreira, 2013; McGrath, 2008; Price, 2013; Walters, 1995). However, there was also acknowledgement of the risk of nurses giving ‘…too much focus to the devices’ (Tunlind et al., 2015, p. 120) and becoming dependent on the technology; “…you do get very reliant on the machinery because they make you feel safe and in control” (Alasad, 2002, p.410).

Although nurses across the studies acknowledged their responsibilities in developing caring relationships with patients, the episodes of care wherein the equipment and machinery were considered by nurses to take centre stage over other aspects of nursing care, demonstrates the very real risk of depersonalising patients. The studies exposed that nurses felt much of their time was spent caring for machines (Alasad,
2002; Almerud et al., 2008; Crocker and Timmins, 2009; da Silva and Ferreira 2013; Häagström et al., 2013; Kongsuwan and Locsin, 2011; Price 2013; Tunlind et al., 2015; Wilkin and Slevin, 2004). This meant that nurses often worried “more about the machines” (Kongsuwan and Locsin, 2011, p.106), avoided undertaking some nursing care in case of disconnecting dialysis or other connections (Tunlind et al., 2015), had limited time available for ‘the little things that make patients comfortable” (Alasad, 2002, p. 411), and worried that “it’s not the patient who is most important” (Almerud et al., 2008, p.133). Nurses expressed frustrations with time spent preparing equipment. This was perceived as time lost or wasted time. In this instance, the ‘patient work’ (i.e. patient care) was viewed as a separate entity to the work of preparing the equipment.

“Yes, when priming and preparing the dialysis equipment it might take away hours of patient work. . . And those messes and yes, you may be stuck with it for several hours. . . a whole morning” (Tunlind et al., 2015, p.119).

In addition, the equipment and technology were seen as distracting and a level of disengagement from patients and their concerns was obvious as a result.

“The patients and their families may be fearful of the alarms. Sometimes we forget about the patients and don’t concern ourselves to explain the reason for the alarms” (Kongsuwan and Locsin, 2011, p.107).

This highlights technology as a potential barrier to developing meaningful relationships with patients, primarily as a result of how much time is spent interacting with equipment (Almerud et al., 2008; Kongsuwan and Locsin, 2011).

**With experience the patient becomes the focus**

Novice critical care nurses lack confidence in using technology. Their care as a result focuses on the technology and not the patient (Kongsuwan and Locsin, 2011) because they need technology in an effort for “full control” (Haggstrom et al., 2012, p. 512). However, with experience the critical care nurse can use technology in the background
They accept the technology as just one facet in caring for the whole patient. Paradoxically, their high level of technical competence results in technology holding less, rather than more prominence in their provision of patient care, in order to ‘to see the patient first’ (Tunlind et al., 2015, p. 120) and “have no problem reducing the technology for a patient” (Haggstrom et al., 2012, p. 512). This relates to the experience that develops with technological competence (McGrath, 2008) and knowing that ‘caring is technological’ (Alasad, 2002, p. 410), but also that “…technology is dumb; it needs care” (da Silva and Ferreira, 2013, p.1327). With increasing experience, critical care nurses are able to bring the patient centre stage, and keep technology in perspective in their caring endeavours, “…you mustn’t lose sight of the pressure area care, the comfort, the reassurance…” (Alasad, 2002, p.411) while being cognisant that “Technology assists us to know the patient more and be with the patient more but we may not be more interested in really knowing the patient” (Kongsuwan and Locsin, 2011, p. 106)

Experienced nurses articulated an awareness of their transition from novice to expert nurse and spoke with a slightly self-deprecating tone about their early career selves, where technology was centre-stage, and they experienced fear and anxiety as novice nurses (Almerud et al., 2008; Haagstrom et al., 2013; Kongsuwan and Locsin, 2008; McGrath, 2008; Tunlind et al., 2015). The ability to hold technology in abeyance develops with experience and results in a shift from focusing on technology to focusing on the patient and delivering person-centred care within the bounds a technological dominant environment (Alasad, 2002; Almerud et al., 2008; Crocker and Timmons, 2009; McGrath, 2008; Tunlind et al., 2015; Walters, 1995; Wilkin and Slevin, 2004). Technology is viewed as necessary for caring, and “incorporated into caring … helping
you use all the tools around you ... the monitors are giving you information which you use in caring” (Walters, 1995, p. 405). Nurses also involve relatives to help “bring the patient out from the technology” (Walters, 1994, p.26).

**Technology can’t save everybody**

Nurses worried that machines were “sometimes ….more important” than patients (Almerud et al., 2008, p.133), and also considered technology in critical care to be useless in ‘hopeless medical situations’ (Kongsuwan and Locsin, 2011, p. 105). Despair resulted when reliance on technology was not realistic (McGrath, 2008). Nurses articulated concerns relating to treatments and interventions that they perceived as extending life inappropriately. Whilst recognising that technology in an ICU is life-saving and life-sustaining, nurses acknowledged the limitations that such technologies could offer in certain circumstances, and questioned these limitations (Häägström *et al.*, 2013; Kongsuwan and Locsin, 2011; Mc Grath, 2008). Nurses were also cognisant of ethical considerations such as the possibility of inflicting suffering by prolonging futile treatment (Kongsuwan and Locsin, 2011; McGrath, 2008; Wilkström *et al.*, 2007). Helping families come to terms with a relative’s imminent death in the context of a ‘false faith in science’ was also highlighted (McGrath, 2008, p. 1102).

**Discussion**

The findings of this evidence synthesis suggest that technology is central to caring in critical care, and supports Locsin’s theory of technological competence (Locsin, 2010). Achieving a balance in critical care nurses’ relationship between caring and technology is clarified in the mid-range theory of ‘Technological Competency as Caring’ (Locsin, 2010). Locsin (2010) presents the more optimistic foundational view
that nurses’ competency in the use of technology enhances their ability to care for and engage with patients in critical care. This technological competency or knowing is viewed as demonstrative of the focused attention that the nurse offers, and an understanding of ‘technology and caring as co-existing in nursing’ (Locsin, 2010; p.470) which is made explicit in a ‘harmonious relationship between technological competency and caring in nursing’ (p.461). This finding is also supported elsewhere where a positive association between nurses’ caring attributes and influences of technology is reported (Bagherian et al., 2017).

Nurses viewed technology simultaneously as time-wasting and time-saving (Almerud et al., 2008; McGrath, 2008; Price, 2013; Tunlind et al., 2015). These paradoxical findings mirror the similar contradictory nature of patients’ experiences of technology and care, wherein patients’ experiences are described as ‘impersonal yet personal, alienating yet reassuring, uncomfortable yet comforting’ (Stayt et al., 2015, p.2058). However, the review has also found that technology often dominates care (Alasad, 2002; Konguwan and Locsin, 2011; Tunlind et al., 2015; Wilkin and Slevin, 2004). This is not surprising as cognitive work is required for critical care nurses, for instance, to engage with alarming machines in order to determine the context of the alarm in relation to the patient’s condition (Gazarian et al., 2015).

ICU environments can be potentially ‘hostile’ (Donchin and Seagull, 2002; Ely et al., 2001). Disease, pain, the invasive nature of treatments and interventions, coupled with environmental issues such as excessive noise, light, and social isolation combine to have a significant effect on patient well-being (Wenham and Pitard, 2009). Alarm fatigue among critical care nurses is also prevalent (Casey et al., 2018). Caring for
patients faced with such testing issues, in a highly technological environment, will therefore pose challenges for critical care nurses, especially novice nurses.

As reported in the review findings, novice critical care nurses experience fears and anxieties relating to caring for technologically dependent patients. Nurses new to critical care report feeling ill-prepared in managing critical care technology (Gohery and Meaney, 2013). Such specialised technology can overwhelm novice nurses (Despins, 2017), and dominate their attention resulting in loss of opportunities for what is termed ‘compassionate presence’ in the context of patient centred nursing in intensive care (Jakimowicz and Perry, 2015, p.1511).

However, once technological competence or mastery is achieved, caring may actually be enhanced by virtue of technology contributing to decision making and nursing care (Tunlind et al., 2015; Wilkin and Slevin, 2004). The contribution that the experienced ICU nurse has to offer is a salient finding of this review. The experienced ICU nurse demonstrates the ability to hold technology in abeyance and see the patient beyond the life-sustaining technology. This is captured succinctly by Whelton (2016, p. 31) who asserts that ‘when one is focusing on the patient, the equipment slides into the background’. Drawing upon Haraway’s (2000) suggestion of a ‘cyborg ontology’, it is argued that person centred care can thrive in a technological environment if nurses make attempts to ‘mediate this delicate balance between person-centred practice and technological knowing’ (Lapum et al., 2012, p.281). This can be achieved by adopting a hybridity where ‘human and technological features of our cyborg ontology can work in a more synergistic as opposed to dualistic fashion’ (Lapum et al., 2012, p. 284).
The theme ‘technology can’t save everybody’ highlights the potential for nurses’ despair when technology was used to extend patients’ lives inappropriately, for instance in futile situations. Work-related responsibilities and moral distress among critical care nurses is a known concern (Burston and Tuckett, 2013; Wiegand and Funk, 2012). End-of-life decision making is reported as being a major cause of moral distress for nurses in critical care (McAndrew et al., 2018). ‘Moral discord’ among critical care nurses can arise as a result of end-of-life issues because nurses are often not involved in the decision-making but are left with managing the outcomes of these decisions (Pattison, 2017). This view is not surprising as nurses’ knowledge in critical care often goes unrecognised by doctors, and also by nurses themselves; this knowledge is therefore not sought to contribute to discussions and decision-making around the use of technology to prolong life (Kryworuchko et al., 2016).

The technological demands on caring in critical care is evident. Nurses therefore need to care for each other. A suggested approach is nurse-to-nurse caring, which can create a healing environment in critical care where the empowerment and autonomy gained can actually counteract burnout and staff turnover (France et al., 2011). In addition, it is recommended that orientation programs for novice critical care nurses focus on technological confidence (Despins, 2017) but this must be balanced in the concept of caring. Such programs may help in easing anxiety among novice nurses and thereby re-balance their focus towards person-centred care.

The study has a number of limitations. While the search strategy was comprehensive, only studies published in the English language were included. Furthermore, only studies which explored the broader concept of the technological environment in critical
care units and the most important issues for nurses were included in the review. Including studies exploring distinct technological aspects such as alarms, and preparing and tending to specific equipment may have resulted in a deeper understanding of critical care nurses’ experience of caring in a highly technological environment. Moreover, while the struggles of novice critical care nurses are clear, insufficient data were provided in all of the included studies to determine what proportion of nurses were novice versus seasoned critical care nurses. Therefore, aspects of nurses’ experiences of providing care in this highly technological environment may not be adequately represented in this analysis. Nonetheless, a strength of the study was the team approach undertaken for the synthesis (Centre for Reviews and Dissemination, 2009).

Conclusion
This review highlights caring in a highly technological work environment through the eyes of critical care nurses. It lends clarity to critical care nurses’ unique perspectives and highlights that caring in this environment may be jeopardised by an unbalanced focus on technology. The struggles of novice critical care nurses and the value of experienced critical care nurses in their provision of holistic person centred care has also been illuminated. These findings force a spotlight on the educational and empathetic supports that are needed to underpin nursing care in this unique environment.
**Relevance to clinical practice**

The review highlights that critical care nurses need to actively balance caring for the person and machines. Experienced nurses achieve this balance and can offer support to novice nurses in relation to their emotions and insecurities around technology. Critical care nurse orientation programmes should be underpinned by a holistic approach which embraces the dualism that is technology and care in critical care settings, while simultaneously empowering nurses with knowledge on how to manage technology that ‘demands’ nurses’ attention. Finally, technology is central in critical care nursing; therefore, novice nurses need guidance on developing an acute awareness to their possible over-emphasis on the technological workload, which if left unchecked, can lead to depersonalised care.
References


### Table 1 Search Terms

Search terms & Boolean operators (AND, OR).

<table>
<thead>
<tr>
<th>Setting</th>
<th>Perspective</th>
<th>Phenomenon of Interest</th>
<th>Evaluation</th>
<th>Experience</th>
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<tr>
<td>ICU</td>
<td>ICU nurses</td>
<td>Critical care nursing</td>
<td>Nursing / care</td>
<td>Experiences</td>
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<td></td>
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<td>MESH</td>
<td>(explode)</td>
<td>Perceptions</td>
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<td>ICU nurse</td>
<td>Working</td>
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<td>Registered nurse</td>
<td>High Tech</td>
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<td>Intensive care nurse</td>
<td>High technology</td>
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<td>Critical care nurse</td>
<td>Technologically intense</td>
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<td>Advanced practitioner</td>
<td>Technological</td>
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<td>Burns nurse</td>
<td>environment</td>
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<td>Coronary care nurse</td>
<td>Highly technological</td>
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<td></td>
<td>CCU nurse</td>
<td>Monitoring equipment</td>
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<td>OR</td>
<td>ICU nurses</td>
<td>Providing care in High Tech environment</td>
<td>Machinery</td>
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<td>Intensive care unit MESH</td>
<td>ICU nurse</td>
<td>High Tech</td>
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<td>Intensive care unit</td>
<td>ICU nurse</td>
<td>Technologically intense</td>
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<td>ICU</td>
<td>ICU nurse</td>
<td>Technological environment</td>
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<tr>
<td>Stroke care unit</td>
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<td>Monitoring equipment</td>
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Figure 1 Prisma Flow Diagram

- **Identification**
  - Records identified through database searching (n=1721)
  - Additional records identified through other sources (n=1)
    (citation searching)

- **Screening**
  - Records after duplicates removed (n=1328)

- **Eligibility**
  - Records screened (n=1328)
  - Records excluded (n=1251)

- **Included**
  - Full-text articles assessed for eligibility (n=77)
  - Studies included in qualitative synthesis (n=12; reported in 13 papers)
  - Full-text articles excluded, with reasons (n=64)
    - 17 Wrong focus
    - 13 Not in English
    - 7 Could not access study
    - 5 Not primary study
    - 3 Wrong outcomes
    - 3 Wrong study design
    - 5 Duplicate
    - 3 Wrong nurse population
    - 2 Wrong publication type
    - 1 Secondary reflection on previous studies
    - 2 No qualitative data
    - 1 Unable to identify nurse from other professionals
    - 1 Focus on using computer for documenting care not technology in broader sense
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<th>Author(s)/year</th>
<th>Country</th>
<th>Design</th>
<th>Sample</th>
<th>Method</th>
<th>Study focus</th>
<th>Methodological quality (CASP)</th>
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<td>1</td>
<td>Alasad (2002)</td>
<td>Jordan</td>
<td>Phenomenological hermeneutics</td>
<td>22 critical care nurses</td>
<td>In-depth interviews and overt participant observations (@240 hours). Draper’s hermeneutical analysis</td>
<td>To describe the experiences of a group of critical care nurses regarding the use of technology in the intensive care unit</td>
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<td>Sweden</td>
<td>Phenomenological</td>
<td>Eight nurses and two physicians*(*Data extracted from nurse population only).</td>
<td>Open interviews. Phenomenological analysis (Lifeworld) (Dahlberg)</td>
<td>To uncover the meaning of being a caregiver in the technologically intense environment.</td>
<td>9</td>
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<td>3</td>
<td>Croker and Timmons (2009)</td>
<td>United Kingdom</td>
<td>Ethnography</td>
<td>12 critical care nurses (ICU and HDU units)</td>
<td>Participant observation and focused interviews. Content analysis (Silverman)</td>
<td>To identify the meaning of technology related to weaning from mechanical ventilation for critical care nurses and to explore how that technology is used in practice.</td>
<td>9</td>
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<td>4</td>
<td>da Silva and Ferreira (2013)</td>
<td>Brazil</td>
<td>Qualitative field research.</td>
<td>21 Intensive Care Nurses.</td>
<td>Observation and interview.</td>
<td>To characterise the specific practice of intensive care nursing</td>
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<td>5</td>
<td>Håggström et al., (2013)</td>
<td>Sweden</td>
<td>Classic Grounded Theory</td>
<td>22 ICU nurses; One anaesthesiologist. (*Data extracted from nurse population only).</td>
<td>Focus group interviews (x3); Individual interviews (x 9). Observation (x13)</td>
<td>To provide a deeper understanding of the experience of ICU staff regarding the reduction in the use of medical devices in the ICU.</td>
<td>8</td>
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<tr>
<td>No.</td>
<td>Author(s)</td>
<td>Country</td>
<td>Study Design</td>
<td>Participants</td>
<td>Methodology</td>
<td>Study Objective</td>
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<tr>
<td>6</td>
<td>Kongsuwan and Locsin (2011)</td>
<td>Thailand</td>
<td>Hermeneutic Phenomenological approach</td>
<td>8 ICU nurses. 5 working in Medical ICU, 3 in Surgical ICU.</td>
<td>Grounded theory, constant comparative analysis.</td>
<td>To describe the meaning of the experience of Thai nurses caring for persons with life-sustaining technologies in intensive care settings.</td>
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<tr>
<td>7</td>
<td>McGrath (2008)</td>
<td>Ireland</td>
<td>Heideggerian phenomenological study</td>
<td>10 Critical Care nurses working in 2 cardiothoracic critical care units.</td>
<td>Analysis guided by hermeneutic method devised by Waters (1995) adapted from Diekelmann (See number 10 below)</td>
<td>To describe the lived experiences of experienced critical care nurses caring within a technological environment.</td>
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</tr>
<tr>
<td>8</td>
<td>Price (2013)</td>
<td>United Kingdom</td>
<td>Ethnographic</td>
<td>8 nurses were observed and 16 health care professionals were interviewed* (13 were nurses) (*Data extracted from nurse population only).</td>
<td>Observation (8 nurses) Interviews (13 nurses). Constant comparative analysis (Glaser and Strauss).</td>
<td>To describe aspects which affect registered health care professionals’ ability to care for patients within the technological environment of a critical care unit.</td>
<td></td>
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<tr>
<td>9</td>
<td>Tunlind et al., (2015)</td>
<td>Sweden</td>
<td>Qualitative descriptive study.</td>
<td>8 Critical Care nurses working in the ICU.</td>
<td>Semi-structured interviews. Thematic inductive content analysis</td>
<td>To describe critical care nurses’ experiences of performing nursing care in a high technology healthcare environment</td>
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<td></td>
<td>Study</td>
<td>Country</td>
<td>Methodology</td>
<td>Research Design</td>
<td>Sampling Method</td>
<td>Data Collection</td>
<td>Data Analysis</td>
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<td>10</td>
<td>Walters 1994</td>
<td>Australia</td>
<td>Hermeneutic phenomenology</td>
<td>Eight intensive care nurses, all of whom were classified as clinical nurse specialists in recognition of their expertise in critical care nursing.</td>
<td>One open question ‘Tell me what it is like to care for a critically ill person’</td>
<td>Analysis guided by Reinharz’s hermeneutic method.</td>
<td>To provide an interpretation of the lifeworld of critical care nursing.</td>
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<tr>
<td>11</td>
<td>Wikström et al., (2007)</td>
<td>Sweden</td>
<td>Ethnography (part of a larger study)</td>
<td>Purposive sampling. 12 Participants, (#4 Anaesthetists, 4 Enrolled Nurses, 4 Registered Nurses. (*Data extracted from nurse population only).</td>
<td>Open questions using a semi-structured interview guide. Inductive analysis.</td>
<td>To search inductively for categories that could explain ‘how is intensive care produced?’</td>
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<tr>
<td>12</td>
<td>Wilkin and Slevin (2004)</td>
<td>Ireland</td>
<td>Heideggerian phenomenological approach.</td>
<td>Purposive sampling of registered nurses (n=12) working in ICU. With a minimum of 1 year ICU experience</td>
<td>Semi-structured interviews. Data analysis guided by Colaizzi’s seven-step method.</td>
<td>To explore the meaning of caring to intensive care unit nurses. The aim was to determine if the meaning of caring to these nurses has...</td>
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stage process of analysis
potential for altering nursing practice and to gain an insight into how caring experiences were evident to them.
<table>
<thead>
<tr>
<th></th>
<th>1. Was there a clear statement of the aims of the research?</th>
<th>2. Is a qualitative methodology appropriate?</th>
<th>3. Was the research design appropriate to address the aims of the research?</th>
<th>4. Was the recruitment strategy appropriate to the aims of the research?</th>
<th>5. Was the data collected in a way that addressed the research issue?</th>
<th>6. Has the relationship between researcher and participants been adequately considered?</th>
<th>7. Have ethical issues been taken into consideration?</th>
<th>8. Was the data analysis sufficiently rigorous?</th>
<th>9. Is there a clear statement of findings?</th>
<th>10. How valuable is the research?</th>
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<tbody>
<tr>
<td>1</td>
<td>Alasad, 2002</td>
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<td>2</td>
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<td>3</td>
<td>Crocker &amp; Timmons, 2009</td>
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<td>4</td>
<td>da Silva et al., 2013</td>
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<td>6</td>
<td>Kongsuwan, 2011</td>
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<td>McGrath, 2008</td>
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<td>8</td>
<td>Price, 2013</td>
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<td>9</td>
<td>Tunlind et al., 2015</td>
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<td>10</td>
<td>Walters, 1994, 1995</td>
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Table 4
Review Findings

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<tr>
<th>Supporting quotes</th>
<th>Studies contributing to the review findings</th>
<th>Confidence in Evidence</th>
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<tbody>
<tr>
<td>“When you come to ICU I think you can become quite overawed with the equipment the machinery and the noise. The technology can be quite almost exciting and that can make you lose sight of the patient” (Alasad, 2002, p.410).</td>
<td>1, 2, 4, 5, 6, 8, 9, 12</td>
<td>High confidence: Five studies with no concerns about coherence, relevance, adequacy and methodologic limitations (1, 2, 6, 8, 9, 12)</td>
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<td>“The other thing you’ve got to try and not do is let the machines take over the patient which they can do especially if you’ve got somebody who’s very sick. You tend to be nursing the machines rather than nursing the patient”. (Alasad, 2002, p.411).</td>
<td>1, 2, 4, 5, 6, 8, 9, 12</td>
<td>High confidence: Five studies with no concerns about coherence, relevance, adequacy and methodologic limitations (1, 2, 6, 8, 9, 12)</td>
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<td>“Some machines are almost, well, more important. You feel this helplessness because what I’m supposed to be doing is caring for patients not the machines” (Almerud, 2008, p.133).</td>
<td>1, 2, 4, 5, 6, 8, 9, 12</td>
<td>High confidence: Five studies with no concerns about coherence, relevance, adequacy and methodologic limitations (1, 2, 6, 8, 9, 12)</td>
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<tr>
<td>“It’s easy to focus on the monitoring device. And you see that quite often, people forgetting to say hello to the patient” (Almerud et al 2008, p. 134).</td>
<td>1, 2, 4, 5, 6, 8, 9, 12</td>
<td>High confidence: Five studies with no concerns about coherence, relevance, adequacy and methodologic limitations (1, 2, 6, 8, 9, 12)</td>
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<td>“The Prisma [dialysis machine] wants a person to pet it all the time for it to be pleased. It has to get immediate attention, as soon as it says anything” (Almerud et al., 2008, p.134)</td>
<td>1, 2, 4, 5, 6, 8, 9, 12</td>
<td>High confidence: Five studies with no concerns about coherence, relevance, adequacy and methodologic limitations (1, 2, 6, 8, 9, 12)</td>
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<td>“[Technology] can provide me with the information about the patient…When caring for patient 1, I can look at the technology of patient 3 and it will tell me if I must stop what I am doing…”(Da Silva and Ferreira, 2013)</td>
<td>1, 2, 4, 5, 6, 8, 9, 12</td>
<td>High confidence: Five studies with no concerns about coherence, relevance, adequacy and methodologic limitations (1, 2, 6, 8, 9, 12)</td>
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<td>“…we continue to monitor the patient to the full extent until the very last second, even if it is not needed.” (Häggström et al 2012, p.511).</td>
<td>1, 2, 4, 5, 6, 8, 9, 12</td>
<td>High confidence: Five studies with no concerns about coherence, relevance, adequacy and methodologic limitations (1, 2, 6, 8, 9, 12)</td>
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<tr>
<td>“Sometimes we forget about the patients and don’t concern ourselves to explain the reason for the alarms” (Kongsuwan and Locsin, 2011, p.107).</td>
<td>1, 2, 4, 5, 6, 8, 9, 12</td>
<td>High confidence: Five studies with no concerns about coherence, relevance, adequacy and methodologic limitations (1, 2, 6, 8, 9, 12)</td>
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<td>“Instead of caring for the patients, we are now caring for the [technological] environment” (Kongsuwan and Locsin, 2011, p. 107)</td>
<td>1, 2, 4, 5, 6, 8, 9, 12</td>
<td>High confidence: Five studies with no concerns about coherence, relevance, adequacy and methodologic limitations (1, 2, 6, 8, 9, 12)</td>
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Sometimes machines get all the attention
Technology is synonymous with caring in critical care but simultaneously it interferes with caring by virtue of the time needed to care for the machines.
"We stand at the patient's bed most of the time but we may talk less. Sometimes, we come to record the [data about the patients from the] machines and then leave. Sometimes the patient is waiting for our eyes but our eyes don't look at the patient" (Kongsuwan & Locsin, 2011, p.106)

"When there are many technologies used for the care of the patient, we touch the patient less. We touch their heart and body less. If we have fewer technologies, we will care less for the technologies and care more for the patients. We will have time to talk to the patients and know them-about their happiness and suffering" (Kongsuwan and Locsin, 1011, p. 106)

[Participant talking about CVVH machine says it is 'craving all my attention' and might have to 'bring it down'. (Price, 2013, p.283)]

“Yes, when priming and preparing the dialysis equipment it might take away hours of patient work. . . And those messes and yes, you may be stuck with it for several hours. . .a whole morning. . .” (Tunlind et al., 2015).

"To pick up a patient in five minutes at the bedside, might take an hour just to release all the cords and move all the pumps and everything, so we might ignore it". (Tunlind et al., 2015, p.120).

"Sometimes you are wrapped up looking after the machines, you forget to look after that patient and yet that person is a human being who needs you to spend time with them”. (Wilkin & Slevin, 2004, p. 54).
With experience the patient becomes the focus

Novice critical care nurses lack confidence in using technology; however, with experience the critical care nurse can keep technology in abeyance and this results in a shift from focusing on technology to focusing on the patient and deliver person-centred care within the bounds a technological dominant environment

“...as you become more aware and more confident in what you're doing, you then concentrate on the patient and use the machines as just an added source for your care they are a side-line that is helping them to get better. (Alasad, 2002, p.410).

“In the beginning you noticed that, kind of, it was only numbers, results and machines all the time. It's still like that, sometimes, that you have to think twice, I can look at the patient too”. (Almerud et al., 2008, p.134).

“You need to look at why patients are not weaning. It is not a case of just turning down the pressures...You need to look at the person holistically” (Crocker and Timmons, 2008, p.56).

“After you have been working a while in ICU, you learn to notice the patient first and the technology second. Technology sometimes gives a false sense of security (ICU nurse with 25 years of experience”. (Häggström et al., 2013, p.512).

“Working in the ICU for the first time we felt fear — afraid since we didn't know the machine technologies” (Kongsuwan & Locsin, 2011, p.105).

“So once the patient is settled into the intensive care, the technology is just there in the background...we just focus on the patient and their family”. (Mc Grath, 2008, p.1100).

“So even though she was on dialysis and she was ventilated through a tracheostomy, which she had done previously, she was still able to wear her own nighties and have her own cuddly toys and her music and we were even able to play (board) games...with her and her family. Even though to the outsiders it might have looked that it was all very invasive, in actual fact her family began to feel quite at home in there...”(Mc Grath, 2008 p.1100).

“I was new and there was not an eye on all parts. But now I think it's like you're used to it there, and these devices are just a part of the work”. (CCN 3) (Tunlind et al, 2015, p.120).

High confidence:
Seven studies with no concerns about coherence, relevance, adequacy and methodologic limitations (1, 2, 5, 6, 7, 9, 10)
Two studies with minor concerns about adequacy and coherence (3, 12).
“I try to get to the person in the bed. I try to organize the bed areas in an attempt to make the person more visible. I hide things under pillows, like the ECG cable, so that the patient won’t see them. I tidy up my bed area so that all the clutter is gone. You can get to the patient. I see my patient better” (Walters, 1995, p.495).

“By trying to utilize tools such as writing, or picture boards we can tell what their fears are, this enables patients to express what their needs actually are”. (Wilkin & Slevin, 2004, p.55).

Technology can’t save everybody

Nurses often despaired when a reliance on technology was not realistic and patients’ lives were extended inappropriately by technology.

“High technology was used to prolong a patient’s life although his condition was hopeless. His heart was not functioning as it should. We inserted IABP [Intra-Aortic Balloon Pump] to extend the patient’s life and wait for the family. We don’t know whether or not extending the patient’s life was making him/her suffer more”. (Kongsuwan & Locsin, 2011, p105).

“We don’t seem to have quite yet the intelligence to deal with all the technology we have. [Regarding decisions failed to be made on what technology realistically had to offer]. (Mc Grath, 2008, p1102)

“He was in, I’d say he was in eight or nine weeks and he had complication after complication. He just looked like death in the bed. They were still putting tubes in and putting him up on more drugs. It’s very, very disheartening. I mean we can just voice our opinion but it’s not a nursing decision” (Mc Grath, 2008 p.1102).

...“Someone who is on massive life support and it is clear that the person is not going to survive needs someone to speak on their behalf. I have an important role in counteracting or balancing the medical management”. (Walters, 1995 p.495).

“Preserving the individuality of the person is important. Their individuality can become lost day by day in ICU. Someone who is on massive life support and it is clear that the person is not going to survive needs someone to speak on their behalf. I have an important role in counteracting or balancing the medical management”. (Walters, 1995, p.495).
"First, we are to give them everything and then suddenly we are to withdraw. This confuses me as a nurse, not to mention the relatives" (Wikström et al., 2007)