

# Chapter 12

## Researching Nursing Informatics in a Digital Age



Tracie Risling, Gillian Strudwick, and Richard Booth

**Abstract** To ensure that nurses are able to practice in evidence informed environments, nursing research has become an essential part of the profession. This chapter provides a foundational overview of the research process commonly used in nursing study, while highlighting how informatics can contribute to the research process but also be a researched topic in itself. The chapter begins with a detailed description of the common steps taken when conducting nursing research for both nursing informatics and other topics. Then, a number of ways nursing informatics can be used to support the research process itself are given using practical examples. The chapter concludes with a discussion of current and future opportunities for nursing informatics research.

**Keywords** Nursing informatics research · Nursing research · Quantitative methods · Qualitative methods · Mixed methods research

### Learning Objectives for the Chapter

1. Explain nursing research and research methods.
2. Discuss qualitative, quantitative and mixed methods research.

---

**Electronic Supplementary Material** The online version of this chapter ([https://doi.org/10.1007/978-3-030-58740-6\\_12](https://doi.org/10.1007/978-3-030-58740-6_12)) contains supplementary material, which is available to authorized users.

---

T. Risling (✉)

College of Nursing, University of Saskatchewan, Saskatoon, SK, Canada  
e-mail: [tracie.risling@usask.ca](mailto:tracie.risling@usask.ca)

G. Strudwick

Centre for Addiction and Mental Health, Toronto, Ontario, Canada

Institute of Health Policy, Management and Evaluation, University of Toronto, Toronto, ON, Canada

e-mail: [gillian.strudwick@camh.ca](mailto:gillian.strudwick@camh.ca)

R. Booth

Arthur Labatt Family School of Nursing, Western University, London, ON, Canada  
e-mail: [rbooth6@uwo.ca](mailto:rbooth6@uwo.ca)

© Springer Nature Switzerland AG 2021

P. Hussey, M. A. Kennedy (eds.), *Introduction to Nursing Informatics*, Health Informatics, [https://doi.org/10.1007/978-3-030-58740-6\\_12](https://doi.org/10.1007/978-3-030-58740-6_12)

3. Describe at least two areas influencing the future of nursing informatics research.
4. Introduce emerging technologies impacting nursing research such as artificial intelligence (AI) and machine learning (ML).
5. Review the importance of compassionate care in nursing informatics intervention and research.

## 12.1 Introduction

With the increased digitalization of all aspects of the nursing role and healthcare over the last few decades, the influence on nursing research has begun to be felt in all domains of knowledge generation and inquiry. Historically, while nursing informatics has existed for numerous years as a specific topic within the body of nursing literature, the growing importance and presence of digital technologies in all aspects of life and work has resulted in a paradigm shift toward *how* these forms of innovation and informatics can be used as a supportive mechanism (Polit and Beck 2012), to extend, and at times, underpin many forms of nursing research activities. Inasmuch as, the increased presence and visibility of informatics in the workplace and society has subtly offered nurses new and important opportunities to leverage the functionalities of these technologies to assist in many types of research activities, including information aggregation, data collection, and knowledge dissemination. While using supportive elements of informatics to conduct research has become commonplace in nursing research, it is important to appreciate that the topic of nursing informatics also exists as its own nursing specialty, and the foci of significant research activities by numerous scholars and practitioners worldwide (Sidani and Braden 2011; Peters et al. 2015).

For instance, the recent increased adoption of electronic medical records (EMR) and other digitalized record keeping systems have opened entirely new fields of inquiry to nursing scholars. With the increased ability to query, trend, and aggregate datasets arising from disparate locations, nursing researchers now have the opportunity to generate micro- and macro- interpretations related to population health, wellness, and other areas of inquiry relevant to the nursing role and health (Levac et al. 2010). To date, there is a growing body of nursing researchers who use healthcare administrative data arising from EMR and other digitized record systems to generate insights and other clinical recommendations to support practice (Levac et al. 2010; Arksey and O'Malley 2005). Further, the increased use of digital community technologies has also afforded researchers new and novel mechanisms from which to interact with vulnerable individuals and populations. For instance, the use of mobile technology to support individuals experiencing mental illness and homelessness is a novel approach that leverages the use of communication technology in a proactive fashion to support the wellbeing of individuals (Canadian Agency for Drugs and Technologies in Health 2018).

As outlined above, while nursing informatics can act as a supportive mechanism to conduct and apply nursing research, the topic can also be subject of its own inquiry (Trust MKP 2002). The discipline of nursing informatics has a long history of generating evidence related to the use of digital technology to support the nursing role and client care. While research focused on nursing informatics is broad and diverse, a few common traits do exist that span most inquiry in this area. For instance, as described by Matney et al. (Munhall 2012), the philosophical foundations of all nursing informatics research encapsulate concepts related to *data*, *information*, *knowledge*, and *wisdom*. Further, Matney et al. outlines that nursing informatics inquiry is appreciative of different philosophical and ontological lenses from which to explore the core concepts of data, information, knowledge, and wisdom. This philosophical and ontological plurality and receptivity can be viewed throughout published nursing informatics literature – including researchers that seek to rigorously evaluate technology systems used by nurses through post-positivist or objectivist methods (e.g., (Creswell and Clark 2007; Barnard and Sandelowski 2001)); while, other researchers prefer to utilize interpretive and constructivist approaches to better understand the experiences, workflow, and other fluid interpretations of human-technology interactions (e.g., (Kaminski 2011; Strudwick 2015)). Regardless of the philosophical or ontological approaches, research exploring specific aspects of nursing informatics will likely continue on into the future as distinct sub-set of other nursing research and continue to provide valuable insights to inform aspects of practice and healthcare delivery. Therefore, due to the multidimensional nature from which nursing informatics can both influence aspects of nursing research, and/or be the foci of nursing research, efforts will be taken in this chapter to provide a fulsome range of descriptions that accentuates these potentials and implications for the future.

## 12.2 Section 1: Steps in the Research Process

Nursing research is conducted on a variety of different topics that are important to the profession. This includes research on topics of relevance to those in clinical practice, administration/management, education, research, regulatory and other settings. This research is essential to the generation of evidence that nurses can use to make informed decisions in their respective roles. While the methods used by nursing researchers vary significantly based on the topic being studied, the general process that nursing researchers use to approach research is often quite similar. This section of the chapter will provide an overview of the common steps used by nursing researchers when engaging in research. This section applies to both research that is about nursing informatics, or uses nursing informatics approaches, as well as non-nursing informatics topics. The following section will provide examples of how the research steps outlined in this section apply specifically within a nursing informatics context.

### 12.2.1 *Overview of the Nursing Research Process*

The research process typically begins with the identification of a key issue, topic or problem relevant to nurses (Polit and Beck 2012). It then involves a series of investigative techniques to understand what is already known about the topic, and what aspects of the topic remain unknown. From this point, nursing researchers identify a need to conduct research to answer or address an important gap in what is known about a particular topic, problem or aspect of a topic. Often a series of research questions are then developed to address the particular gap identified from the literature review. A number of methods are then selected, designed and carried out to answer the research questions. The data obtained from this process is then analyzed, interpreted and discussed in the context of the original problem or topic, as well as the literature. These findings are then shared to those who would benefit from knowing the research results, traditionally through journal articles and conference presentations. The steps in a typical nursing research process are shown in Table 12.1, and are detailed in the remaining part of this section of the chapter.

### 12.2.2 *Step 1: Identify a Key Issue, Topic or Problem Relevant to Nurses*

The first step in the nursing research process is to identify a key issue, topic or problem that is relevant to nurses and that is important to address. This issue could be relevant to nurses working in clinical practice, administration/managerial, education, informatics, research and other settings. Key issues, topics or problems that need to be addressed could range from identifying appropriate nursing interventions to prevent pressure ulcers (Sidani and Braden 2011), to uncovering the appropriate

**Table 12.1** Steps of the nursing research process

Step	Research Process Activity
1	Identify a key issue, topic or problem relevant to nurses
2	Conduct a review of the literature
3	Develop research questions that address the gaps identified in the literature
4	Select an appropriate theoretical framework
5	Determine the methods required to carry out the research
6	Collect the research data based on the methods determined in step 5
7	Perform data analysis
8	Interpret and discuss the results
9 <sup>a</sup>	Conduct knowledge translation activities

<sup>a</sup>it may be appropriate to conduct knowledge translation activities during different steps in the research process

compliment of nurse staffing that would yield the best patient outcomes in a particular care setting, to identifying how best to educate nursing students to learn to use a new form of technology to deliver care. As the environments in which nurse's practice evolve, nursing research will continue to ask and answer important questions for the profession.

A common place to identify a key issue, topic or problem relevant to nurses is in their place of work, whether it be clinical, administration/managerial, educational or otherwise. It may be that nurses in these various settings are required to make important decisions, but lack (or are not aware of) the appropriate evidence to do so in an informed way. This lack of evidence may serve as a motivation for nurses to identify a key issue, topic or problem that they wish to pursue through formal research.

### ***12.2.3 Step 2: Conduct a Literature Review***

Once a key issue, topic or problem has been identified, a review of the literature can be done. The goal of the literature review is to uncover all that is known about the key issue, topic or problem that may help to identify how to solve it. It may be that research has already been completed that addresses the key issue, topic or problem, and that no further steps in the research process need to take place. So as long as the research that addresses the area of interest was done in a scientifically rigorous and appropriate way, it may be that the findings can be directly applied to the original problem or issue. Where gaps in the research exist that would prevent the application of appropriate findings, the nurse would proceed to step 3, which is to develop research questions.

There are different types of literature reviews that can be done to find out more about a key issue, topic or problem. These include traditional, narrative, integrated, rapid, scoping and systematic reviews (Peters et al. 2015; Levac et al. 2010; Arksey and O'Malley 2005). Each has their own specific methods and steps for conducting the literature review. However, while there are several established methods for conducting literature reviews, most follow a similar approach. This approach involves searching electronic databases and identifying articles within that may address the key issue, topic or problem, and then appraising the research to determine if the findings may be applicable to address the issue or problem. Common electronic databases that are searched among nursing researchers include (but are not limited to):

- CINAHL: The Cumulative Index of Nursing and Allied Health Literature
- PubMed
- PsycInfo
- Medline
- Scopus
- Google Scholar

- EMBASE
- Cochrane Library
- ERIC: Education Resources Information Center
- Joanna Briggs Institute

As well as the electronic databases listed above, depending on the focus of the research, it may be appropriate to utilize a database that is specific to another scientific domain. For example, to identify articles that discuss the design of a health related technology, it may be valuable to search an engineering database like Engineering Village. Many nursing schools are affiliated with academic libraries and librarians with knowledge of the many databases available to search. Consulting with a librarian can support the identification of the most appropriate databases to search for a given topic.

Each of the previously listed electronic databases that may be relevant to nursing is searched in a different way. Some (e.g. Medline) require the use of keywords and Medical Subject Headings (MeSH), combined together through a series of symbols called ‘Boolean operators’. Others (e.g. google scholar) allow for text to be searched more similarly to how searches are done in a regular web based search engine like google. It’s important to know how to search these electronic databases appropriately in order to yield the best results, including how to use Boolean operators if necessary. Often these databases have online tutorials, or instructions available that can be used to support successful use. As well, some educational institutions, healthcare organizations and libraries offer supports (e.g. librarians) and courses or tutorials to assist in the successful use of these electronic databases.

In addition to literature reviews of academic databases, there are also ‘grey’ literature reviews that are conducted to identify sources of important information that may not be found in traditional academic library environments. Grey literature sources can include websites, briefing notes, newsletters, government reports, conference presentation and beyond (Canadian Agency for Drugs and Technologies in Health 2018). These sources may contain information that was not formally written in a research article that could address the key issue, topic or problem. A common method for searching the grey literature is through web search engines such as google, or through searching organizational intranet sites. Depending on the key issue, topic or problem being investigated, including a grey literature search may be appropriate. One way to identify if a grey literature search may be worth conducting is to ask yourself, ‘could the answer to my key issue, topic or problem be found in a report, website or conference presentation?’ If the answer to this question is ‘yes’, it is likely worth conducting a grey literature search.

Once academic or grey literature is identified that may address or provide important information related to the key issue, topic or problem, it is important to conduct an appraisal of its quality. If a study is identified that addresses the issue in a problematic way or the scientific approach is not done well, the findings may not be relevant or useful to you. Several tools to support nurses in appraising academic articles exist. For example, the Critical Appraisal Skills Programme (Trust MKP 2002), developed in the United Kingdom, is one such resource that offers nurses free worksheets with key questions to ask when appraising research studies. The worksheets can be found at the following web address: <https://casp-uk.net/casp-tools-checklists/>

### ***12.2.4 Step 3: Develop Research Questions That Address the Gaps Identified in the Literature***

The next step in the research process is to develop a clear set of research questions that address the gaps that have been identified from the literature review conducted in the previous step. The research questions are what will be answered once the research has been conducted, and analyzed. One of the most important steps in the research process is to ensure that the research questions are clear, and addressable through nursing research. The research questions will then be used to identify the appropriate methods that would answer these questions. Thus, if the research questions have not been articulated well, are too vague, or are easy to misinterpret, it could lead to fatal flaws in the overall research. Once research questions are initially written, it's often useful to seek the feedback of others, particularly those with nursing research expertise. Another perspective in reviewing these questions is often helpful to support the 'honing in' on the best wording and use of language in the development of these research questions.

### ***12.2.5 Step 4: Select an Appropriate Theoretical Framework***

Once the research questions have been developed, a theoretical framework can be identified that appropriately addresses these questions. While not all health related research utilizes theoretical frameworks, it is common in nursing research to ground the research in a theoretical framework that helps to provide a basis for the research approach. There is not one ideal framework that is appropriate for all studies carried out by nurses. There are many different frameworks and models and the selection of any one of these is typically topic dependent. Depending on the topic, frameworks may be chosen from the nursing discipline, or others such as psychology, public health, sociology, gender studies and beyond.

In qualitative research, it is also common for studies to be reflective of the worldview that a researcher brings to their research. A worldview is often described as the way someone understands the world and the phenomenon they are studying (Munhall 2012). In some qualitative research studies, the researchers will explicitly discuss their worldviews within the context of their work.

### ***12.2.6 Step 5: Determine the Methods Required to Carry Out the Research***

In step 5, the methods that are required to carry out the research are determined. The selected methods are largely chosen based on the research question being asked (Polit and Beck 2012). Open-ended research questions that are exploratory in nature tend to be answered best through qualitative research approaches and methods, whereas research questions that are answerable by a more definitive and

closed-ended response typically use quantitative approaches and methods. Mixed methods are used when the research questions require both quantitative and qualitative approaches to answer them (Creswell and Clark 2007).

Once the approach (qualitative, quantitative or mixed methods) is selected, the sample, setting and data sources can be identified (if appropriate) to address the research questions. In research involving human subjects, the sample is the population which is studied for the purpose of the research. Commonly in nursing research, the sample consists of a group of patients with a similar condition (e.g. women with diabetes), or nurses themselves. The place or context in which the research takes place is called the setting. In nursing research, the setting is commonly a clinic, hospital, or community setting. Data sources vary widely in nursing research. In many forms of research, it is common for the data source to be a human participant themselves with data obtained through interviews and focus groups or by instruments or tools delivered through a questionnaire or survey, for example. The subject or participant could be a patient, family member, nurse etc. In other kinds of research, the data source could come from a non-human source like nursing documentation in an electronic health record, step counts on a pedometer, a heart rate monitor, staffing databases and beyond. It is important that the sample, setting and data source(s) are appropriately matched to the research questions so that these questions can be adequately answered. There are many different data sources that may answer a research question. Carefully considering how well the information is contained in the data source, as well as the feasibility of accessing the data source are key questions that should be thought about when selecting these sources.

In many settings it is a required step to write a research proposal summarizing steps 1 through 4, and detailing the specific methods that would be used in step 5. If money is required to execute the research, this research proposal may be read by potential funders like a granting agency, a donor or senior leadership at an organization where the research may take place. In addition, it is standard practice in many organizations around the world to have the research proposal reviewed and approved by a Research Ethics Board prior to conducting the research. This is to ensure the research is carried out in an ethical way.

### ***12.2.7 Step 6: Collect the Research Data Based on the Methods Determined in Step 5***

In Step 6, the methods identified and approved by the Research Ethics Board are carried out. If the research involves human subjects, recruitment of potential subjects occurs during this step. These participants are typically required to provide informed consent before they participate in the research, which communicates that they understand what they are being asked to do, along with any risks or benefits.



For research involving secondary data sources, during this step, researchers would obtain the various data sources and prepare the data for analysis.

Depending on the methods utilized, the outputs of the research at this step will vary. For example, focus groups and interviews will typically yield long transcripts of what was said by participants, whereas administrative secondary data may be captured on a spreadsheet. Artefacts from research may also include audio files, videos, photos, logbooks, reflection journals and artwork developed by participants. These outputs are dependent on the research methods used.

### ***12.2.8 Step 7: Perform Data Analysis***

The next step of the research process is data analysis. Techniques for data analysis vary depending on the type of research that was conducted. Various software tools have been created to support these analysis types. For example, for quantitative data analysis there are a variety of different statistical software programs, and for qualitative studies there is software that can support the organization of themes and coded categories. Ensuring that the right analytical methods are used is important in accurately and sufficiently answering the research questions.

### ***12.2.9 Step 8: Interpret and Discuss the Results***

Once the data has been analyzed, the next step is to interpret and situate the findings back into the literature, as well as the context in which the key issue, topic or problem was identified. When the results of the research are available, it is often important to ask if there are any key decisions, practices or policies that should be modified as a result? In addition, researchers may also ask what other questions have been identified as a result of the research that was conducted? It is not uncommon for additional research questions to be uncovered as a result of the research process in itself.

### ***12.2.10 Step 9: Conduct Knowledge Translation Activities***

In some studies, the knowledge gleaned from the research activities is shared with those who would benefit from it after the study has been completed. In other studies, there is a more integrated approach, where knowledge translation occurs throughout the research process. Traditional knowledge translation activities that take place once a study is completed include an academic publication in a scientific journal, and a conference presentation. Other activities may include web-based seminars (e.g. webinars), factsheets, briefing notes, presentation at stakeholder meetings,

social media campaigns, the development of videogames to share the information, websites, toolkits, and beyond.

In nursing clinical practice, it is often a challenge to ensure that the latest evidence is incorporated into routine practice. One way to support knowledge translation in these settings is to regularly review and update practice related policies and subsequent education/training for nurses based on the latest evidence. This would require an organizational commitment to ensure the appropriate resourcing and staff with expertise to review and update these policies regularly.

## **12.3 Section 2: How Nursing Informatics Can Be Used Throughout the Research Process**

Nursing informatics can be viewed as both a topic of study, as well as an approach to support the conduction of good quality nursing research. This section of the chapter outlines how nursing informatics approaches can be utilized to support the various steps in the nursing research process, with a special emphasis on step 5, which is to determine the methods required to carry out the research.

### ***12.3.1 Step 1: Identify a Key Issue, Topic or Problem Relevant to Nurses***

Informatics is changing nursing education, practice, and research. As technology continues to flow into nursing environments potential research topics increase correspondingly. The expanding use of electronic health records (EHRs) in nursing care is a good example of this. As EHR data became more commonly used around the world, nurses began to identify research priorities associated with this technology. These included, the urgent need to standardize data across records and systems, the impact of the use of this technology on existing work practices and patient relationships, and emerging ideas about what could potentially be done with the large amount of patient and nursing data being created in these records. From these few examples dozens of related research questions could, and in fact have been generated in nursing informatics as detailed further in Chaps. 3 and 11.

In general, the rapid pace of digital development tends to provide consistent opportunities or need for informatics research. Because of this, new researchers may be overwhelmed in choosing a topic or problem to study, as opposed to trying to find an area of research. A good starting point for all researchers is to examine the literature, in particular looking for any systematic or rapid reviews that have been done on their topic or within their practice area of interest.

Researchers in all disciplines are also increasingly interacting with each other on social media and in other online communities, further examples of which are

highlighted in Chap. 14 on Knowledge and Social Networks. Not surprisingly, these digital connections tend to be heavily used by informatics researchers. New researchers should establish their own networked communities using platforms such as Twitter, ResearchGate, Mendeley or Google Scholar as a starting point in their research. Find and follow nursing informatic and research organizations on Twitter and keep up to date on current hashtags to easily find information, for examples #Nurses4HIT and #NursingInformatics.

### ***12.3.2 Step 2: Conduct a Literature Review***

The purpose and value of online databases in conducting a comprehensive literature review has already been detailed, and librarians can be very valuable team members or resources in this work. In addition to the use of Medical Subject Headings (MeSH) or other subject key words, informatics researchers can also take advantage of the work done to establish standardized nursing data. Along with the long-standing presence of [NANDA International](#), the global source of standardized nursing diagnoses, researchers can also pull literature search terms from [SNOMED International](#) or ICNP, the [International Classification for Nursing Practice](#). The increasing development of data standards is not just benefitting the technical advancement of electronic health communication, it is also uniting informatics researchers around the world by aligning their terminology and associated research questions.

There are further ways to promote connectivity using other digital supports during a literature review. Even standard citation management software programs are now likely to offer ways for teams to share data and information. Mendeley has prioritized global collaboration and networking in its citation product, and EndNote also supports team interaction and sharing. Many of the databases used to complete reviews will send data to these other tools, making the work of the researcher much more efficient.

Lastly, another issue that nursing informatics researchers can face during the literature review phase is managing the volume of information gathered. Even when researching very new technologies there are typically large bodies of literature that have to be included in a review at least initially. Try searching the terms internet or mobile application in any of the databases you have learned about and you will quickly see the challenge informatics researchers must learn to manage. While the combining of key search terms can help to reduce the numbers in a literature search, informatics researchers doing systematic review work may want to harness the power of digital review management tools such [Rayyan QCRI](#), or [Covidence](#) to aid them in their work.

More recently, informatics researchers have also begun to explore the opportunities that machine learning, a form of artificial intelligence, or natural language processing may present to automate parts of the literature review process. Although additional study is needed to compare the efficiency and accuracy of computers

versus human researchers in sorting and classifying items in a large literature review, there is emerging evidence to support this automation in managing extensive data.

### ***12.3.3 Step 3: Develop Research Questions That Address the Gaps Identified in the Literature***

The development of a research question can begin as early as the first step in the research process. Very often researchers begin with a question in mind related to their topic or problem of interest. It is also common however, for that research question to evolve or be refined during the literature review process as specific detail about where additional studies are needed is revealed. In nursing informatics research, this is also the time to consider whether or not the emerging question is philosophical, theoretical, or more practical in nature. For example, nursing has long debated the introduction of technology in terms of how it impacts the art and science of nursing, the very essence of how we approach care. Barnard and Sandelowski (2001) noted that nursing had taken “professional ownership of the space between technology and patient, and the responsibility for maintaining humane care in technological environments” thereby becoming mediators or a bridge between these two forces (Barnard and Sandelowski 2001). This philosophical debate is still a part of nursing informatics research today. But, in addition, there are research questions that focus on the development of new technologies for nursing practice, and/or the evaluation of such tools as they are introduced into care environments. These kinds of practical questions or studies are typically called applied research.

Once you have established the foundation for your research question you can review the published work of other researchers and see how they have constructed similar questions. This is where connections established through social media or research platforms such as Mendeley will be valuable. If you are wanting to connect with community members, patients, or potential users of the technology of interest there are online brainstorming tools or meeting sites such as GroupMap or Zoom that may be useful. If you are holding meetings in person or online to refine research questions or ideas you can use additional digital tools such as Poll Everywhere or Mentimeter to allow participants to vote or help evolve the final research question(s).

### ***12.3.4 Step 4: Select an Appropriate Theoretical Framework***

Nursing informatics research tends to be complex and like other study can benefit from the use of general theoretical framework to guide the work. Nursing theory has produced dozens of potential frameworks that may be useful in informatics research, but because this work often requires a more interdisciplinary approach, it is

worthwhile to consider theoretical contributions from other disciplines. Nursing informatics researchers have long partnered and/or borrowed approaches from psychology, computer science, and engineering. As a starting point consider two well-known theoretical approaches to the uptake and use of technology, Rogers Diffusion of Innovation Theory (Kaminski 2011) and the Unified Theory of Technology Acceptance and Use (Strudwick 2015).

The diffusion of innovation theory presents five technology uptake categories innovators (enthusiasts), early adopters (visionaries), early majority (pragmatists), late majority (conservatives), and laggards (skeptics) in a bell-shaped curve that predicts how acceptance of new innovations will progress in a population (Kaminski 2011; Rogers 2003). Nursing informatics researchers can use this framework to anticipate user needs or potential barriers to introducing new technologies.

Similarly, the Unified Theory of Technology Acceptance and Use or UTAUT is another framework that can be used to explore the uptake and integration of digital interventions (Venkatesh et al. 2003). This has been done by nursing informatics researchers as evidenced in an integrative review on technology acceptance in nursing by Strudwick (Rogers 2003). The various acceptance models in this review, including the UTAUT continue to be valuable approaches for supporting informatics research. It is important to note however, that these frameworks also continue to evolve, sometimes as rapidly as technology does itself. For example, the UTAUT has been updated to the UTAUT2 to allow researchers to reflect upon how variables such as age, gender and experience influence consideration of technology uptake and how sustained use is influenced by factors such as motivation, price and habit (Venkatesh et al. 2012).

These theoretical frameworks are only a small representation of what exists in the literature. Even with so many options to choose from, nursing informatics researchers may not find a theoretical foundation that aligns well with the work they are planning to do. In this case, there is also an ongoing innovation of these frameworks themselves. Risling and Risling (2020) united the qualitative nursing methodology Interpretive Description with key elements from the computer science software development lifecycle to create a research framework specific to the development of new health technologies or interventions. This is just one example of how nurses are collaborating with colleagues from other relevant disciplines to develop entirely new or blended theoretical approaches for informatics research.

### ***12.3.5 Step 5: Determine the Methods Required to Carry Out the Research***

To create a strong methodological foundation for a research project you first decide if you are going to using a quantitative, qualitative, or mixed-methods approach. Then you can consider what particular methodology or methodologies will best address the research questions you have identified. Only once these decisions are

made do you want to consider what methods you will use to actually complete the research.

In informatics research common methods including data mining, online surveying, and even crowdsourcing. Data mining is not a new concept for nursing. Goodwin et al. (2003) highlighted the value of using this approach to build nursing knowledge in the early 2000s, identifying key machine learning tools as well as potential challenges to data mining in nursing (Goodwin et al. 2003). This method has become increasingly popular as the amount of electronic health data has expanded in clinical information systems. But data mining is not only restricted to healthcare records and systems, researchers are using other sources, such as posts in online community forums, or social media sites to collect large data sets as well. Computer programs can be set up to 'scrape' this data from platforms, like Twitter, creating very large data sets in a short period of time, depending on the topic. Analytic tools are then used to highlight meaningful patterns or relationships in the data sets by researchers.

The use of online survey tools is also not new, however there are more ways to reach potential participants and conduct these surveys as digital connectivity increases around the world. Universities and healthcare institutions will often have a preferred survey tool for research use, but very simple online polling is also built into common social media platforms such as Twitter™, Instagram™, and Facebook™. While these tools would not typically be used for formal research, they could be valuable in drawing participants into your survey.

Reaching out to a wide range of participants in the community is a key element of crowdsourcing, as well as in the movement that has now become known as citizen science. Basic crowdsourcing can be done through tools, such as Amazon Mechanical Turk™ which is a more formal marketplace. Then there are a number of citizen science projects, websites or applications such as Zooniverse™ which has connected millions of citizens to research projects of interest to them. While crowdsourcing can be an exciting method it is not something researchers should choose to do without understanding the challenges associated with it, such as potential biases and data reliability issues that may arise.

Finally, it is important to remember that researchers will be directed in the methods they use by the methodologies that have been selected to complete the research. Returning to the earlier methodological example uniting nursing and computer science, if you are doing research developing or evaluating a new technological intervention, then using methods from the software development cycle to collect data are needed. This work commonly includes usability testing, or an evaluation of how well the technology is accepted by users, and if it delivers the expected outcomes. Birnie et al. (2018) provide an excellent example of this in their research evaluating the usability of interactive virtual reality (VR) to reduce pain for children and adolescents undergoing cancer treatments (Birnie et al. 2018). In this research, the team worked with patients and practitioners to determine the ease of use, understanding and acceptability of the VR technology as well as examining how well it could be implemented in clinical care, and if its use resulted in any adverse effects (Birnie et al. 2018). This type of usability testing, very common in computer science, is

starting to be used much more frequently in informatics research. Other types of tech data, such as detailed usage statistics from webpages or mobile applications are also more typically collected now in nursing led research.

### ***12.3.6 Step 6: Collect the Research Data Based on the Methods Determined in Step 5***

One of the benefits of employing data collection methods from computer science for nursing informatics research is that much of this reporting can be built right into the technological interventions under study. There are ethical considerations that must be followed if this data is being collected automatically however with all participants fully informed of what specific information, over what period of time will be collected, so that they can evaluate any privacy or confidentiality risks.

Automation of reports and data synthesis is one of the promoted benefits of expanding the use of technology in healthcare and nursing informatics researchers can certainly take advantage of this as well. Data may be compiled locally, nationally, or even globally in some instances, although more work on standardizing nursing data is needed in order to really capitalize on the potential of big data in nursing.

As data is collected, regardless of method, nursing informatics researchers are likely to use further electronic or digital tools to review, clean, and organize their data. Voice recognition software is making automatic transcribing more accurate and accessible, and there are numerous other software and web-based applications researchers can use to organize their data and prepare it for analysis. Extra consideration should be given to securely storing all of this data with the use of password protection, encryption, and secure cloud storage. These security procedures will likely need to be detailed in any research ethics application, with particular processes often dictated by the institute that the researcher is employed by and/or where the research is being conducted.

### ***12.3.7 Step 7: Perform Data Analysis***

There are computer tools to aid your data analysis no matter the methodological approach. SPSS™ is a statistical analysis software platform very commonly used in quantitative research. There are also digital tools for qualitative analysis, such as NVIVO™ or ATLAS.ti™ that support researchers in seeking patterns or themes in their data. When working with large or ‘big data’ sets, artificial intelligence (AI) or more often a subset of AI called machine learning, can also be used. Algorithms are used to support autonomous analysis or classification in machine learning and often output predictions, for example in McLean’s (2018) work using machine learning to classify diabetics by risk and predict incident of foot ulcers. This type of predictive

analysis is being seen more frequently in nursing informatics research identifying patient risks, staffing needs, and even future use of emergency or other health services.

Another tool to support analysis of nursing data is natural language processing or NLP. Using NLP is a means to process large amounts of narrative data and this is not a new approach in nursing informatics research. In 2009 nurse researchers were already using NLP techniques to extract data from nursing narratives (Hyun et al. 2009). Because a lot of nursing data is not standardized and is presented in long-hand or narrative form, advancing the use of NLP techniques is a valuable pursuit. Despite the early efforts in this area, much more refinement of this technique in nursing informatics focused research is needed.

There are other lower tech options for processing complex data sets that are still of value in digital health research. Visualization tools such as concept maps, social network analysis, or the newer application of journey mapping can also be considered. Concept mapping is a familiar tool to many nurses as it is often used by students in their clinical placements to organize patient data and priorities. Social network analysis is part of a methodological approach that reveals key players or networks and relationships in a visual data analysis. In informatics research this is often done to identify where the introduction of new technology will be supported or blocked in an organization.

Journey mapping is a newer approach in nursing informatics, more typically used in marketing or customer service research. Still it is a valuable addition to user-centred research by encouraging researchers to map out every interaction point that a patient or practitioner may have in encountering and using a new technology. These later types of analysis are particularly useful in planning for deployment of technological interventions and/or evaluating their impact especially in terms of quality improvement or other specific outcomes within a health system.

### ***12.3.8 Step 8 Interpret and Discuss the Results***

Nursing informatics research is rarely done in isolation and the results from the studies we do often needs to be interpreted and shared across diverse audiences. Whether you are partnered with patients, practitioners, institutions, technology or other industry partners, educators, policy makers and/or colleagues from any variety of disciplines there will be a point in your research process where you may want to seek expert opinion on your results. Some research processes, like Delphi studies or scoping reviews, have this kind of consultation built into the methodology. However, even if there is no methodological prompt, holding team meetings or sessions with collaborating partners is a worthwhile stop in this part of the research process. One of the key items that tends to be a subject of discussion at this point in any study is how to finalize the analysis and/or presentation of the data.

Much of our information is packaged and shared in digital formats today and this includes research results. However, there are a few interesting approaches that



can be considered to improve the potential impact and translation of study findings. First, if large data sets have been used as part of the research concise data visualization models should be a part of the results. Data visualization has become almost an art form with specialized experts in this field but nursing also has a long history of engaging in visual data representations. Florence Nightingale represented data on mortality statistics from her field work in a visual chart which has come to be called the rose diagram, and nursing informatics researchers still recognize the value of this data visualization today (Monsen et al. 2015). Infographics, which are also increasingly used to share research results, can be built from multiple data visualizations.

Another tool borrowed from computer science and in particular software development that can be extremely useful in finalizing and sharing data results is the use of personas. A persona is an archetypal representation of data and identified needs usually from a particular user group that is identified in informatics research (LeRouge et al. 2013). Personas are short, fictional, biographies created from research results grouped into a collection of ‘people’ who then represent the themes in the study. Essentially, you use data to bring users ‘to life’ through personas, representing data sets through imagery and other characterizations (LeRouge et al. 2013). The use of personas can summarize key findings and also highlight priority needs and requirements for the implementation of informatics findings or developed interventions in an engaging way.

### ***12.3.9 Step 9: Conduct Knowledge Translation Activities***

When the findings of a study are finalized and packaged for release, it is important that research teams think about multiple ways that this information can be shared. Nursing informatics researchers are usually well connected through multiple digital platforms and further advantaged by well-developed digital literacy skills. Given this, nursing informatics research should be widely publicized and disseminated. While there is some very good translation work being done, this is an area that could be improved upon. Nursing journals tend to have lower impact factors than informatics or other disciplinary publications, but it is important to retain a connection to nursing audiences when conducting informatics research. Because this field of study is highly interdisciplinary it is also critical that nursing establish its informatics expertise across disciplines.

In order not to become overwhelmed by the needs related to knowledge translation in nursing informatics research it is important to create a detailed plan at the beginning of any project. While this plan will likely evolve as the research progresses having an early roadmap to the final destination will aid the research team in identifying knowledge translation opportunities during the journey. Any knowledge translation from a research project will include more traditional academic routes such as article publication and conference presentation, but nursing informatics researchers should also always consider novel ways to share their findings.

Harnessing digital skills to create whiteboard animations, social media campaigns, TikToks™, or contributions to newly emerging platforms should be a part of every research plan.

## **12.4 Section: 3: Current and Future Opportunities for Nursing Informatics Research**

As noted, nursing informatics research is a fast-paced field and as technology rapidly evolves so does the opportunity to research the effects of it on nursing practice, people, and healthcare. One of the by-products of increasing connectivity in the world is the amount of data that is being produced. There is a rapid exponential increase in electronic data as technology becomes integrated into more parts of our lives and world. Data is being captured from every internet search, smart phone tap, wearable device, geo-locator, online purchase, and like, comment or tweet. In healthcare, EHRs, biomedical sensors, home and hospital monitoring tools, genomic study and other computer enhanced research further contributes to what many call a ‘fire-hose’ of data. Nursing informatics researchers are working with this data in many forms, from online sources like social media posting, to patient and practice data collected in care settings.

There will be an ongoing need for nursing informatics researchers to develop advanced analytic skills to continue to be leaders in producing meaningful analysis from these ever-expanding data sets. While partnering with colleagues who specialize in AI or machine learning is also an advantage, building foundational knowledge of these tools and basic processes in nursing is a necessity. Nursing is already a leader in advancing data standards work, contributing to the ICNP program and conducting work like the CHOBIC projects to standardize EHR data. This demonstrates a long-held understanding of what is needed for nursing data to be integrated and represented in computer driven systems.

Nursing informatics researchers must also be aware and responsive to what kind of data and study is most urgent. In addition to maintaining an in-depth familiarity with informatics literature, strong national and global networks of researchers are key in identifying needs and gaps as work progresses around the world. It is important that research addresses all specialty areas of nursing across education, practice, and administration. The Canadian Nursing Informatics Association continues to advance the idea that nursing informatics is nursing. Meaning, that in this digital age, all nurses no matter the area of practice are extensively engaged with technology and digital health.

Another area that is emerging strongly in nursing informatics research is patient-oriented or partnered research. Patients, like nurses, are on the receiving end of an increasing amount of healthcare technology and partnering with them to try and influence the design and development of these tools is essential to maximize use and positive health outcomes. Increased study incorporating journey mapping or

user-centred design approaches are needed. However, user-centred or co-design should not just be pursued with patients, more nurses need to be engaged in this kind of research so that the impact of technology on their workflow, patient care and relationships can be studied further.

Ultimately, even when surrounded by technology, nursing and nursing informatics research is about people. Nursing informatics researchers are uniquely positioned to contribute data and findings that highlight aspects of both the art and science of the profession. Recent work on *Nursing and Compassionate Care in a Technological World* represents this kind of contribution (Strudwick et al. 2020). While reviewing current and future influences of AI in nursing the authors demonstrate the critical need for vigilant engagement by the profession in the advancement of this technology in order to ensure that this evolution does not disrupt the ethical, just, and compassionate care that is the essence of nursing (Strudwick et al. 2020).

## 12.5 Conclusion

The value nursing informatics brings to research has only begun to be felt in many areas of inquiry and knowledge generation. With the increasing digitalization of vast aspects of the nursing role and healthcare, the future appears bright in terms of using these forms of innovation to support the generation of knowledge and other inquiry activities important to nurses. In summary, this chapter has sought to explore the research process in light of viewing nursing informatics as both a supportive mechanism to extend and amplify current research activities conducted by nurses, while also reinforcing that nursing informatics can be the target of specific research inquiry. While both dimensions share similar methods, processes, and are commonly mutually synergetic, highlighting the importance of both is equally important. As a profession that has prided itself on advocacy, leadership, and human-centred care, all nursing research should remain cognizant of the potential power informatics can bring to knowledge generation and inquiry. Failing to appreciate contemporary reality would only serve to inhibit timely and relevant research generation to support human wellbeing and evolution of the nursing role to lead change within increasingly digitalized healthcare settings of the future.

## 12.6 Review Questions

1. Within nursing informatics research, how are philosophical and theoretical lenses applied or endorsed to support research conceptualization or activities?
2. How can nursing informatics be used in nursing research? Describe the process from which nursing informatics can act as a supportive mechanism in nursing research.

### 3. What is grey literature?

#### **Discussion (take it online)**

What are some contemporary opportunities for nursing research within the informatics discipline? How do you see these opportunities evolving over the coming decades with increased digitalization in all areas of society and healthcare?

#### **Activities**

1. Conduct a search of the literature on two of the electronic databases listed in Step 2 of Conduct a Literature Review of this chapter. Search under key words Nursing Informatics AND Research
2. Go to the critical appraisal skills programme <https://casp-uk.net/casp-tools-checklists/>

Review the worksheets and select one. Use the worksheet checklist with a paper sourced from your literature review activity completed in activity one above.

## **12.6.1 Answers**

1. As described by Matney et al. (Munhall 2012), the philosophical foundations of all nursing informatics research include concepts such as *data*, *information*, *knowledge*, and *wisdom*. Further, Matney et al. outlines that nursing informatics inquiry is appreciative of different philosophical and ontological lenses from which to explore the core concepts of data, information, knowledge, and wisdom. These different views, or lenses allow nursing informatics researchers to explore different aspects of technology in nursing such as evaluating technology systems, understanding digital experiences, and how technology impacts workflow, and other fluid interpretations of human-technology interactions.
2. The increased use of technology in the workplace and society has given nurses new opportunities to employ these technologies to assist in many types of research activities, including information aggregation, data collection, and knowledge dissemination. While using supportive elements of informatics to conduct research has become commonplace in nursing research, it is important to appreciate that the topic of nursing informatics also exists as its own nursing specialty.
3. ‘Grey’ literature reviews are conducted to identify sources of important information that may not be found in traditional academic library environments. Grey literature sources can include websites, briefing notes, newsletters, government reports, conference presentation and beyond. Information sourced from grey literature can contain information that was not formally written in a research article that could address the key issue, topic or problem you are investigating.

## Glossary

**CINAHL** Cumulative Index of Nursing and Allied Health Literature

**Data mining** Semi-automatic exploration of large data sets, looking for meaning through patterns in the data

**Grey literature** Information sources outside of formal academic or peer reviewed journals (such as industry magazines, newspapers, social media, etc.)

**Knowledge translation** The synthesis, dissemination and exchange of knowledge by researchers to the targeted knowledge users

**MEDLINE** Database of biomedical literature

**MeSH** Medical Subject Headings is a vocabulary thesaurus used for indexing articles in PubMed

**Mixed methods research** The research approach combining both qualitative and quantitative research methods

**NLP** Natural language processing

**Nursing research** Systematic inquiry designed to generate evidence for the nursing profession, including nursing practice, education, administration, and informatics

**PsychINFO** Database of behavioural and mental health literature

**Qualitative research** Investigation of phenomena, typically in an in-depth and holistic fashion, through the collection of rich narrative materials using a flexible research design

**Quantitative research** Investigation of phenomena that lend themselves to precise measurement and quantification, often involving a rigorous and controlled design

**UTAUT** Unified Theory of Technology Acceptance and Use

## References

- Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol.* 2005;8(1):19–32. Available from: <http://www.tandfonline.com/doi/abs/10.1080/1364557032000119616>
- Barnard A, Sandelowski M. Technology and humane nursing care: (ir)reconcilable or invented difference? *J Adv Nurs.* 2001;34(3):367–75.
- Birmie KA, et al. *Usability testing of an interactive virtual reality distraction intervention to reduce procedural pain in children and adolescents with cancer.* *Journal of Pediatric Oncology Nursing.* 2018;35(6):406–16.
- Canadian Agency for Drugs and Technologies in Health. Grey matters: a practical tool for searching health-related grey literature [Internet]. 2018 [cited 2018 Nov 26]. Available from: <https://www.cadth.ca/resources/finding-evidence/grey-matters>
- Creswell JW, Clark VLP. Designing and conducting mixed methods research. In 2007. p. 119–167.
- Goodwin L, VanDyne M, Lin S, Talbert S. Data mining issues and opportunities for building nursing knowledge. *J of Biomed Inf.* 2003;36(4–5):379–88.
- Hyun S, Johnson SB, Bakken S. Exploring the ability of natural language processing to extract data from nursing narratives. *Comput Inform Nurs.* 2009;27(4):215–25.

- Kaminski, J. Theory in nursing informatics: diffusion of innovation theory. *Canadian Journal of Nursing Informatics* [Internet]. 2011;6(2). Available from: <https://cjni.net/journal/?p=1444>
- LeRouge C, et al. User profiles and personas in the design and development of consumer health technologies. *International Journal of Medical Informatics*. 2013;82(11):E251–68.
- Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology. *Implement Sci*. 2010;5(1):69. Available from: <http://implementationscience.biomedcentral.com/articles/10.1186/1748-5908-5-69>
- McLean, A. Machine learning. *Canadian Journal of Nursing Informatics*. 2018. Available from: <https://cjni.net/journal/?p=5857>
- Monsen KA, Peterson JJ, Mathiason MA, Ms K, Lee S, Chi CL, et al. Data visualization techniques to showcase nursing care quality. *CIN - Computers Informatics Nursing*. 2015;33(10):417–26.
- Munhall P. *Nursing research: a qualitative perspective*. 5th ed. Sudbury, MA: Jones & Bartlett Learning; 2012.
- Peters MDJ, Godfrey CM, Khalil H, McInerney P, Parker D, Soares CB. Guidance for conducting systematic scoping reviews. *Int J Evid Based Healthc*. 2015;13:141–6.
- Polit D, Beck C. *Nursing research : generating and assessing evidence for nursing practice*. 9th ed. Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins; 2012.
- Risling TL, Risling DE. Advancing nursing participation in user-centred design. *Journal of Research in Nursing*. 2020;25(3):226–38. <https://doi.org/10.1177/1744987120913590>.
- Rogers EM. *Diffusion of innovations*. 5th ed. New York: Free Press; 2003.
- Sidani S, Braden C. *Design, evaluation and translation of nursing interventions*. West Sussex: John Wiley & Sons, Ltd; 2011.
- Strudwick G. Predicting nurses' use of healthcare technology using the technology acceptance model: an integrative review. *CIN*. 2015;33(5):189–98. Available from: <https://nursing.ceconnection.com/ovidfiles/00024665-201505000-00004.pdf>
- Strudwick G, Wiljer D, Inglis F. *Nursing and compassionate care in a technological world: a discussion paper*. Toronto, ON: AMS Healthcare; 2020.
- Trust MKP. *Critical appraisal skills programme (CASP): making sense of evidence*. Oxford: London (UK); 2002.
- Venkatesh V, Morris M, David G, David F. User acceptance of information technology: toward a unified view. *Manag Inf Syst Q*. 2003;27:425–78.
- Venkatesh V, Thong JYL, Xu X. Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS Quarterly*. 2012;36(1):157–78.