

CADTH RAPID RESPONSE REPORT:  
SUMMARY WITH CRITICAL APPRAISAL

# PET-CT for Cardiology: A Rapid Qualitative Evidence Synthesis of Patients' and Caregivers' Perspectives and Experiences

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## Abbreviations

MRI	Magnetic resonance imaging
PET-CT	Positron emission tomography - computed tomography
SPECT-CT	Single photon emission computed tomography - computed tomography

## Context and Policy Issues

Positron emission tomography-computed tomography (PET-CT) is an advanced nuclear imaging technique that combines a positron emission tomography (PET) scanner and an X-ray computed tomography scanner (CT) into a single machine. PET-CT is primarily used in oncology to diagnose and stage various types of cancers.<sup>1</sup> However over the past decade, their use has expanded from oncology to a variety of other disciplines including cardiology.<sup>2</sup> Within Canada, there is growing interest in expanding public funding for PET-CT for cardiac indications, with some jurisdictions providing access to PET-CT for the assessment of myocardial viability, myocardial perfusion, and sarcoidosis.<sup>2</sup>

Approximately 45 publicly funded PET-CTs exist in Canada, primarily situated within cancer care centres and hospitals.<sup>1</sup> Patients are typically referred to hospital for PET-CT by specialists.<sup>2</sup> Prior to imaging, patients must avoid consuming caffeine (coffee, chocolate and in medications) for 24 hours and not eat or drink beverages other than water four hours before the scan.<sup>3</sup> The exact duration and procedures involved in the scan depends on the indication (e.g., if a stress test will be performed), but in general the patient will receive an intravenous line for the infusion of radioactive contrast, then be required to wait for a short period of time for the contrast to circulate.<sup>4</sup> Patients are then required to lie on the PET-CT table and during the scan, hold their breath, stay still, and raise their arms over their heads.<sup>4</sup> The scans themselves can take approximately 20 minutes, depending on how many images are taken. Depending on the indication and the severity and stability of a patient's condition, follow up and interventions (including angiography) may occur directly after or at a later time.

The perspectives of patients and their caregivers can support decision making around public provision of PET-CT for cardiac indications by identifying patients' preferences, values, and the context in which they seek care. The purpose of this report is to identify and describe patients' and caregivers' experiences and perspectives on PET-CT for cardiac indications.

## Research Question

What are adult patients' and their caregivers' experiences and perspectives of advanced diagnostic imaging for cardiac conditions?

## Key Findings

Scanning was an activity fraught with anxiety and worry, from start to finish. Patients, however, drew on a variety of strategies to cope with the discomfort of the scan. Further, scans were seen as important by patients for the ways they revealed what is going on inside of their bodies and could guide decisions on the most appropriate interventions.

Patient-provider communication was viewed by patients as essential, and attending to patients' information needs contributed to more positive scanning experiences. Information needs include but extend beyond clinical information (e.g., benefits and risks of scanning, how to prepare for the scan) to information about the process and pathway of attending a scan. Patients want to come prepared to their scanning appointment, and their understanding what is required of them can be supported by conversations that include the provision of written material. Ensuring patients have clear understanding on why they are undergoing imaging and why it is important, and what they can expect the process to look like can support alignment between expectations and experiences which appears to facilitate positive experiences of undergoing imaging.

Additionally, patients found frequent contact with staff as a source of emotional reassurance and comfort. At the imaging unit, staff can help by creating a supportive and more familiar environment for patients through music, décor, and warmth (temperature). Ensuring patients have time to ask questions through the process of undergoing the scan and that staff are present and attentive throughout support patients feeling more at ease. In this way, patient-provider interactions figure prominently in how patients experience diagnostic scans. Where patients' expectations did not match their experiences, this tended to lead to less positive experiences and greater worry and discomfort on the part of the patient.

## Methods

### Literature Search Methods

A limited literature search was conducted on key resources including Medline and PsycINFO via OVID, CINAHL, the Cochrane Library, University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. Methodological filters were applied to limit retrieval to qualitative studies. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2014 and February 19, 2019. The main search concept was advanced diagnostic imaging technologies. Additionally, the included publications of a previously published CADTH Rapid Response report on patients' and caregivers' perspectives on diagnostic imaging were also reviewed for eligibility.<sup>1</sup> Reference lists of included publications were reviewed for potentially additional studies.

### Selection Criteria and Methods

One reviewer screened citations and selected studies. In the first level of screening, titles and abstracts were reviewed and potentially relevant articles were retrieved and assessed for inclusion. The final selection of full-text articles was based on the inclusion criteria presented in Table 1.

**Table 1: Inclusion Criteria**

<b>Population</b>	Adult patients undergoing advanced diagnostic imaging and their caregivers
<b>Intervention</b>	Advanced diagnostic imaging (including SPECT-CT, PET-CT, MRI)
<b>Comparator</b>	None
<b>Outcomes</b>	Adult patients' perspectives and experiences relating to advanced diagnostic imaging, including of travelling, scheduling, consenting, undergoing, receiving results and follow-up care
<b>Study Designs</b>	Primary qualitative research; mixed methods studies with separate reporting of the qualitative component; qualitative syntheses

MRI = magnetic resonance imaging; PET-CT = Positron emission tomography-computed tomography; SPECT-CT = single photon emission computed tomography-computed tomography

### Exclusion Criteria

Articles were excluded if they did not meet the inclusion criteria outlined in Table 1 or they were duplicate publications reporting on the exact same data and same findings. Publications with a primary focus on an intervention (e.g., development of an education booklet) or experiences tangential to advanced diagnostic imaging (e.g., receiving results of cancer screening) were also excluded.

### Critical Appraisal of Individual Studies

One reviewer assessed the quality of the included publications. The ten items from the CASP Qualitative Tool<sup>5</sup> were used as prompts for reflection, and the appraisal was guided by three primary questions intended to assess if and how a study demonstrated that it collected rich data, conducted a rigorous analysis, and incorporated reflexive practices leading to robust results that were useful for the objectives of this review: Is it credible? Is it trustworthy? Are the results transferable?<sup>6,7</sup> Results of the critical appraisal were not used to exclude studies from this review, rather they were used to understand the methodological and conceptual limitations of the included publications in specific relation to this review. Particularly, the critical appraisal contributed to the analysis by identifying the limits of transferability of the results of included publications.

### Data Analysis

A framework analysis was used to organize and analyze results of the included studies.<sup>8</sup> The framework consisted of orienting concepts identified through project scoping and from a previously conducted rapid review on patients' experiences of advanced diagnostic testing.<sup>9</sup> These included types of experiences relating to the process of receiving advanced diagnostic imaging (e.g., referral, preparations for the scan, undergoing the scan, waiting for results, receiving results) and individual perspectives on the experience itself (e.g., deciding to be scanned, expectations of the scan, coping with the scanning, processing results).

One reviewer conducted the analysis. Included primary studies and memos were read and re-read to identify key findings and concepts that mapped on the framework, which was modified as new concepts emerged. Diagraming was used to explore how emerging concepts mapped across study findings and across concepts. Using these techniques, concepts were re-ordered and organized into thematic categories. Once the initial categories were identified and described, the included meta-synthesis was read and incorporated into the analysis as both a source of data and as a form of triangulation.

Memoing and diagramming continued until themes were appropriately described and supported by data from the included publications. During the analysis, issues with transferability and the results of the critical appraisal were reflected on to aid with interpretation. The objective of the analysis was to create categories that reveal the how patients experience advanced imaging for cardiac indications.

## Summary of Evidence

### Quantity of Research Available

A total of 2,361 citations were identified in the literature search. Following screening of titles and abstracts, 2,318 citations were excluded and 43 potentially relevant reports from the electronic search in addition to 11 reports from the grey literature and hand searching were retrieved for full-text review. Of these potentially relevant articles, 43 publications were excluded for various reasons, and 11 publications met the inclusion criteria and were included in this report. Appendix 1 presents the PRISMA<sup>10</sup> flowchart of the study selection.

### Summary of Study Characteristics

Details regarding the characteristics of included publications and their participants are provided in Appendix 2 and Appendix 3.

#### *Study Design and Data Collection*

As is frequently the case in published qualitative research, authors of five publications did not report the study design used.<sup>11-15</sup> Three described their study design as qualitative description,<sup>16-18</sup> and two as phenomenology.<sup>19,20</sup> One publication was a qualitative meta-synthesis.<sup>21</sup>

The most commonly reported methods of data analysis were thematic analysis (n=4),<sup>11-13,18</sup> and content analysis (n=4).<sup>14,15,17,18</sup> Authors of two studies did not specify the method of data analysis,<sup>16,21</sup> one used systematic text condensation<sup>20</sup> and one used hermeneutic phenomenology.<sup>19</sup>

Semi-structured, in-depth interviews after imaging were used within six studies.<sup>11,14,16,17,19,20</sup> Two studies used focus groups comprised of participants who had undergone imaging,<sup>12,15</sup> and two studies using interviews before and after imaging.<sup>13,18</sup> The meta-synthesis used comprehensive systematic searching in electronic bibliographic databases and structured data extraction for their data collection methods.<sup>21</sup>

#### *Country of Origin*

No included publications were conducted in Canada. Four studies were conducted in Sweden,<sup>14,17,19,20</sup> three studies in the United Kingdom,<sup>11,16,18</sup> two in the United States,<sup>12,15</sup> and one each in New Zealand<sup>13</sup> and Australia.<sup>21</sup>

#### *Patient Population and Types of Imaging*

A total of 258 patients were included from 10 primary studies in this review. The meta-synthesis included 436 patients and healthy volunteers from 15 primary studies.<sup>21</sup> In the primary studies, patients ranged in age from 19-90 years. Five studies did not specify the reasons patients were undergoing imaging.<sup>15-17,19</sup> Three studies included patients who had cancer or were cancer survivors,<sup>11,12,14</sup> and two studies included patients who were undergoing imaging for cardiac conditions.<sup>13,18</sup>

Five studies included patients who had undergone an MRI,<sup>11,14,17,19,20</sup> two studies where patients had undergone any type of imaging (i.e., MRI, PET-CT, CT, X-ray),<sup>12,16</sup> two studies where patients had undergone a CT scan,<sup>13,15</sup> and one where patients had undergone a SPECT-CT.<sup>18</sup> The meta-synthesis included nine studies where patients had undergone an MRI, four studies where patients had had either a CT or MRI, and two studies where patients had undergone a CT scan.<sup>21</sup> The reasons patients were referred for advanced imaging in the studies included in the meta-synthesis were not reported.<sup>21</sup>

## Summary of Critical Appraisal

Overall the included publications were assessed to be of moderate quality. Details of the critical appraisal, capturing key points on credibility, trustworthiness, and transferability can be found in Appendix 4.

The criterion of credibility assessed whether and how researchers were true to their participants' voices, by demonstrating credibility through clear descriptions of data collection methodology, supporting descriptive analyses with raw data, and reflexively engaging with the processes leading to their findings. Four studies were viewed as credible,<sup>11,17,20,21</sup> with the remainder being assessed as partially credible (n=7).<sup>12-16,18,19</sup> The primary issue that influenced the assessment of a study being only partially credible was the reporting of themes whose dimensions and interrelations were under analyzed or that there seemed to be overlap in themes. The other key issue affecting credibility was the timing of data collection. Some studies conducted data collection pre- and post-scans so that they were able to explore how patients anticipate and experience the scan.<sup>13,18</sup> Others conducted interviews with patients who had undergone a scan within a period of time, say 12 months.<sup>16</sup> The timing of data collection was likely an influence on the credibility of data collected and in how rich the data collected were, and pointed to a need to account for how patients incorporate scanning experiences into their understanding of their lives and health conditions.

The criterion of trustworthiness involves the concepts of dependability and confirmability, and assessed whether there was analytical consistency in the findings and whether the authors demonstrated reflexive engagement with assumptions. Seven studies were assessed as trustworthy,<sup>11,12,14,17,19-21</sup> and four as partially trustworthy.<sup>13,15,16,18</sup> Overall, studies demonstrated using a form of triangulation (comparison across time, data types, patient populations or to the published literature) that demonstrated that the findings were dependable.

The criterion of transferability assessed whether and how the study was relevant to the current review. The assessment was made by exploring reporting of individual study participants, situations and analyses. Two studies were assessed as transferable,<sup>13,18</sup> eight studies as partially transferable,<sup>11,12,14,15,17,19-21</sup> and one study as not transferable.<sup>16</sup> The primary issue of transferability centered on studies investigating patients' experiences of MRI, which differ in important ways from PET-CT (including being longer, louder, more confined and not requiring the use of an intravenous contrast agent). Additionally, several of the studies did not report the health conditions for which patients received imaging, or were conducted using patients who had (survived) cancer, which affected the ability to assess transferability.

## Summary of Findings

### *Referral and the Decision to Undergo a Scan*

Most of the included publications focused on experiences undergoing the scan itself, rather than on the context in which a patient was seeking or receiving care of which the scan was a part. As such, there were limited findings around patients' perspectives and experiences of being referred for scanning and deciding to attend a scan.

This review identified that patients sought clarity over why they were referred for imaging and the process of being referred (e.g., how appointments will be scheduled). In one study some patients who had been referred for cardiac SPECT-CT imaging were unclear as to why they had been referred, and with the sense that the scan was not necessary they worried about being "over imaged" – "... I'm caught up in the NHS and costing it millions." (p. 248) <sup>18</sup>Long waiting times between referral and the scanning appointment were stated as being confusing to patients, particularly whose symptoms reduced over time, as they were taken by some patients to mean that they no longer needed imaging.<sup>18</sup> These can be viewed as illustrations of how some patients might perceive their scheduled imaging, highlighting the importance of a referral process that clearly explain the reason for the referral.

When probed about their expectations of imaging, patients appear to be consistent in their expectations that a scan would enable their providers to see what is going and allow for decision making and appropriate treatment.<sup>12-14,18</sup> These reflect the way scans are viewed as making the body and illness visible allowing for intervention.

An important dimension of decision making in the context of advanced medical imaging is the balancing of risks and benefits. In weighing benefits and risks of imaging techniques with radiation exposure, patients valued clarity in the purpose of the diagnostic imaging.<sup>12</sup> Many patients agreed that basic benefit-risk information should be presented to patients, but many also felt that they trusted their physician and did not want to share in decision making, particularly when they felt that an imaging test was essential for their care.<sup>12</sup> Similarly, in a study of the ethical reasoning around communication of radiation risk in patients who underwent imaging, patients were found to value autonomy, pointing to the desire for information on radiation risk.<sup>15</sup> But again, some preferred a more paternalistic approach to the patient-provider relationship and wished to defer to their physician for decision making.<sup>15</sup> Taken together, this suggests that patients vary in their desire to engage in decision making around undergoing scans, and engaging in discussion around shared decision making needs may be tailored on an individual basis.

### *Worries of Undergoing Scanning*

A central theme found across investigations of patients undergoing advanced diagnostic imaging is worry. The experience of worry and anxiety threads its way throughout the process of undergoing imaging for many patients.

Worry can enter patients' experiences at the point of referral. Patients referred for cardiac SPECT-CT described entering the scan knowing something is wrong but unsure of its seriousness.<sup>18</sup> Before the scan, telephone calls from staff at the scanning centre were reported as being very beneficial for patients, as the interaction with staff served to reassure patients by giving them a sense of familiarity with the staff and the centre.<sup>18</sup> Some cardiac patients expressed worries about side effects of the stress injection, and if they could endure it, and these worries became so great that they thought of not undergoing



their scheduled cardiac SPECT-CT.<sup>18</sup> For those who undergo repeat CT scans, patients described worrying about the long term effects of radiation exposure, but more so worried about the potential for the intravenous contrast material to cause kidney damage, and worried about how to assist their bodies to rid themselves of the radioactive tracers.<sup>12</sup> As explored in each of the key findings below, the provision of information, patient-provider communication, and humanizing the environment and process can serve to alienate or reduce patients' worries and fears.

### *Preparing for the Appointment*

Patients undergoing cardiac PET-CT must prepare for the scan by following instructions around consuming caffeine, food, beverages and medications. Patients who received written information often were confused about that information.<sup>18,20</sup> In one study of cardiac patients undergoing PET-CT, the dietary preparations were found to be confusing, with the result being that some did not follow the instructions and thus had to reschedule their appointments.<sup>18</sup> This was similar in a study of patients undergoing MRI, where presenting patients realized they had either not understood or misunderstood the information.<sup>20</sup>

Emotional preparations were an important dimension of patients' experiences of preparing for scanning. Part of preparing for the scan was hearing and navigating the stories friends and family told about undergoing scanning.<sup>18,20</sup> Patients often described other people's stories unhelpful as they typically focused on the hardships of the experience of undergoing a scan, often raising patients' own level of worry.<sup>20</sup>

Patients undergoing scanning also faced logistical challenges. Making travel arrangements was difficult for some patients, especially those without their own transportation. Patients experienced stress in trying to ensure they were on time, particular for early morning appointments which required travel at rush hour. For those who required using public transport to travel to the hospital, the early morning trip was an ordeal. "...I had to catch three buses from six am and I was an hour early." (p. 250)<sup>18</sup> Further, patients sometimes struggled to follow the directions to parking and locate the imaging centre within the hospital, even when they were provided written information.<sup>18</sup>

### *Undergoing the Scan – the Scanning Appointment*

Patients undergoing advanced medical imaging for the first time can be confronted with an entirely new environment – being in the scan room is like "being in another world."<sup>19,20</sup> In a highly medicalized and unfamiliar space, patients can become uncomfortable and ill at ease, compounding or instigating worries and fears. Music in the scan room, décor, and the warmth emitted by the scanner aided to reduce the anxiety experienced by patients undergoing cardiac PET-CT.<sup>18</sup> This suggests that efforts to make the scan environment itself more familiar and less medicalized are likely to reassure patients.

Often the scanning process was very different than patients had anticipated.<sup>20</sup> When things happened that were not expected (for example, vibrations while undergoing an MRI), patients often reacted with fear and worry.<sup>19</sup> On the converse, when appropriately prepared, patients reported feeling comfortable and reassured: "[t]hey told me all about it so I didn't get anxious. I knew what to expect" (p. 6)<sup>11</sup>

Patients employed a variety of coping strategies to deal with the anxiety and discomfort they experienced during their scan. These including humour, downplaying their feelings, distracting themselves,<sup>11,18</sup> being distracted by staff,<sup>11</sup> listening to music, and closing their eyes.<sup>14,18</sup> Having a family member or caregiver present was also viewed as helpful.<sup>19</sup>

Undergoing scanning was particularly challenging for patients who had pre-existing anxiety or claustrophobia.<sup>14,19</sup> Some patients with pre-existing musculoskeletal conditions (i.e., back pain, neck pain, arthritis) also found it difficult to get comfortable during the scan.<sup>11,14</sup> Further arm raising was a struggle for some patients, as was the need to keep still.<sup>18</sup>

Patients drew on their expectations of the scan to motivate them through the discomfort and unease of the scan. As one patient put it, “[t]he information from this examination is very important. You have to think about that. If I terminate the scan now I’m back to square one. I thought a lot about that.”(p. 958)<sup>19</sup> Although from a patient who underwent an MRI, a longer and more confining procedure than PET-CT, this statement articulates the ways that patients use their expectation to carry them through the challenges they experience during scanning.<sup>11,20</sup>

A key feature of patients’ experience of scanning was communication with staff, which was highly valued by patients.<sup>11,13-15,18,20</sup> Preparation for the scan (e.g., inserting an IV) was an important time for patients, as they were able to build a relationship with the staff during this time, and often use it to ask questions or become more comfortable with the procedure.<sup>20</sup> Communication involved information, such as being clear on what the procedure entails, but also that staff were responsive and available.<sup>19</sup> Frequent communication with staff reduced patients’ feelings of isolation and unfamiliarity, making them feel safer,<sup>14,20</sup> and conversely, patients felt isolated and uncomfortable when they were left alone in the room for long periods.<sup>18</sup> As such, communication afforded patients an opportunity for human interaction, a critical factor which shaped their ability to negotiate the scanning experience.<sup>13,14,20</sup>

Rather than being passive participants, patients can be active participants in scanning. From arm raising to breathing strategies, patients actively participate in assuring the best quality images can be taken.<sup>18,20</sup> As with decision making, some patients would prefer if radiographers and staff lead these activities by providing clear direction throughout (thereby reducing the agency on patients which is experienced by some as stress and a burden.)<sup>17</sup>

When it comes to communicating to staff or asking questions, some patients describe how they withheld their questions as they worried they would slow things down, as they were aware of the highly scheduled environment of the scanning unit.<sup>15,16</sup> Similarly, patients’ appreciated the speed and efficiency of the scanning appointment.<sup>13</sup>

After the scan, many patients viewed the appointment and scan positively.<sup>13,18</sup> Some, in contrast, particularly those who were not aware of the nature of their appointment, found themselves surprised by the complexity of the test, of the waiting periods, and of the scanning times. “I didn’t know I would lie down for a whole 20 minutes”.(p. 251)<sup>18</sup> This further draws attention to how understanding the purpose and nature of the scan prior to the appointment plays an important role in patients’ experience.

### *The Results of the Scan*

Receiving results was experienced as a relief to cardiology patients.<sup>13,18</sup> Receiving results allayed patients’ worries by ruling out a diagnosis or confirming the cause of their symptoms.<sup>13</sup> In the case a negative results (confirming diagnosis), some patients experienced disappointment but saw the benefit in being diagnosed.<sup>13</sup> Importantly, the benefits of diagnosis come from the availability of interventions.<sup>13,18</sup> This suggests that during the period of time post-scan and pre-results consultations, patients may experience anxiety or worry over the uncertainty of their condition before they receiving scan results.<sup>20</sup>

Further, uncertain or uninterpretable results may prolong patients' worries, compounding their sense of not knowing.

In the case of patients who received the results (either positive or negative) of their cardiac computed tomography angiography, several articulated that they felt poised to engage in heart health behaviours, stating their intentions to improve their diets and increase their exercise.<sup>13</sup>

Actually seeing scan results during their post-scan consultation was perceived as valuable by patients.<sup>13,16</sup> Patients stated that this helped their understanding of their hearts and their condition.<sup>13</sup> Viewing the results of scans reassured patients, and gave patients a sense of being involved in their care.<sup>16</sup> However, not all patients may value seeing scan results, with some feeling that it is too time consuming for their physicians, or that they did not have the knowledge to interpret it and so it was not of value, or that they wanted to differ to their physicians' judgement and trusted their interpretation and course of action.<sup>16</sup>

### Limitations

The focus of the included publications was undergoing the scan itself. This means that the pathway of care in which the imaging was situated was, for the most part, not explored. This bears on this review as issues such as travel and access often figure prominently in patients' experiences of specialized health care services, which tend to be geographically centralized in Canada.

The majority of the included publications included patients who had undergone MRI as opposed to PET-CT scan. Being noisier, taking longer, having a narrower and more confining tube than a PET-CT scanner, and not requiring the injection of contrast dye, there are substantial differences between imaging technologies that likely translate to somewhat different patient experiences. These differences were considered throughout the analysis, and patients' experiences of PET-CT (and SPECT-CT) scans served as the anchor for reflecting on the interpretation of studies of patients who had undergone an MRI.

Within the included studies, there was no analysis of differences in populations, for example, gender, socio-economic status, geographic location, and ethnicity that may influence or shape patients' experiences. Vulnerable or marginalized patients may require specific concern not addressed in the included publications or this analysis.

### Conclusions and Implications for Decision or Policy Making

This review used a framework analysis to synthesize 11 included studies and described key features of patients' experiences across the process of undergoing advanced diagnostic imaging. From referral until they receive results, patients experienced scanning as fraught with worry. Scans were seen as important by patients for the ways they revealed what is going on inside of their bodies and could guide decisions on the most appropriate interventions. Patient-provider communication, as a source of information and of interaction, offered both emotional support and met patients' informational needs, which placed patients in better stead when undergoing advanced diagnostic imaging. In particular, patients who understood the purpose of the scan and what the scanning appointment would entail reported that the scan was consistent with their expectations.

A previous CADTH review on diagnostic pathways for pulmonary embolism found similar findings.<sup>1</sup> Both this review and the previous CADTH review share many key findings,

including patients' expectations of scans, importance of human patient-provider communication, and the emotional impact of the scan. However, this review did not identify patients' lack of self-control and requirement for a caregiver as key themes, as did the other review. This review gave greater weight to patients' experiences of PET-CT (and SPECT-CT) for cardiac indications (primarily as opposed to MRI), and in neither of the two publications which focused on this experience did loss of control (as a theme or a type of experience) arise.<sup>13,18</sup> This is consistent with differences between types of scans and the scanning machines themselves, where noise, isolation, and being confined are more typical of MRI scanning experiences.<sup>11</sup>

The findings of this review are also consistent with a previously published meta-synthesis on advanced medical imaging.<sup>21</sup> This review focused on patients' experiences of scanning per se and did not attend to differences by type of or reasons for imaging. Like this review, many of the findings related to communication, interactions, and information sharing which facilitated patients having positive experiences when undergoing imaging.

A recent literature review of patients' experiences in imaging and radiation therapy also highlights the role of interpersonal interactions for reassurance, for decision making, and for the provision of information.<sup>22</sup> Bolderston 2017 draws on theories of patient-centred care and patient engagement, and goes farther by suggesting a key feature defining patients' experiences of imaging relates to the availability of time for patient-provider interactions.<sup>22</sup> This review is unique in that it identified that scanning may create possible opportunities to build in behavioural interventions for heart health through viewing scans, during consultations.<sup>13</sup>

When evaluating the public provision of PET-CT scanning for cardiac indications, the results of this review suggest several specific considerations. Patients are likely to welcome the opportunity to peer inside their bodies by undergoing scanning if it is integral for deciding on an available and effective intervention.

Ensuring patients have clear understanding on why they are undergoing imaging and why it is important, and what they can expect the process to look like can support alignment between expectations and experiences which appears to facilitate positive experiences of undergoing imaging.

Patients' experiences of scanning can be made more positive by attending to these informational needs. These information needs extend beyond clinical information (e.g., benefits and risks of scanning, how to prepare for the scan) to information about the process and pathway of attending a scan. Explaining next steps, such as how they will be contacted to schedule a scan, and who and how they will be contacted to follow up with results is important. Patients want to come prepared to their scanning appointment, and their understanding what is required of them can be supported by conversations that include the provision of written material. Patients appear to benefit from information being provided in a variety of formats at a number of time points.

When scheduling appointments, allowing for some flexibility and for patients to have input, where feasible, may aid patient's experiences, specifically by allowing patients' who rely on public transit or others for their travel to select more optimal appointment times. Further, given that most PET-CT scanners are located in hospitals in urban centres, many patients in Canada may have to travel some distance for their scan, including requiring overnight stays with a caregiver. For patients from out-of-town, additional information on how to navigate the way to the hospital would likely be appreciated. Similarly, some consideration

may be given to the out-of-pocket expenses (including loss of income) that patients and their caregivers might incur for such travel.

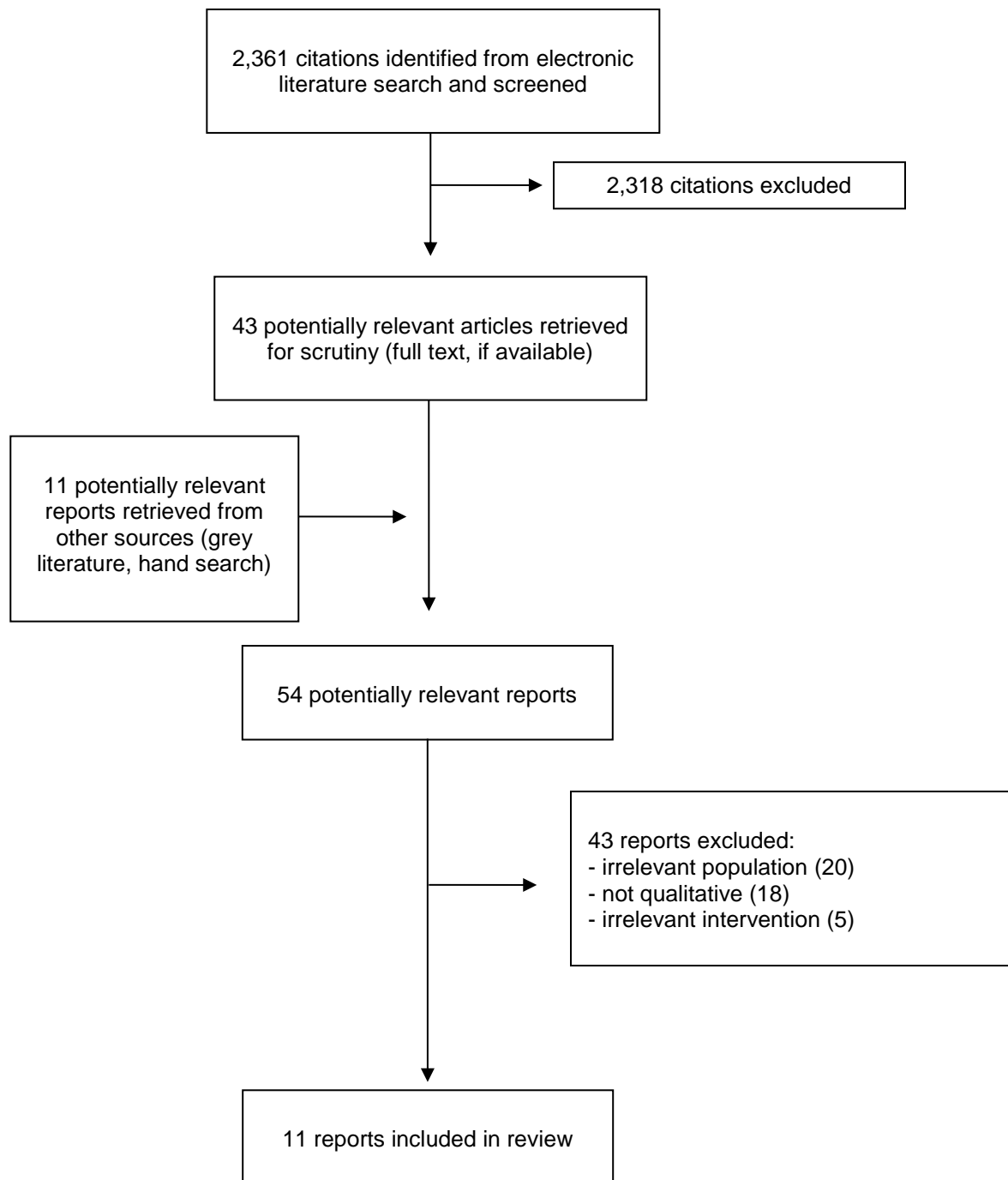
At the imaging unit, staff can help by creating a supportive and more familiar environment for patients through music, décor, and warmth (temperature). Ensuring patients have time to ask questions through the process of undergoing the scan and that staff are present and attentive throughout support patients feeling more at ease.

Lastly, patients may be interested in seeing the images from the scan to help them further understand their condition. This may create possible opportunities to build in and reinforce behavioural interventions for heart health.

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## Appendix 1: Selection of Included Studies



## Appendix 2: Characteristics of Included Publications

**Table 2: Characteristics of Included Studies**

First Author, Publication Year, Country	Study Design (Data Analysis)	Study Objectives	Sample Size	Inclusion Criteria	Data Collection
Evans, 2017, UK <sup>11</sup>	Not specified (Thematic analysis)	To describe patients' experiences of whole-body MRI to standard imaging	51	Adult patients with suspected or known colorectal or lung cancer involved in a clinical trial on whole-body MRI for staging cancer	Semi-structured interviews after diagnostic imaging
Thornton, 2016, USA <sup>12</sup>	Not specified (Thematic textual analysis)	To identify opportunities for improving patient-centred communication about diagnostic tests that involve the use of radiation in a cancer care setting	30	Adult patients or caregivers of pediatric patients with cancer who underwent diagnostic imaging that involved ionizing radiation	Focus groups post-imaging
Carlin, 2014, UK <sup>16</sup>	Qualitative description (Not specified)	To understand the meaning of seeing images of their own interior body and their meaning in the consultations	25	Adult patients who were referred from general practice for X-ray, CT or MRI in past 12 months	Semi-structured interviews within 12 months post-imaging
Devcich, 2014, New Zealand <sup>13</sup>	Not specified (Thematic analysis)	To understand patients' perceptions and understandings of their heart health and health behaviours as they related to diagnostic cardiac computed tomography angiography	13	Adult patients undergoing first time diagnostic cardiac computed tomography angiography	Semi-structured interviews before diagnostic imaging and after results consultation
Funk, 2014, Sweden <sup>17</sup>	Qualitative description (Content analysis)	To describe patients' experiences of MRIs and breath holding techniques	28	Adult patients attending an appointment for a liver MRI	Semi-structured interviews immediately post-imaging
Robey, 2014, USA <sup>15</sup>	Not specified (Content analysis)	To identify opportunities to improve radiation risk communication	27	Adult patients who had at least one CT scan in the emergency department in the past two years.	Focus groups within two years post-imaging



First Author, Publication Year, Country	Study Design (Data Analysis)	Study Objectives	Sample Size	Inclusion Criteria	Data Collection
Strand, 2014, Sweden <sup>14</sup> ,	Not specified (Latent content analysis)	To explore patients' experiences of MRI examinations for metastatic cancer in the spine	12	Adult patients with suspected or known metastatic cancer in the spine and undergoing a MRI	Semi-structured interviews after diagnostic imaging
Carlsson, 2013, Sweden <sup>20</sup>	Phenomenology (Systematic text condensation)	To describe patients' expectations before and during a head-first MRI	10	Adult patients undergoing first time head-first MRI scan	Semi-structured interviews post-imaging
Nightingale, 2012, UK <sup>18</sup>	Qualitative description (Thematic content analysis)	To explore patients' experiences of referral and undergoing a SPECT-CT for cardiac indications	22	Adult patients undergoing first time diagnostic cardiac SPECT-CT	Semi-structured interviews before and after diagnostic imaging
Munn, 2011, Australia <sup>21</sup>	Meta-synthesis (not specified)	To identify the patient experience of high technology medical imaging	15 studies	Studies that used qualitative methods to explore patients' experiences of undergoing high technology medical imaging	Comprehensive literature search
Törnqvist, 2006, Sweden <sup>19</sup>	Hermeneutic phenomenology (not specified)	To explore patients' lived experience during magnetic resonance imaging	30	Adult patients scheduled for an MRI scan	Conversational interviews after imaging

MRI = magnetic resonance imaging; PET-CT = Positron emission tomography-computed tomography; SPET-CT = single photon emission computed tomography-computed tomography

## Appendix 3: Characteristics of Study Participants

**Table 3: Characteristics of Study Participants**

First Author, Publication Year, Country	Sample Size	Sex (% male)	Age Range in Years	Health Conditions	Type of Diagnostic Imaging
Evans, 2017, UK <sup>11</sup>	51 patients	61%	40-89 years	Patients with colorectal and lung cancer	Whole body MRI
Thornton, 2016, USA <sup>12</sup>	30 patients	40%	mean of 57 years	Patients with colorectal, breast, or testicular cancer, survivors of thoracic cancer, and parents of children with neuroblastoma	Diagnostic imaging that uses ionizing radiation (not specified)
Carlin, 2014, UK <sup>16</sup>	25 patients	36%	41-86 years	Patients referred for imaging in past 12 months	X-ray, CT or MRI
Devcich, 2014, New Zealand <sup>13</sup>	13 patients (26 interviews)	85%	39-71 years	Coronary artery disease	CT
Funk, 2014, Sweden <sup>17</sup>	28 patients	25%	Median of 55 years in women; 49 years in men	Not specified (patients needing an MRI of their liver)	MRI
Robey, 2014, USA <sup>15</sup>	27 patients	47%	19-70 years	Not specified	CT
Strand, 2014, Sweden <sup>14</sup>	12 patients	50%	48-90 years	Cancer patients with suspected metastasis in their spine	MRI
Carlsson, 2013, Sweden <sup>20</sup>	10 patients	50%	21-70 years	Not specified	MRI (head first)
Nightingale, 2012, UK <sup>18</sup>	22 patients (42 interviews)	41%	36-83 years	Cardiac conditions requiring myocardial perfusion (e.g., coronary artery disease)	SPECT-CT
Törnqvist, 2006, Sweden <sup>19</sup>	30 patients	23%	22-73 years	Not reported	MRI (performed with head inside tunnel)

MRI = magnetic resonance imaging; PET-CT = Positron emission tomography-computed tomography; SPET-CT = single photon emission computed tomography-computed tomography

## Appendix 4: Critical Appraisal of Included Publications

**Table 4: Critical Appraisal of Included Publications**

First author, Publication year, Country	Is the study credible?	Is the study trustworthy? (Dependable, Confirmable)	Is the study transferable?
Evans, 2017, UK <sup>11</sup>	Yes. Large sample size (n=51) and semi-structured interviews using a refined interview guide supported collecting rich data. Analysis is full of participants' voices. Themes are described in detail, and their interconnections are described through a model. Lots of contextual details are taken into consideration in the analysis.	Yes. Data supplied, methods described, and the analysis being grounded in the published literature support the trustworthiness of the analysis.	Partially. Includes patients undergoing scanning who reflected on prior CT scans (including PET-CT) so helpful for drawing out differences in patient experiences. Cancer population which invokes differences as well.
Thornton, 2016, USA <sup>12</sup>	Partially. Little acknowledgment of patients' own experiences and history of imaging in the analysis. Limited presentation of patients' voices. Use of focus groups brought out a plurality of perspectives on communication of medical risks, likely not rich enough to delve into patients' values and views re: long-term risks (i.e., what does it mean to be told you are being exposed to a carcinogen in order to treat your cancer?)	Yes. Study authors compare findings across focus groups (by cancer type) to assess the dependability of their findings within the study. Given that the findings are superficial, overall trust in the data versus the reported themes.	Partially. Includes patients who underwent PET-CT, CT, X-ray and MRI (no information on proportions of patients who received which is provided). Cancer population where a history of repeat imaging is highly likely.
Carlin, 2014, UK <sup>16</sup>	Partially. The themes, dimensions and their relations are not well explained or described in detail. Unclear when interviews occurred, how long after the consultations, which may affect the meaning of the scans for patients. Used the computerized coding embedded in NVivo. Does not account for other factors in the patient-provider relationship which are likely important in the context of the research question.	Partially. Limited credibility affects trustworthiness, unsure if the findings would hold true. Trust in the data, moreso than the analysis.	No. Unclear what portion of patients had which type of scan, not reported how long after imaging, and unclear what conditions (from general practice) patients had.

First author, Publication year, Country	Is the study credible?	Is the study trustworthy? (Dependable, Confirmable)	Is the study transferable?
Devcich, 2014, UK <sup>13</sup>	Partially. The inductive themes derived using thematic analysis are mostly aggregative descriptions of topics raised during interviews (indicating the potential for superficial analysis). Open-ended questions were directive, perhaps influencing the data collected. Interrelations between themes are not identified, and differences in perspectives and expectations pre- and post- scan are not explored.	Partially. Some concern regarding the small number of participants and how dependable the findings are. Interpretation of stated interest in health behaviours is appropriately framed as intention (versus actual behavior). Trust the overall themes, but some question that they could be developed further.	Yes. The sample and recruitment methods support the transferability of the findings to the research question of this review.
Funk, 2014, Sweden <sup>17</sup>	Yes. The authors describe the methods of data collection and analysis and their justifications are coherent. They present their analysis in great detail, including how they built themes from sub-themes and categories. Data are presented that support their analysis.	Yes. The authors' discussion of their methods indicates that they were thoughtful in a variety of ways when engaging with patients and their responses.	Partially. Includes patients undergoing MRI, health conditions not specified. Though the specific techniques are likely not transferable, the analysis of breath holding techniques and roles of the patients and radiographers is relevant for this review.
Robey, 2014, USA <sup>15</sup>	Partially. This is an empirical ethics study which uses qualitative data and analysis. The findings are discrete (about patients' preferences for ethical principles), unclear if this was probed deeply enough, feels like patients' data were taken at face value.	Partially. Use of multiple data types (focus groups, interviews with patients and physicians) used to triangulate their data, improves credibility and trustworthiness. However, patients' voices are barely used.	Partially. Between the differences in the population (people who had undergone CT in the past 2 years in the ED) and the methodological issues, this study bears only slightly on the question of this review.
Strand, 2014, Sweden <sup>14</sup>	Partially. Descriptions of authors' practices of reflexivity are offered (e.g., laying out presumptions). Themes are described in detail however interconnections between them are not adequately explored.	Yes. The authors provide ample contextualization of their findings in regards to their research question. Data supporting their analysis suggest it is robust. Authors have a dedicated discussion on what they reflected on, what they brought to the investigation (experience, assumptions), and indicating one form of reflexive practice.	Partially. The sample (cancer patients) and the type of imaging (MRI) require the tentative transferability to the research question of this review.
Carlsson, 2013, Sweden <sup>20</sup>	Yes. The study authors describe their methods in details and provide justification. The team used a number of strategies to	Yes. Good use of participants' voices lends to its trustworthiness. Additionally the analysis is coherent in relation to the literature in	Partially. Participants' health conditions are not described. However, likely not limited to cancer patients which have specific consideration.

First author, Publication year, Country	Is the study credible?	Is the study trustworthy? (Dependable, Confirmable)	Is the study transferable?
	improve the consistency and credibility of their analysis, including immersion in the data, conversations as a team. The data support the analysis which is coherent and reported in detail.	which it fits.	Important difference between MRI and PET-CT make it only of limited use for the purposes of this review.
Nightingale, 2012, UK <sup>18</sup>	Partially. The study authors describe the data collection and analysis methods used and their justifications are coherent. Using pre- and post-diagnostic imaging interviews, they examine the process of undergoing testing. The resulting themes do not entirely map on to all the dimensions described, leaving findings somewhat ambiguous in their interpretation. Data are used under multiple themes and their differences poorly developed.	Partially. Study is well contextualized in the field of inquiry (patients' perceptions of advanced medical imaging). Give the limitations in the credibility of the analysis, the data presented seem trustworthy but not the analysis.	Yes. The sample and recruitment methods support the transferability of the findings to the research question of this review. As this is theoretically grounded and findings are well-described and their interconnections explored, this study is very relevant to this review.
Munn, 2011, Australia <sup>21</sup>	Yes. The synthesis uses comprehensive searching, data extraction and analysis techniques that facilitated describing patients' experiences of imaging. The approach to analysis stays close to the data from the primary studies, without much critical reflection or reflexivity.	Yes. The findings lean towards aggregative, and thus findings are consistent at a very high level (themes are all-encompassing and therefore consistent). The authors published the data extracted which provides the ability to assess their analysis.	Partially. The review considers publications that use any type of advanced imaging and do not tease out patient experiences by type of imaging.
Törnqvist, 2006, Sweden <sup>19</sup>	Partially. Conversational interviews suitable for phenomenology. Themes are described in detail and with supporting data. Some overlap between themes (especially threat to self-control and need for support), suggests further analysis might lead to these interconnections being explored.	Yes. Study is well contextualized in the field of inquiry. Good use of participants' voices leads to its trustworthiness. Some question if participants experiences were different by reason for the MRI that is not explored.	Partially. Reasons for MRI (health conditions) are not reported making it unclear if relevant to cardiology. Also study focuses on MRI (head in during imaging) which is very different from PET-CT. Thus only partially transferable to the question guiding this review.

MRI = magnetic resonance imaging; PET-CT = Positron emission tomography-computed tomography; SPET-CT = single photon emission computed tomography-computed tomography