

Heart of Critical Care: The Lived Experiences of Cardiac Sonographers in the Intensive Care Unit

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Abstract

Cardiac Sonographers are essential in managing patients assigned to the Intensive Care Unit. This hermeneutic phenomenological research was conducted to determine the lived experiences of the Cardiac Sonographers assigned in the Intensive Care Unit (ICU). Ten (10) participants were referred and purposively selected from hospitals in Regions XI and XII. Data were extracted via In-depth interviews facilitated through face-to-face and online modalities. Van Manen's Data analysis technique was utilized to answer the objectives. Data shows three (3) essential themes surfaced for roles and realities: ultrasound machine and equipment use, critically ill patients, and challenges among sonographers. Behavior-changing practices by Cardiac Sonographers showed five (5) essential themes: micro-recovery strategies, interprofessional communication, reviewing patient records for reassurance, self-regulation, and sonographer efficiency practices. Professional outlook of the participants reflected five (5) essential themes: professional development, psychological resilience, high-tech portable devices, expanded collaborative networks, and professional learning nexus. This study illuminates the need to revisit the experiences and how the hospital entities ensure holistic management among Cardiac Sonographers assigned in the Intensive Care Units. The study's findings provide implications for the Radiologic Technology profession by highlighting the needs of Radiologic Technologists working as Cardiac Sonographers in the Intensive Care Unit (ICU), providing enhancement and curriculum revision to strengthen awareness and knowledge of the Cardiac Sonographers to cement their preparedness in the management of patients in the Intensive Care Unit.

Keywords: *Cardiac Sonography, Radiologic Technology, Intensive Care Unit, Hermeneutic Phenomenology, Philippines*

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Introduction

Echocardiography is a key diagnostic technique in Intensive Care Units (Robba et al., 2021). This non-invasive imaging method lets clinicians assess cardiac function, detect anatomical and physiological anomalies, and monitor hemodynamic parameters in real time (Lashin et al., 2024). Its potential to lead critical illness patients to life-saving interventions makes it essential (Peng et al., 2020). Despite its growing integration into

intensive care protocols, the lived experience of Cardiac sonographers who perform these procedures in a high-pressure environment like the Intensive Care Unit is often overlooked (Rodriguez-Ruiz et al., 2024).

Echocardiography is used worldwide to diagnose heart failure, shock syndromes, and cardiac tamponade (Robba et al., 2021). Depending on their experience, techniques, and talents, Cardiac Sonographers may confront problems when

performing echocardiographic operations at the bedside or in the Intensive Care Unit (Jenkins et al., 2021). Heart disease assessment with handheld devices and portable devices may be less accurate than with ultrasound equipment due to limited sight, difficulties, and machine performance, which can lead to misdiagnosis (Wierda et al., 2022). The complexity of patient cases and clinician experience affect echocardiographic evaluation accuracy (Reilly, 2023). In one study, experienced Cardiac Sonographers identified cardiac problems requiring advanced echocardiographic procedures in critical care settings, demonstrating their contribution to patient management (Jain et al., 2021).

Almubarek et al. found that sonographers with more experience had higher rates of work-related musculoskeletal diseases (WRMSDs) in the field (Almubarek et al., 2022). Saikhan's study found that Cardiac Sonographers have a high rate of musculoskeletal pain, indicating physical strain (Saikhan, 2023). In a study, cardiac sonographers follow strict regulations and risk infection, and emotional dynamics are crucial in intensive care facilities (Jain et al., 2021). In another study, Westhuizen et al. examined how sonographers view their job as caring, showing the emotional work they put into patient encounters (2020).

A Philippine study by Nario et al. (2023) highlighted the role of Cardiac Sonographers in detecting regional wall motion anomalies of the heart in emergencies. Another survey by Vidal and Montepio (2024) examined how bedside ultrasound can measure inferior vena cava diameter and collapsibility to estimate proper ventricular function. These studies show the clinical value of echocardiographic instruments but do not examine sonographers' working conditions and responses in difficult situations. On a different note, Cardiac sonographers were least represented in Davao (1.5%) and SOCCSKSARGEN (0.7%), according to Magno et al. (2023). Magno et al. (2023) found that some Cardiac Sonographers work alone, highlighting the region's shortage.

There are limited to no studies about cardiac sonographers highlighting their experiences, except for Ionescu (2023), whose study highlighted

the lived experiences of cardiac sonographers regarding the burden of work injuries. On another note, only Magno et al.'s study (2023) highlighted the state of Cardiac Sonographers in the Philippines. Hence, this study sought to fill a gap in the literature by uncovering, exploring, and documenting the lived experiences of Radiologic Technologists working as Cardiac Sonographers in the Intensive Care Units across selected hospitals in Region XI and XII in Mindanao. A qualitative, phenomenological approach aims to capture their voices, challenges, coping mechanisms, insights, and professional journeys—thereby contributing to a thorough understanding of their role in the Philippine healthcare system, especially in underserved and underrepresented regions. This study can also help enhance the working profession and conditions, create programs and solutions to tackle these challenges, and support associations in the Cardiology Field.

Methods

Research Design. The study used the Hermeneutic phenomenological research design to explore the lived experiences of Radiologic Technologists working as Cardiac Sonographers in the Intensive Care Unit. Hermeneutic phenomenology involves crafting stories from qualitative data, which can provide insights into phenomena that might remain hidden through other forms of data analysis (Crowther et al., 2016). In research, the hermeneutic circle is employed to understand the phenomena and the perspective of those who experience it, in this case, the researcher, revealing the subjectivity and essence of the phenomena (Guerrero-Castañeda et al., 2019).

The study was conducted in Central and Southern Mindanao, Philippines, in hospitals with Radiologic Technologists specializing in cardiac sonography and who have experience working in the intensive care unit. The study focused on 10 Radiologic Technologists working as Cardiac Sonographers or Echocardiographers in the Intensive Care Unit. Purposive and snowball sampling were used in this study by selecting participants based on specific characteristics or qualities, ensuring that the sample is particular to

the matter at hand and gaining their deeper insights (Shaheen et al., 2018). Since the study was hindered due to a limited number of participants (Magno et al., 2023), the study subjects referred other qualified participants in an area where cardiac sonographers were lowly supply (Naderifar et al., 2017). In reaching the number of participants, the first 4 participants referred 2 participants. Meanwhile, two other participants referred 1 participant. Other medical professionals working as Cardiac Sonographers were omitted.

The study used in-depth interviews with Radiologic Technologists working as Cardiac Sonographers as the primary data source. The study's data analysis was guided by the hermeneutic interpretative analysis following the methods of

Van Manen (1990) in exploring and interpreting the lived experiences of Radiologic Technologists working as Cardiac Sonographers in the intensive care unit setting. Van Manen's thematic analysis method focuses on understanding lived experiences through a phenomenological lens (Kralik, 2000). It emphasizes the importance of reflective interpretation and the subjective meanings participants attach to their experiences (Paley, 2018). Van Manen's descriptive and interpretive approach aims to reveal the essence of human experience through deep reflection and rigorous thematic analysis (Zahavi, 2020).

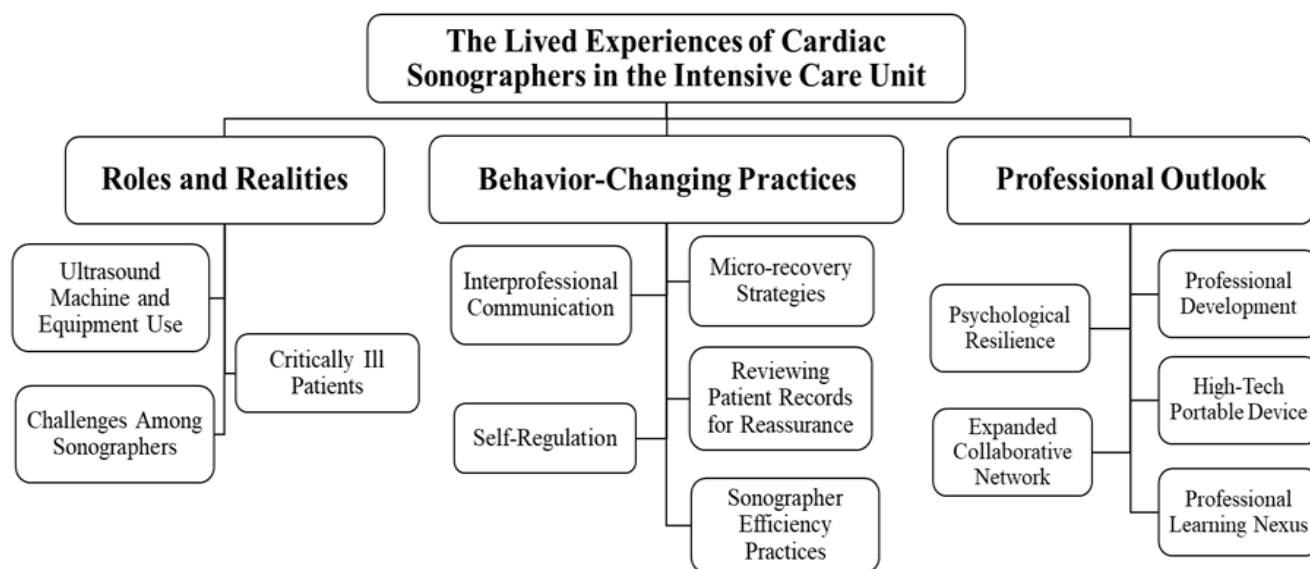
Results and Discussion

Table 1. Profile of the Participants

Participant Number	Pseudonym	Gender	Length of Service	Age	Study Group
1	Aorta	Female	8 years	29	IDI
2	Apex	Female	2 years	25	IDI
3	Artery	Female	7 years	27	IDI
4	Atrium	Female	5 years	28	IDI
5	Base	Female	2 years	25	IDI
6	Septum	Female	6 years	28	IDI
7	Valve	Female	2 years	25	IDI
8	Vein	Female	7 years	30	IDI
9	Vena Cava	Female	6 years	28	IDI
10	Ventricle	Female	6 years	32	IDI

Table 1 represents the profile of the participants. The table is divided into five columns with five labels: Pseudonym, Gender, Length of Service, Age, and Study Group. This study had 10 respondents, some of whom were referred, and all accepted to participate in the in-depth interview voluntarily. The researcher used a pseudonym for each participant; all were named after the anatomical parts of the heart. The researcher used pseudonyms to protect the respondents' identities while presenting the results. This study is also concerned with privacy and confidentiality, wherein their identities will remain confidential and will not be disclosed in any form or way.

Figure 1. Thematic Map of the Lived Experiences of Cardiac Sonographers in the Intensive Care Unit



Presented in Figure 1 is the thematic map of the study. Data shows three emergent themes: (1) the roles and realities, (2) behavior-changing practices, and (3) professional outlook of the Cardiac Sonographers in the Intensive Care Unit. Under the emergent theme roles and realities, there are three essential themes: (1) ultrasound machine and equipment use, (2) critically ill patients, and (3) challenges among sonographers. Under the emergent theme behavior-changing practices, there are five essential themes: (1) micro-recovery strategies, (2) interprofessional communication, (3) reviewing patient records for reassurance, (4) self-regulation, and (5) sonographer efficiency practices. Lastly, under the emergent theme professional outlook, there are five essential themes: (1) professional development, (2) psychological resilience, (3) high-tech portable device, (4) expanded collaborative network, and (5) professional learning nexus.

Table 2. Thematic Table on the Roles and Realities of Cardiac Sonographers in the Intensive Care Unit (Core Ideas – Essential Theme – Emergent Theme)

Ideas – Essential Theme – Emergent Theme)		
Core Ideas	Essential Theme	Emergent Theme
Heavy Machine	Ultrasound Machine and Equipment Use	The Roles and Realities of Cardiac Sonographers in the Intensive Care Unit
Technically Poor Echo Window		
Low Image Quality		
Patients Undergoing Dialysis	Critically Ill Patients	
Intubated Patients		
Patient’s Body Habitus		
Patient’s Unconsciousness and Limited Mobility		
Patient’s Undesirable Behavior	Challenges Among Sonographers	
Limited Workforce		
Musculoskeletal Discomfort		
Wearing of Personal Protective Equipment		
Emotional Empathy		

Emergent Theme 1. Roles and Realities

This section discusses the lived experiences

of Cardiac Sonographers in the Intensive Care Unit. The participants shared their day-to-day experiences performing echocardiographic procedures in the ICU. They also emphasized and

described the ultrasound machine equipment they use, the behaviors and characteristics of patients they encounter in the ICU, and the challenges they experience when performing procedures.

Essential Theme 1. Ultrasound Machine and Equipment Use

This essential theme is characterized by the following three core ideas: (1) heavy machine, (2) technically poor echo window, and (3) low image quality. The participants stated that the ultrasound machine used for portable echocardiography in the Intensive Care Unit differs from that in their department.

Some participants shared that the new portable machine is relatively heavy to carry to the ICU. Ultrasound devices are heavy and awkward to move manually (Straily et al., 2021). As stated by participant 6:

"Our machine, although it is portable, is slightly larger and heavier, and it is not easy to bring because it is heavy" (Septum)

They added that another challenge is the machine's technically poor echo window because of the patient's condition. In echocardiography, the left side lying or left lateral decubitus is the typical position for enhancing acoustic windows (Ottenhoff et al., 2022). As stated by participant 1:

"There are times when the imaging window is nice; however, the imaging windows for the ICU patients usually are not good" (Aorta)

Aside from their frustrations with TPEW, the participants also mentioned that the machine sometimes resulted in low image quality. Studies have demonstrated that the imaging quality from portable machines can be considerably lower than their more sophisticated counterparts, particularly regarding achieving sufficient resolution and contrast necessary for accurate interpretation of cardiac structures and functions (Mor-Avi et al., 2023). As stated by participant 2:

"The portable machine that we use in the ICU is not actually a high-quality device, and it lacks some advanced features, but it can still offer sufficient capabilities,

and it still affects the results or quality of the images at times" (Apex)

The participants expressed the difference in the echocardiographic image quality when using the portable machine and the situations they encountered when using the equipment on critically ill patients. This study shows the critical equipment choice of echocardiography in the ICU.

Essential Theme 2. Critically Ill Patients

The participants expressed that the patients encountered in the Intensive Care Unit are typically critically ill. Their encounters with these patients differ on a case-by-case basis. This essential theme is characterized by the following five core ideas: (1) Patient Undergoing Dialysis; (2) Intubated Patients; (3) Patient's Body Habitus; (4) Patient's Unconsciousness and Limited Mobility; and (5) Patient's Undesirable Behavior.

Patients who are critically ill and undergoing dialysis hinder their seamless procedures because of the life support equipment attached. Obtaining echocardiographic images in dialysis patients and those on life support presents several significant challenges due to physiological, technical, and situational factors (Hassan et al., 2023). As stated by participant 9:

"Especially when there is something attached to the patient, a patient that undergoes dialysis, there is a case like that, it is difficult since a lot is attached to the patient" (Vena Cava)

According to the participants, even intubated patients add burdens when doing the sonographic procedures. In the ICU, numerous obstacles, such as mechanical ventilation, patient positioning, recent surgeries, technical limitations, patient condition, sedation, and limited mobility, can significantly hinder optimal positioning and impact the quality of the images obtained (Femine et al., 2024). As stated by participant 6:

"The views are difficult to obtain, and also in the room of the patient, there is not a lot of attached equipment because the patient is intubated, so there is something attached to the patient (tube)" (Septum)

As for the participants, they shared that a

patient's body habitus can provide clues about a patient's health. They mentioned that it can influence the position of internal organs, which is relevant in medical imaging. Increased BMI is associated with reduced image quality in echocardiography (Ellenberger et al., 2021). In contrast, Ionescu (2023) explained that Cardiac Sonographers face challenges when performing procedures on very skinny patients. However, this is a challenge for the Cardiac Sonographers in the Intensive Care Unit. As stated by participant 8:

"Well, based on my experience, if the patient is very fat or very skinny, because you cannot tell if both patients have the same poor views" (Vein)

The participant expressed that they are no longer surprised seeing patients in the ICU with limited movements and even unconscious. Practical challenges arise in the ICU because most critical patients are immobilized, often supine or have life-support machines, which creates obstruction and makes it difficult to assess the heart (Chung et al., 2021). As stated by participant 6:

"The patient in the ICU needs patient care because they are usually in pain, so they cannot be positioned properly, unlike the usual 2D echo position, which is a left-side lying position, so patients in the ICU usually lie flat or supine on the bed" (Septum)

Participants shared their views on the undesirable behaviors of critically ill patients in the Intensive Care Unit. Patients in the ICU feel irritable because of their critically ill conditions; sometimes, they show undesirable behavior to Cardiac Sonographers. In a study by Ionescu (2023), critically ill patients do not cooperate for other reasons, making it challenging for the sonographers to perform procedures. As stated by participant 9:

"Of course, performing procedures in the ICU is very difficult. It is not easy. It is difficult because the patient will not cooperate, they are irritated because of their illness, and they cannot assume the proper position" (Vena Cava)

Patients in the ICU are critically ill with different health and medical statuses, as stated by

the participants. Depending on their status, it may pose a challenge to Cardiac Sonographers when performing echocardiographic procedures.

Essential Theme 3. Challenges Among Sonographers

The participants discussed the challenges of working as cardiac sonographers in the intensive care unit. This essential theme is characterized by the following four core ideas: (1) Limited Workforce; (2) Musculoskeletal Discomfort; (3) Wearing of Personal Protective Equipment; and (4) Emotional Empathy.

The participants expressed that there is a limited number in the workforce. The increasing number of patients admitted to the ICU who need Cardiac Sonography is undeniably increasing. According to a survey by Won et al. (2024), the demand for echocardiography has significantly increased despite the limited workforce in the Cardiac Sonography profession, leading to a supply-demand mismatch. They shared that cardiac sonographers cannot cater to immediate doctors' sonographic requests because of the limited number of professionals who can perform them. As stated by participant 4:

"Hhhmmm, there are times that I get emotional when the work piles up or the number of patients increases, and it is draining since we are understaffed. I cry at times because of the exhaustion and stress, because there are many patients that the staff cannot accommodate all the requests in a day, and this was during the pandemic, when there were a lot of admitted patients, especially in the ICU" (Atrium)

They added that because of the increasing number of cases in the ICU needing cardiac sonographic procedures, their number is challenged to meet the immediate demand of the physicians. Sonographers in the ICU face high job demands, including unrealistic

workloads and time pressures contributing to high stress levels (Hall et al., 2024). As stated by participant 8:

"Well, sometimes, there are many patients, it adds to our burdens, pressure" (Vein)

The participants also expressed that they experience musculoskeletal discomfort, including the following: neck pain, back and shoulder pain, and even prolonged standing. Being assigned to the ICU doing sonographic procedures requires additional strength. According to Saikhan's (2023) study, it was found that work-related musculoskeletal diseases are highly prevalent among Cardiac Sonographers, with 84.8% of them reporting pain. The experiences of physical discomfort are no longer surprising in all participants. As shared by participant 3:

"The shoulder, the shoulder would get stiff and usually the hips, it is exhausting, so your energy gets drained easily, I think there are no other huge problems" (Artery)

Not even for shoulder pain, back pain has been their consistent complaint due to prolonged standing. Echocardiographers often experience musculoskeletal pain due to awkward postures and repetitive movements (Tetteh et al., 2022). As shared by participant 1:

"Musculoskeletal pain, that is what I am trying to fix, so I have a musculoskeletal disorder on my back, so it affects me when I stand for a long period, and then, of course, exhaustion. And for the well-being, well, it affects my health" (Aorta)

Because patients in the ICU are highly

sensitive, Cardiac Sonographers must wear all the necessary Personal Protective Equipment, which adds to their discomfort. Sonographers and healthcare providers must use appropriate Personal Protective Equipment to protect themselves and patients, especially during procedures that may generate aerosols when performing in close contact with the patient (Nicoara et al., 2020). As shared by participant 4:

"One of the challenges is when the patient's case is an infectious one. Hence, we need to wear the PPE, those suits that look like those of an astronaut" (Atrium)

Participants expressed that critically ill patients displayed unpleasant behaviors; despite that, they shared that they feel and understand the patients' critical situations; they even mentioned that seeing them unresponsive and uncomfortable sometimes affected them emotionally. This intimate exposure to critically ill patients' vulnerabilities often fosters empathy, as sonographers recognize the patients' pain and uncertainty about their health outcomes (Demir, 2023). As shared by participant 6:

"In terms of getting emotional, well, at first I felt pitiful towards the patient and their status, you would also feel how the family felt" (Septum)

Cardiac Sonographers in the Intensive Care Unit face multiple challenges when performing echocardiographic procedures on critically ill patients. As participants shared, the challenges have affected their health, but they maintain their performance to provide quality service.

Table 3. Thematic Table on the Behavior-Changing Practices of the Cardiac Sonographers in the Intensive Care Unit (Core Ideas – Essential Theme – Emergent Theme)

Core Ideas	Essential Theme	Emergent Theme
Practicing in-between breaks	Micro-recovery Strategies	Behavior-Changing Practices of the Cardiac Sonographers in the Intensive Care Unit
Stretching and Exercise		
Rewards and Relaxation		
Communication with peers	Interprofessional Communication	
Communication with critically ill patients		
Verifying and Assuring Patient's Medical Records	Reviewing Patient Records for Reassurance	
Diligent Procedure Noting		
Stretches Patients' and Peers' Understanding	Self-Regulation	
Maintain Composure and Calmness		
Quick Scanning Time		
Ensure Machine Readiness	Sonographer Efficiency Practices	
Positioning and Procedural Adjustments		
Peer Assistance		

Emergent Theme 2. Behavior-Changing Practices

This section highlights the coping mechanisms and practices that shaped the behavior of the Cardiac Sonographers in the Intensive Care Unit. There were five essential themes extracted, including: (1) micro-recovery strategies; (2) interprofessional communication; (3) reviewing patient records for reassurance; (4) self-regulation; and (5) sonographer efficiency practices.

Essential Theme 1. Micro-Recovery Strategies

This essential theme is characterized by the following three core ideas: (1) practice in between breaks, (2) stretching and exercise, and (3) rewards and relaxation. It is noted that technicians experienced back and shoulder pain and other musculoskeletal problems, so one way of relief is to practice during breaks. Regular breaks, including micro-breaks, have been associated with increased vigor and reduced fatigue, which are critical for maintaining the well-being of sonographers (AlMubarek et al., 2022). As expressed by participant 9:

"Sometimes we pause and take a break, we cannot continue straight with the procedures since we will burn. You also take time" (Vena Cava)

As suggested by their peers, they need to do stretching or exercise at least to ease the back and shoulder pains experienced when performing the procedure. Interventions such as chair massages and stretching exercises have shown promise in reducing discomfort, suggesting that breaks incorporating these activities could be beneficial (Onwordi et al., 2024). As expressed by participants 4 and 8:

"In terms of the pain that I feel, I stretch before and at the end of the day, and I would rest, rest like relax, or take breaks in between the tiring work so that I would not get more stressed" (Atrium)

"We have a colleague who suffers from a neck disease. So she was given exercises. So every one of us was like "hey, let us do this, I think we also need to do this" (Vein)

They also give rewards to themselves, like eating out and even getting a relaxing massage. In a study by Ionescu (2023), cardiac sonographers expressed coping methods by taking relaxation and massages out of their pocket to alleviate their pain from working hard. As shared by participant 3:

"Ma'am, well, of course, massages, and aside from that, rest is a must. Well, not to the point that I need to drink pain medications like those, yeah, I think it is

just rest. Well, aside from rest, rewarding yourself by eating outside could be done also hahaha just like that” (Artery)

“I think we should reward ourselves also, like treating yourself, eating, strolling, relaxing, and massage appointments” (Artery)

Cardiac Sonographers expressed how they adapted to taking breaks and micro-recovery strategies like stretching, relaxation, and even self-rewarding, which are essential for their physical and mental health when performing procedures in the ICU. They highlighted the need to practice self-care. Self-care prevents burnout and fatigue, which is important in the profession in the long run, especially in a stressful environment like the ICU.

Essential Theme 2. Interprofessional Communication

According to the participants, communication is essential in any team or organization. This essential theme is characterized by two core ideas: (1) communication with peers and (2) communication with critically ill patients. The participants mentioned that patient communication and establishing connections among colleagues will ensure seamless dynamics among patients and technicians. Effective communication among team members, including Cardiac Sonographers, is critical to prevent medical errors, maintain accurate diagnoses, and ensure patient safety (Mishra et al., 2024). As stated by participants 7, 9, and 6:

“I look up to my senior because she is more experienced and she can give me recommendations on what to do” (Valve)

“Communication with your colleague is also included” (Vena Cava)

“Usually, I would ask for permission from the resident on duty if it is possible that I can open the surgical wound gauze, if only it is possible to be opened a little” (Septum)

Other than communication with peers, it is very pivotal to communicate clearly and calmly with patients. They find it very significant to address challenges encountered, including those

with limited or no movement and those who are irritated. Effective communication helps build patient trust, which is essential for reducing anxiety and ensuring patient cooperation during procedures (Nyhagen et al., 2024). As shared by participant 1:

“It is not that all of the patients are unable to communicate, it is just to avoid them from getting irritated or disturbed, that you slowly communicate with them if they can adjust their positions, because how they feel is important in this situation” (Aorta)

Cardiac Sonographers have adapted to practicing proper communication with their peers, colleagues, and even critically ill patients in the ICU. This incorporated practice benefits smooth and quality service when performing echocardiographic procedures in the ICU.

Essential Theme 3. Reviewing Patient Records for Reassurance

This essential theme comprises two core ideas: (1) verifying and assuring patients' medical records and (2) diligent procedure noting. This refers to the Cardiac Sonographer reviewing the patient's medical records and reassuring that they are accurate, complete, consistent, and trustworthy before performing the procedure.

This is crucial in healthcare for several reasons, including patient safety, legal compliance, and effective communication among healthcare providers. They must check medical record history to avoid inconveniences and errors when performing the procedure. This is part of being ready before the procedure. The quality of written communication in echocardiography referral forms is crucial (Kimura et al., 2024). Studies have shown that incomplete or inaccurate forms can lead to misdiagnoses and inefficient use of resources, highlighting the need for improved communication skills in clinical documentation (Kotzé et al., 2022). Standardized protocols ensure that all necessary details, such as patient demographics and clinical history, are captured systematically, making it easier for sonographers to focus on critical aspects of the examination (Laing et al., 2024). As shared by participants 2, 4, 6, and 8:

“we verify the medical history of the patient, and the current status or

condition, if the patient has suspected cardiac dysfunction, why the patient has to undergo 2D echo or is there a need to rule out based on the fluid assessment that was seen on the X-ray or any valvular abnormalities" (Apex)

"I plan before I enter the ICU area, if the doctor ruled out or noted a partial diagnosis, so that I can have an idea of what images or routine to use on the scanning procedure" (Atrium)

"Going to the station and asking the person in charge of the station as to what they need in order to lessen the burden of thinking about the cases in the ICU, also you should check the records to know the full history of the patient" (Septum)

"Before entering the patient's room, all records should be reviewed so you can be sure what to do or what to do as instructed. It is not acceptable that you do not know what to do when you perform the procedures, especially when they are critically ill" (Vein)

"So, before scanning, always check the patient's chart, doctor's order, and the patient's case so you can plot your goals beforehand, so there are times that the order in the chart is ruled out as fluid. So it might be a pleural or cardiac effusion, so preparation is needed beforehand" (Apex)

When performing procedures, they also ensure that information gathered will be recorded accurately, so when physicians ask for any related information, the recorded notes are readily available. By keeping detailed records, sonographers provide essential information to the healthcare team, enabling cohesive and informed patient care management (Smith et al., 2024). As shared by participant 2:

"In the ICU, I usually note or document the findings immediately since the doctors would ask me what the initial findings are based on what I saw and my perspectives regarding the procedure" (Apex)

One of the practices that the Cardiac

Sonographers have incorporated is reviewing patient data and providing recorded information from the echocardiographic procedure. This practice has been incorporated because it would help them minimize their time and maximize the quality of their services in the Intensive Care Unit.

Essential Theme 4. Self-Regulation

This essential theme is characterized by two core ideas: (1) stretches patients' and peers' understanding and (2) maintains composure and calmness. To the participants, self-regulation is a crucial skill allowing individuals to manage their behaviors, emotions, and thoughts. It is the ability to control impulses, adapt to changing circumstances, and work towards long-term goals. When emotions burst among patients, technicians mentioned that regulating emotional and behavioral aspects is essential. Cardiac Sonographers develop emotional resilience through training, experience, and self-care strategies such as deep breathing and short mental breaks to maintain their composure and patience during procedures involving critically ill patients (Sheata et al., 2021). The concept of "professional distance" is necessary to allow healthcare providers to perform their roles effectively while safeguarding their emotional well-being (Filip, 2020). As shared by participants 3, 1, and 8:

"Always remember patience, it is just patience, you need to extend your patience because there are times that you are overwhelmed because you cannot find any views, eventually you get upset at times" (Artery)

"You need to understand them, because the pain that they experience is not easy, so you are the one who should understand the patient" (Aorta)

"You should just understand the patient, the condition or pain that they are going through is not easy" (Vein)

Even if adverse events happen in the ICU, they always maintain composure and calmness, believing that not everything inside can be easily controlled. Setting professional boundaries is crucial for Cardiac Sonographers to prevent emotional overload (Huang et al., 2022). This balance helps them provide necessary care while

preserving their emotional well-being, allowing them to remain objective during procedures (Harthy et al., 2023). As shared by participants 4 and 7:

"Also, keeping calm and having longer patience when performing is usually one of the reasons why I lasted longer in my work profession. It is not easy, it is tough to perform 2D Echo procedures on ICU patients, but if you are focused and calm, things will eventually end well" (Atrium)

"Well, that is it. The stressful events in the ICU, I do not take it to heart because I would get affected in the long run" (Valve)

Cardiac Sonographers practice self-regulation and resilience when performing procedures in the ICU. This habitual practice strengthens their professional condition, especially in the long run, when performing in a stressful environment like the ICU.

Essential Theme 5. Procedural Optimization

Procedural Optimization refers to improving the efficiency, effectiveness, and quality of a specific set of actions or steps (a procedure) to achieve a desired outcome. It is about finding ways to streamline processes, reduce waste, and enhance performance. This is characterized by the following four core ideas: (1) Quick Scanning Time, (2) Ensure Machine Readiness, (3) Positioning and Procedural Adjustments, and (4) Peer Assistance.

The participants mentioned that they do scanning in the least possible time. That is to avoid disturbances among critically ill patients. Rapid echocardiographic procedures contribute to streamlined workflows in the ICU (Metkus et al., 2022). According to Monteagudo et al. (2022), the ICU environment demands a broader skill set, including the ability to perform under pressure and adapt to rapidly changing patient conditions. As stated by participants 7 and 3:

"I try to scan the patient while looking for a good image, in the least possible time, you should be quick with your scanning while maintaining to look for a good quality image" (Valve)

"Usually, I scan the patient rapidly, depending on the situation of the patient, if

I can see that the patient is having difficulty and needs to be checked by a nurse every time (there is a procedure), so I tend to scan" (Valve)

"Performing a Quick Scan. If the protocol starts with a B-mode, then it should all be a b-mode continuously, if it is color mode then it should all be color mode, if it is Doppler mode then it should all be Doppler mode, For me, in regards with this protocol, back then I follow the usual or standard protocol, but later on you are the one doing the procedure. So what I do is if I see that I am in that view, right away I perform all the modes on that view, so that I will not have any difficulty looking for the views individually again in performing those modes in the ultrasound that I need for the study. It tends to extend my time longer, my exposure with the patient, as well as the scanning time, takes longer than usual" (Artery)

They also ensure that machines are ready before going into the ICU. They ensured the device would provide precise results or images whenever it was ready. In a critical care setting where timely information is essential, sonographers can work more efficiently by preparing beforehand, enabling them to conduct echocardiograms without interruptions quickly (Shaddock et al., 2022). As shared by participants 10 and 2:

"Before I start with the procedure in the ICU, I make sure that the machine is working because there might be a scenario where the machine is working here, and upon arriving in the ICU, the machine might malfunction. This event happened a lot, wherein upon arriving in the ICU, the machine has some trouble or malfunction, then the procedure gets delayed" (Ventricle)

"You should know how to find a way to do this when scanning procedures. Also, before scanning the settings on the ultrasound machine should be preconfigured, the probe should be- all the equipment should be complete before going to the ICU, for example " Oh I should bring this cause the patient might have this and that", to minimize any

disruptions and adjustments during scanning you should always prepare for the worst case scenario" (Apex)

Participants also mentioned that they are doing self-positioning adjustments, meaning looking for areas that would provide a viable TPEW and adjusting the patient's physique to provide favorable images. Proper sonographer and patient positioning is critical for obtaining high-quality echocardiographic images (Grotberg et al., 2024). Cardiac sonographers must be adaptable, modifying patient positioning or adjusting their position based on clinical circumstances such as the presence of cardiac devices, respiratory support, or pre-existing conditions like pleural effusion (Pektaş et al., 2023). As expressed by participants 2 and 3:

"So I used my left hand, I did a left-hand scan and I was on the right side, like I was scanning similarly to a dextrocardia case that was difficult but I managed hahaha, I can do it if I try my best, because I set my mindset during that time "If I cannot do this who else will perform the procedure?" it was like that, and yes those are the scenarios and words that I kept on thinking, mind-mindfulness and being calm, you can defy those obstacles although through time you can eventually build up your techniques and skill" (Apex)

"Aside from that, it is not just about your position when scanning since you cannot move the patient, it is also because you cannot instruct the patient like those unconscious patients, sometimes it is your effort to adjust, right?" (Artery)

"So the major adjustments that I made when scanning difficult patients are that you should be flexible on your imaging techniques, the thing that I always say, the alternative windows, subcostal, suprasternal, those views. Like I talked about it before, recently, my experience on a patient where I climbed up on the patient's bed, in those scenarios, you should be flexible, and you know how to adjust yourself" (Apex)

According to the participants, part of procedural Optimization is seeking peer assistance. Collaborating with nurse practitioners, intensivists,

or other healthcare professionals enables Cardiac Sonographers to adapt to evolving patient needs more effectively (Zhang et al., 2022). Working collaboratively with peers allows for a more streamlined approach to echocardiography. For instance, one professional can conduct the echocardiogram while another assists with patient positioning, managing the ultrasound machine, or documenting findings (Abdollahimohammad et al., 2024). As stated by participants 9, 6, 2, and 10:

"Since the ICU patient cannot cooperate, if there is a nurse, sometimes I ask for assistance since I do need assistance when positioning the patient, as to where the patient can only tolerate." (Vena Cava)

"I ask my colleague to assist me in my scanning because of the machine placement. It is difficult if you do it alone because of the patient's position" (Septum)

"I called for my co-worker so that at least I can manipulate the probe and my co-worker can manipulate the machine and do the measurements" (Apex)

"Coordinate with the nurse, you should coordinate with your peers so that you will not go back to the patient repeatedly when you perform a procedure on an ICU patient. Ask the nurse station if I am allowed to perform the procedure" (Ventricle)

Cardiac Sonographers in the ICU incorporate practices to optimize their procedures within the unit. They perform rapid scanning, quick assessments, and procedure preparation by checking equipment, adjusting positions when performing procedures, and even seeking peer assistance to perform the procedures efficiently and maintain quality images.

Emergent Theme 3. Professional Outlook of Cardiac Sonographers in the Intensive Care Unit.

This section highlights the aspirations and professional outlook of the Cardiac Sonographers in the Intensive Care Unit. There were five essential themes extracted, including (1) professional development, (2) psychological resilience, (3) high-tech portable device, (4) expanded collaborative

networks, and (5) professional learning nexus.

Essential Theme 1. Professional Development

This essential theme is characterized by two core ideas: (1) attendance at training and (2) joining conventions. As expressed by the participants, professional development encompasses individuals' activities to enhance their skills, knowledge, and expertise within their chosen career fields. To them, it is a continuous

process of learning and growth that extends beyond formal education. The participants were interviewed on their aspirations based on their experiences. The sonographers wish to attend more training and join conventions related to their work. Professional development opportunities allow Cardiac Sonographers to advance their clinical skills and competencies in echocardiography (Edwards et al., 2022). As expressed by participants 2 and 9:

Table 4. Thematic Table on the Professional Outlook of Cardiac Sonographers in the Intensive Care Unit (Core Ideas – Essential Theme – Emergent Theme)

Core Ideas	Essential Theme	Emergent Theme
Attendance at Training	Professional Development	Professional Outlook of Cardiac Sonographers in the Intensive Care Unit
Joining Conventions		
Emotional Resiliency	Psychological Resilience	
Psychological Readiness		
Advanced Portable Device	High-Tech Portable Device	
Peer Collaboration	Expanded Collaborative Network	
Interhospital Partnerships		
Learning Hub	Professional Learning Nexus	

"I aspire to continuously refine the skills like using advanced medium techniques to keep up and updated with the merging protocols" (Apex)

"I hope we are given more opportunities for training that are related to our work, well, you cannot just learn everything from school, it is also from the experience" (Vena Cava)

They clarified that although they had already attended several trainings, more programs and upskilling activities were still significant. An important finding in a study by Perry et al. (2024) suggested that employers should support cardiac sonographers with specialized training and supervision, even after finishing their formal studies. Continuous learning demonstrates commitment and leadership qualities, making sonographers more competitive candidates for promotions (Saikhan, 2023). As expressed by participants 3 and 4:

"Well, there should be proper and formal training for the staff. It should be a formal training where you are sent to school or a training center. It should not be "oh, a

senior just taught me" because if a senior were to teach, they would have varied knowledge when teaching, like how senior A and senior B would teach or share this knowledge, and only what they teach is your knowledge, and what you can apply to work. Hence, it is not a universal..." (Artery)

"Additional trainings and learnings, those that can help you with your continuous learning, especially if you have not encountered the cases. This would help improve yourself at work and handle cases without fear or worry." (Atrium)

As wryly shared, joining conventions plays a significant role in their work; they believe getting acquainted with people from other places is crucial. They learned several concepts worth applying in their line of work. Conventions and conferences, such as those organized by ASE, provide platforms for Cardiac Sonographers to engage with peers, learn from experts, and stay informed about the latest research and technological advancements in echocardiography (Little, 2022). At conventions, Cardiac Sonographers can present their research findings, participate in discussions, and learn about

the latest studies in the echocardiography field (Somani et al., 2023). By attending these events, sonographers can familiarize themselves with new tools, equipment, and methodologies to enhance their practice (Lympopoulos et al., 2021). As expressed by participant 6:

"Aside from the training, it is nice attending conventions, gathering with different technicians, and of course, if there are topics or sessions that are related to the work" (Septum)

Cardiac Sonographers have expressed their desire to improve their professional growth and career development by taking additional training and attending seminars and conventions. As they shared, these events would help them improve their skills and grow within their careers, especially in challenging environments with critically ill patients like the ICU.

Essential Theme 2. Psychological Resilience

This essential theme is characterized by two core ideas: (1) emotional resiliency and (2) psychological readiness. It is no longer surprising that sonographers assigned to the ICU are challenged emotionally and psychologically. To them, those assigned in the unit should envelop themselves with the highest level of emotional readiness. According to Moreno-Jiménez et al. (2022), healthcare workers in ICUs, including echocardiographers and sonographers, are exposed to emotionally taxing situations, which can lead to burnout and compassion fatigue. Emotional resilience allows sonographers to maintain composure under pressure, ensuring they can perform their responsibilities effectively without becoming overwhelmed by the gravity of the clinical context (White et al., 2024). As expressed by participants 3 and 2:

"Those technicians who are assigned to the ICU should be emotionally and physically ready. They should know how to manage their feelings, especially those who encounter critical cases" (Artery)

"You should practice emotional preparedness, mindfulness, calmness, and focus on the situation (procedure), like the case I explained earlier, where I experienced the patient going to a flatline unexpectedly while scanning. So there are

times that you would panic, but I can only say to be mindful during those situations. You should stay calm because I experienced it. I was just a newbie, and the patient had a flatline unexpectedly" (Apex)

They also shared that psychological preparedness should be highest among sonographers assigned to the unit. Psychological preparedness can help healthcare professionals feel more prepared for real-world challenges (Newton et al., 2023). This readiness enables them to maintain composure and focus, which is essential for performing accurate echocardiograms under pressure (Wang et al., 2024). As expressed by participants 2 and 5:

"Ahh, what I can suggest is that the sonographer should be exposed and trained with stress management techniques to handle critical situations, like the sonographer should always ask about other alternative techniques regarding image scanning. It is better if you would teach the sonographer regarding those" (Apex)

"We, Cardiac Sonographers, assigned in the ICU, should be ready psychologically, because the patients have different natures" (Base)

Cardiac Sonographers expressed the need to be mentally and emotionally prepared when entering the Intensive Care Unit. The unit's rapidly changing status, critical patients, and stressful environment are inherent, and one should be able to adapt and maintain composure and professionalism while maintaining high-quality service.

Essential Theme 3. High-Tech Portable Device

This essential theme is characterized by the core idea: an advanced portable device. Sonographers have been looking for a high-tech and relatively lighter portable device. They complain about the relatively heavier weight of the device, and sometimes the inconsistency in the reliability of the image provided. Cardiac Sonographers must often navigate complex cases; thus, high-resolution imaging facilitates better visualization of cardiac structures and pathology, which is crucial for timely and accurate assessments (Kallstrom, 2024). Developing trolleys with foldable or compact designs can help address space constraints, transport

difficulty, and improve storage efficiency (Krishnaraj et al., 2024). Future strategies focus on improving ultrasound diagnostics' non-invasive nature and accuracy, essential for better patient care (Mbaeke et al., 2023). As expressed by participants 4, 6, and 7:

"One thing is to improve the machine by making it lighter, easy to maneuver, because it is cumbersome to bring the machine, especially portable machines, unlike compact devices" (Atrium)

"I hope there is a better machine, one that can produce quality images, and if it is possible, the machine would be lighter (not heavy), we are the ones carrying it, and it is cumbersome" (Septum)

"Using machines that are high quality, because the patients tend to have poor echo windows and the machines will not even support you in your work (produce low quality images)" (Valve)

Cardiac sonographers desire better ultrasound machines when performing echocardiographic procedures in the ICU. This would improve the quality of the images and their performance, helping them achieve easier and more efficient performance within their profession, especially in the ICU.

Essential Theme 4. Expanded Collaborative Network

This essential theme is characterized by two core ideas: (1) peer collaboration and (2) interhospital partnerships. According to the participants, there is a need for growth and broadening connections between individuals, groups, or organizations that work together to achieve shared goals. Effective interprofessional collaboration is crucial in complex clinical settings where communication and teamwork significantly impact patient safety and outcomes (Mishra et al, 2024). In a study in Germany, the role of sonographers is still developing, with a focus on establishing high academic standards and interprofessional collaboration with other healthcare professionals to enhance patient care (Paetzold, 2024). As expressed by participants 6, 1, and 4:

"I hope that there is extra support whenever tilting or moving the patient in the right position because we do need help from

nurses in order for us to achieve a high-quality image, and what else? I think that is it so far" (Septum)

"Understanding and support from peers, we know that ICU is a toxic environment, we ask for support from nurses, so I hope that they can understand our desires, that is why we ask for assistance while on procedure" (Aorta)

"Sharing your knowledge and ideas with others can be especially helpful if your colleague is having difficulty; you can give him or her ideas on how procedures could be done on different cases or scenarios. I think it is teamwork and communication" (Atrium)

This collaborative framework allows sonographers from various hospitals to learn from each other, share best practices, and collectively address common challenges. The need to practice interhospital collaborations has been considered essential in their work. Research indicates that hospital partnerships can improve diagnostics through shared expertise (Barker, 2021). For instance, the study by Hilts et al. emphasizes hospital partnerships that enhance the availability of services like echocardiography through joint efforts, resulting in better health outcomes for communities (Hilts et al., 2021). As expressed by participants 2 and 6:

"Well, outside the hospital, you can ask or gain insights because there are many radtechs that are working as Cardiac Sonographers, but they are not working at the hospitals, they work at clinics, so at times we ask them, 'How were you able to scan this case?'. They have different styles apparently and at times we do collaborative work like "when you perform this, you can do this measurement? The cardiologist will accept this?" So, engaging in workshops or brainstorming with other echo techs" (Apex)

"It is also nice if we could benchmark with what other hospitals are doing. There might be cases from them that we may know on how they handled it" (Septum)

Cardiac Sonographers expressed how collaboration with fellow Cardiac Sonographers, other healthcare workers within the hospital, and other hospitals could provide better service, especially in echocardiographic procedures in the ICU. This could foster teamwork, knowledge sharing, and communication among colleagues, which is essential in promoting career growth and professional development.

Essential Theme 5. Professional Learning Nexus

This essential theme is characterized by the core idea: a learning hub. Sonographers have considered relying on and utilizing trustworthy, reliable, and accurate information to be another essential element in their clinical practice. It is crucial to informed decision-making, research, and general knowledge acquisition. The professional hub could serve as an educational platform that promotes ongoing professional development, and the hub could act as a forum for interdisciplinary discussions and knowledge sharing (Childs et al., 2022). This approach enhances professional development and encourages interaction among sonographers, cardiologists, and other healthcare providers, strengthening interdisciplinary collaboration in patient management (Petch et al., 2021). As shared by participants 1 and 8:

"Read, watch videos, research, or YouTube"
(Aorta)

"Then you have to read or research, even if it is just from Google, because it will help us on how and what you need to do during the procedures" (Vein)

"For me, if there is something that I do not know, for example, unusual cases, the cardiologist is not always present, so I would do research. I like doing much research, like cardiac pathologies, what are the necessary formulas and measurements"
(Aorta)

In the ongoing development and growth of the profession, one should be able to commit to continuous learning. Cardiac Sonographers have expressed that there should be continuous learning, especially when performing procedures in the ICU. Critically ill patients in the ICU have a range of cardiac cases that one may not have encountered

before, highlighting the need to develop continuous learning and improve skills.

Conclusion and Recommendations

The following conclusions are formulated based on the salient findings of the study. First, roles and realities of the Cardiac Sonographers in the Intensive Care Unit include: ultrasound machine and equipment use; critically ill patients and challenges among sonographers. Practices of cardiac sonographers that have shaped and changed their behavior include micro-recovery strategies, interprofessional communication, reviewing patient records for reassurance, self-regulation, and sonographer efficiency practices. The professional outlook of the participants reflected professional development, psychological resilience, high-tech portable devices, expanded collaborative networks, and a professional learning nexus. This study illuminates the need to revisit the experiences and how the hospital entities ensure holistic management among Cardiac Sonographers in the Intensive Care Units.

The study highlights the need for Radiologic Technologists to develop strategies for coping with the varying challenges encountered. Problems identified include ultrasound machine usage constraints, patient habitus, critically ill patients' condition constraints during procedures, behavioral and emotional vulnerability, patients needing advanced physiological support, musculoskeletal discomfort, and a limited workforce. This study's findings can help improve the Cardiac Sonography profession and career. Radiologic Technologists working as Cardiac Sonographers can improve their career by developing their cardiac imaging skills, promote ergonomic practices within the workplace, promote collaboration and communication with peers and colleagues, provide stress management and emotional well-being support, employer support by providing high quality and ergonomic friendly equipment and portable machines, and continuous learning and updates by attending conventions additional trainings. These can improve the Cardiac Sonographer's general health, work satisfaction, career development, and quality of care delivery.

Enhancement and possible curriculum revisit are needed to strengthen awareness and knowledge of the cardiac sonographers and cement their

preparedness in managing patients in the Intensive Care Unit, in effect providing quality health care. Integration of critical care sonography can expose Radiologic Technology students who could choose a career in Cardiac Sonography. Interprofessional communication can be improved by integrating topic simulations and situational contexts in the curriculum, highlighting the importance of teamwork, efficient collaboration, and professional communication.

Future researchers can utilize this study's findings to explore the current challenges and various coping mechanisms used by Radiologic Technologists working as Cardiac Sonographers in the Intensive Care Unit. Another study may be conducted, this time employing a quantitative approach to possibly generalize findings or even using mixed methodologies to substantiate the data gathered. Furthermore, the scope of the study should be widened to cover more Cardiac Sonographers across hospital entities. In turn, this will increase the reliability of the findings, thereby increasing uptake of the results among hospital entities.

References

- Abdollahimohammad, A., Rahnama, M., & Firouzkouhi, M. (2024). Experiences of family members when accompanying patients in intensive care units: a qualitative study. *Nursing in Critical Care*, 29(4), 777-784. <https://doi.org/10.1111/nicc.13058>
- AlMubarek, N. A., Al-Otaibi, S. T., & Herzallah, H. K. (2022). Musculoskeletal disorders among sonographers in secondary care hospitals in the city of al-ahsa, Saudi Arabia. *Work*, 71(4), 1105-1111. <https://doi.org/10.3233/wor-205145>
- Barker, P. (2021). Council on pediatric and congenital heart disease (pchd) year-in-review. *Journal of the American Society of Echocardiography*, 34(9), A13-A14. <https://doi.org/10.1016/j.echo.2021.07.003>
- Childs, J., Thoirs, K., Quinton, A., Osborne, B., Edwards, C., Stoodley, P., ... & Halligan, T. (2022). Development of a professional competency framework for Australian sonographers—perspectives for developing competencies using a delphi methodology. *International Journal for Quality in Health Care*, 34(2). <https://doi.org/10.1093/intqhc/mzac017>
- Chung, J. and Kim, N. (2021). Usefulness of echocardiography for general surgery patients on intensive care units: when and how?. *Journal of Acute Care Surgery*, 11(1), 22-29. <https://doi.org/10.17479/jacs.2021.1.22>
- Crowther, S., Ironside, P., Spence, D., & Smythe, L. (2016). Crafting Stories in Hermeneutic Phenomenology Research: A Methodological Device. *Qualitative Health Research*, 27(6), 826-835. <https://doi.org/10.1177/1049732316656161>
- Demir, A. (2023). Emotion-laden spaces: a phenomenological study on intensive care unit workers. *Journal of Turkish Studies*, 18(Volume 18 Issue 3), 965-987. <https://doi.org/10.7827/turkishstudies.68111>
- Edwards, C., Thoirs, K., Osborne, B., Slade, D., McDonald, S., Lombardo, P., ... & Childs, J. (2022). Australian sonographer competency—a new framework. *Sonography*, 9(3), 108-115. <https://doi.org/10.1002/sono.12309>
- Ellenberger, K., Jeyaprakash, P., Sivapathan, S., Sangha, S., Kitley, J., Darshni, A., Chen, D., Negishi, K., & Pathan, F. (2021). The effect of obesity on echocardiographic image quality. *Heart Lung and Circulation*, 31(2), 207-215. <https://doi.org/10.1016/j.hlc.2021.06.525>
- Femine, F. C. D., D'Arienzo, D., Liccardo, B., Pastore, M. C., Ilardi, F., Mandoli, G. E., Sperlongano, S., Malagoli, A., Lisi, M., Benfari, G., Russo, V., Cameli, M., & D'Andrea, A. (2024). Echocardiography in the ventilated patient: What the clinician has to know. *Journal of Clinical Medicine*, 14(1), 77. <https://doi.org/10.3390/jcm14010077>
- Filip, C. (2020). The importance of remaining empathic. *McGill Journal of Medicine*, 12(2). <https://doi.org/10.26443/mjm.v12i2.263>
- Grotberg, J. C., McDonald, R. K., & Co, I. N. (2024). Point-of-Care Echocardiography in the Difficult-to-Image Patient in the ICU: A Narrative review. *Critical Care Explorations*, 6(1), e1035. <https://doi.org/10.1097/ccx.0000000000001035>
- Guerrero-Castañeda, R. F., De Oliva Menezes, T. M., & Prado, M. L. D. (2019). Phenomenology in nursing research: reflection based on Heidegger's hermeneutics. *Escola Anna Nery*, 23(4). <https://doi.org/10.1590/2177-9465-ean-2019-0059>
- Hall, C., Pignata, S., Tie, M., Bezak, E., & Childs, J. (2024). Sonographer well-being in Australia: Perceptions of job demands and resources in clinical working environments. *Sonography*,

- 11(3), 231–242.
<https://doi.org/10.1002/sono.12417>
- Harthy, B. M. A., Manji, F. S. A., Varughese, M., Sharji, S. A. A., Humaidi, I. H. A., Shukaily, H. T. A., ... & Siyabi, M. M. A. (2023). Experience of non-icu nurses and factors influencing the resiliency while working in icu during the covid-19 pandemic in a tertiary hospital. *Journal of Nursing Education and Practice*, 13(5), 18.
<https://doi.org/10.5430/jnep.v13n5p18>
- Hassan, A., Mohamed, S., Allah, A., Salem, M., & Salama, R. (2023). Evaluation of cardiac complications using conventional echocardiography among children with end stage renal disease. *The Egyptian Journal of Hospital Medicine*, 90(2), 2784–2788.
<https://doi.org/10.21608/ejhm.2023.287327>
- Hilts, K. E., Yeager, V. A., Gibson, P. J., Halverson, P. K., Blackburn, J., & Menachemi, N. (2021). Hospital partnerships for population health: a systematic review of the literature. *Journal of Healthcare Management*, 66(3), 170–198.
<https://doi.org/10.1097/jhm-d-20-00172>
- Huang, S., Vignon, P., Dessap, A. M., Tran, S., Prat, G., Chew, M. S., ... & Daix, T. (2022). Echocardiography findings in covid-19 patients admitted to intensive care units: a multi-national observational study (the echo-covid study). *Intensive Care Medicine*, 48(6), 667–678.
<https://doi.org/10.1007/s00134-022-06685-2>
- Ionescu, C. (2023). *The Burden of Work Injuries in Sonography with a Focus on Diagnostic Cardiac Sonographers' Lived Experiences* (Doctoral dissertation, Franklin University).
- Jain, R., Salinas, P. D., Kroboth, S., Kaminski, A., Roemer, S., Moreno, A. C. P., ... & Khandheria, B. K. (2021). Comprehensive echocardiographic findings in critically ill covid-19 patients with or without prior cardiac disease. *Journal of Patient-Centered Research and Reviews*, 8(1), 68–76.
<https://doi.org/10.17294/2330-0698.1791>
- Jenkins, S., Alabed, S., Swift, A., Marques, G., Ryding, A., Sawh, C., Wardley, J., Shah, B. N., Swoboda, P., Senior, R., Nijveldt, R., Vassiliou, V. S., & Garg, P. (2021). Diagnostic accuracy of handheld cardiac ultrasound device for assessment of left ventricular structure and function: systematic review and meta-analysis. *Heart*, 107(22), 1826–1834.
<https://doi.org/10.1136/heartjnl-2021-319561>
- Kallstrom, E. (2024). *Ultrasound-Enhancing Agent and IV Administration in Cardiac Sonography: How Sonographers Play a Key Role in Positively Affecting Key Performance Indicators*. *Journal of Diagnostic Medical Sonography*.
<https://doi.org/10.1177/87564793241230982>
- Kimura, C. J., Nayak, K., Varyani, R., Kini, P., Waalen, J., & Kimura, B. J. (2024). Observations of out-of-pocket travel costs in seeking free cardiac care in india: would point-of-care ultrasound help?. *BMC Health Services Research*, 24(1).
<https://doi.org/10.1186/s12913-024-11858-4>
- Kotzé, C., & Parrish, A. (2022). Reasonable requests: echocardiography referral forms as a measure of coherent clinical communication. *BMC Medical Education*, 22(1).
<https://doi.org/10.1186/s12909-022-03602-5>
- Kralik, D. (2000). Women with ovarian cancer during childbearing years felt that they looked normal, but “in [their] skin, [they were] different.” *Evidence-Based Nursing*, 3(1), 28.
<https://doi.org/10.1136/EBN.3.1.28>
- Krishnaraj, S., Kumar, R. S., Sedhumadhavan, P., Abdullah, I. M. M., & Rahman, N. A. (2024). Multiuso Faltbar Wagen: a multipurpose foldable trolley designed for efficiency and ergonomics. *SAE Technical Papers on CD-ROM/SAE Technical Paper Series*.
<https://doi.org/10.4271/2023-01-5118>
- Laing, S., Jarman, S., Elliott, J., Dang, J., Gylfadottir, V., Wierst, K., ... & Nair, V. (2024). Codesigned standardised referral form: simplifying the complexity. *BMJ Health & Care Informatics*, 31(1), e100926.
<https://doi.org/10.1136/bmjhci-2023-100926>
- Lashin, H., Vasques, F., & Bhattacharyya, S. (2024). Echocardiographic image quality deteriorates with the severity of cardiogenic shock. *The Egyptian Heart Journal*, 76(1).
<https://doi.org/10.1186/s43044-024-00544-9>
- Little, S. H. (2022). ASE – home for all cardiovascular ultrasound users. *Journal of the American Society of Echocardiography*, 35(7), A19–A20.
<https://doi.org/10.1016/j.echo.2022.05.004>
- Lymperopoulos, A., Cora, N., Maning, J., Brill, A., & Sizova, A. (2021). Signaling and function of cardiac autonomic nervous system receptors: insights from the gpcr signalling universe. *The FEBS Journal*, 288(8), 2645–2659.
<https://doi.org/10.1111/febs.15771>
- Magno, J. D. A., Ubaldo, R. J. C., Nunez, J. B., Cornel, M. U., Cuyco, R. E., Tucay, E. S., & Santos, R. J. (2023). The State of Cardiovascular Resources and Expertise in Echocardiography Nationwide: The Philippine Survey on Echocardiography (The PHIL-SCREEN Study).

- Philippine Journal of Cardiology, 51(2), 10–24. <https://doi.org/10.69944/pjc.4f0a88da4e>
- Mbaeke, C. E., Nwobodo-Nzeribe, N. H., Gbaden, A. G., Oluka, S. I., & Afam, E. S. (2023). Development, functions, design-features of Ultrasound machine and future improvement strategies. *International Journal of Research Publication and Reviews*, 4(7), 2668–2674. <https://doi.org/10.55248/gengpi.4.723.49397>
- Metkus, T. S., Baird-Zars, V. M., Alfonso, C. E., Alviar, C. L., Barnett, C. F., Barsness, G. W., ... & Morrow, D. A. (2022). Critical care cardiology trials network (ccctn): a cohort profile. *European Heart Journal - Quality of Care and Clinical Outcomes*, 8(7), 703-708. <https://doi.org/10.1093/ehjqcco/qcac055>
- Mishra, S., Dias, R. D., Zenati, M. A., & Chaspari, T. (2024). Acoustic Patterns of Interprofessional Communication and Quality of Teamwork in the Cardiac Operating Theatre. 103–104. <https://doi.org/10.31256/hsmr2024.52>
- Mishra, S., Dias, R. D., Zenati, M. A., & Chaspari, T. (2024). Acoustic Patterns of Interprofessional Communication and Quality of Teamwork in the Cardiac Operating Theatre. 103–104. <https://doi.org/10.31256/hsmr2024.52>
- Monteagudo, M. Á. R., Roselló, I. A., Del Mazo Carrasco, Á., García, P. C., & Jauregui, I. Z. (2022). Update on the use of ultrasound in the diagnosis and monitoring of the critical patient. *Revista Española De Anestesiología Y Reanimación (English Edition)*, 69(9), 567–577. <https://doi.org/10.1016/j.redare.2022.01.003>
- Mor-Avi, V., Khandheria, B. K., Klempfner, R., Cotella, J. I., Moreno, M., Ignatowski, D., ... & Lang, R. M. (2023). Real-time artificial intelligence-based guidance of echocardiographic imaging by novices: image quality and suitability for diagnostic interpretation and quantitative analysis. *Circulation: Cardiovascular Imaging*, 16(11). <https://doi.org/10.1161/circimaging.123.015569>
- Moreno-Jiménez, J. E., Demerouti, E., Blanco-Donoso, L. M., Chico-Fernández, M., Iglesias-Bouzas, M. I., & Garrosa, E. (2022). Passionate healthcare workers in demanding intensive care units: its relationship with daily exhaustion, secondary traumatic stress, empathy, and self-compassion. *Current Psychology*, 42(33), 29387–29402. <https://doi.org/10.1007/s12144-022-03986-z>
- Naderifar, M., Goli, H., & Ghaljaie, F. (2017). Snowball sampling: a purposeful method of sampling in qualitative research. *Strides in Development of Medical Education*, 14(3). <https://doi.org/10.5812/sdme.67670>
- Nario, K. R. R., Babasa III, R. B., De Luna, K. A. B., Evangelista-Gonzales, R., Tupas, G. P., Nones, K. D. G., ... & MCHM, D. (2023). Inter-rater Reliability Among Emergency Medicine Physicians in the Detection of Regional Wall Motion Abnormalities using Focused Cardiac Ultrasound. *The Official Journal of the Philippine College of Emergency Medicine*, 5(1).
- Newton, J., & Smith, A. (2023). Developing emotional preparedness and mental resilience through high-fidelity simulation: A ‘Bridge Too Far’ for institutions teaching major trauma management and mass-casualty medicine? *Research Square (Research Square)*. <https://doi.org/10.21203/rs.3.rs-2591658/v1>
- Nicoara, A., Maldonado, Y., Kort, S., Swaminathan, M., & Mackensen, G. B. (2020). Specific Considerations for the Protection of Patients and Echocardiography Service Providers When Performing Perioperative or Periprocedural Transesophageal Echocardiography during the 2019 Novel Coronavirus Outbreak: Council on Perioperative Echocardiography Supplement to the Statement of the American Society of Echocardiography Endorsed by the Society of Cardiovascular Anesthesiologists. *Journal of the American Society of Echocardiography*, 33(6), 666–669. <https://doi.org/10.1016/j.echo.2020.04.008>
- Nyhagen, R., Egerod, I., Rustøen, T., Lerdal, A., & Kirkevold, M. (2024). Family members' engagement in symptom communication, assessment, and management in the intensive care unit. *Dimensions of Critical Care Nursing*, 43(3), 111-122. <https://doi.org/10.1097/dcc.0000000000000637>
- Onwordi, E., Harris, A., Atkinson, C., West, C., Pearce, K., Hancock, J., Demetrescu, C., Rakhit, D., Shah, B. N., Khattar, R., Gorman, J., Encarnacion, D., Lloyd, G., & Bhattacharyya, S. (2024). Prevalence, characteristics and clinical impact of work-related musculoskeletal pain in echocardiography. *Echo Research and Practice*, 11(1). <https://doi.org/10.1186/s44156-024-00042-3>
- Ottenhoff, J., Hewitt, M., Makonnen, N., Kongkatong, M., & Thom, C. (2022). Comparison of the quality of echocardiography imaging between the left lateral decubitus and supine positions. *Cureus*. <https://doi.org/10.7759/cureus.31835>
- Paetzold, K. (2024). Analyse des Verantwortungs- und Tätigkeitsbereichs des Berufsbilds

- „Sonographer“ und Möglichkeiten der Umsetzung in Deutschland. *Endo-Praxis*, 40(01), 41–48. <https://doi.org/10.1055/a-2167-8555>
- Paley, J. (2018). Meaning, lived experience, empathy and boredom: Max van Manen on phenomenology and Heidegger. *Nursing Philosophy*, 19(3). <https://doi.org/10.1111/NUP.12211>
- Pektaş, A., Bükülmez, A., Çeleğen, M., & Eker, İ. (2023). Rash and gastrointestinal dysfunction may indicate cardiac involvement in children with multisystem inflammatory system associated with coronavirus disease 2019. *Journal of Pediatric Infectious Diseases*, 18(02), 088-093. <https://doi.org/10.1055/s-0042-1760411>
- Peng, Q., Liu, L., Zhang, Q., Zhu, Y., Zhang, H., Yin, W., He, W., Shang, X., Chao, Y., Lv, L., Wang, X., & Zhang, L. (2020). The characteristics of echocardiography in ICU patients and its relationship with the outcomes. *Research Square* (Research Square). <https://doi.org/10.21203/rs.3.rs-64860/v1>
- Perry, R., Forshaw, A., Childs, J., Chester, D., & Edwards, C. (2024). Cultivating competency in cardiac sonography: aligning entrustable professional activities with industry expectations. *Heart Lung and Circulation*, 33(7), 1067–1073. <https://doi.org/10.1016/j.hlc.2024.01.027>
- Petch, S., McCarthy, C., McLoughlin, J., Dunn, L., Franta, J., Mhuirheartaigh, R., ... & Donnelly, J. (2021). Multi-institutional and multi-disciplinary care: a successfully managed aortic dissection in the third trimester of pregnancy. *Obstetric Medicine*, 15(4), 267-269. <https://doi.org/10.1177/1753495x211017700>
- Reilly, C., Brown, V., Correa, G. C., Acevedo, H. G., & Kalivoda, E. J. (2023). Bedside cardiac ultrasound evaluation of a young male with chest pain. *Journal of the American College of Emergency Physicians Open*, 4(6). <https://doi.org/10.1002/emp2.13066>
- Robba, C., Wong, A., Poole, D., Tayar, A. A., Arntfield, R. T., Chew, M. S., Corradi, F., Douflé, G., Goffi, A., Lamperti, M., Mayo, P., Messina, A., Mongodi, S., Narasimhan, M., Puppo, C., Sarwal, A., Slama, M., Taccone, F. S., Vignon, P., . . . Vieillard-Baron, A. (2021). Basic ultrasound head-to-toe skills for intensivists in the general and neuro intensive care unit population: consensus and expert recommendations of the European Society of Intensive Care Medicine. *Intensive Care Medicine*, 47(12), 1347–1367. <https://doi.org/10.1007/s00134-021-06486-z>
- Rodriguez-Ruiz, E., Van Mol, M. M. C., Latour, J. M., & Fuest, K. (2024). Caring to care: Nurturing ICU healthcare professionals' well-being for enhanced patient safety. *Medicina Intensiva* (English Edition). <https://doi.org/10.1016/j.medine.2024.03.008>
- Saikhan, L. A. (2023). Prevalence, characteristics, consequences, and awareness of work-related musculoskeletal pain among cardiac sonographers compared with other healthcare workers in Saudi Arabia: A cross-sectional study. *PLoS ONE*, 18(5), e0285369. <https://doi.org/10.1371/journal.pone.0285369>
- Shaddock, L. and Smith, T. (2022). Potential for use of portable ultrasound devices in rural and remote settings in australia and other developed countries: a systematic review. *Journal of Multidisciplinary Healthcare*, Volume 15, 605-625. <https://doi.org/10.2147/jmdh.s359084>
- Shaheen, M., Pradhan, S., & Ranajee, N. (2018). Sampling in qualitative research. In *Advances in business information systems and analytics book series* (pp. 25–51). <https://doi.org/10.4018/978-1-5225-5366-3.ch002>
- Sheata, I. M., Smith, S. R., Kamel, H., Varrassi, G., Imani, F., Dayani, A., ... & Taha, S. S. H. (2021). Pulmonary embolism and cardiac tamponade in critical care patients with covid-19; telemedicine's role in developing countries: case reports and literature review. *Anesthesiology and Pain Medicine*, 11(2). <https://doi.org/10.5812/aapm.113752>
- Smith, J. and Mistry, R. (2024). Management change following transthoracic echocardiogram in the intensive care unit. *Australasian Journal of Ultrasound in Medicine*, 27(3), 174-178. <https://doi.org/10.1002/ajum.12397>
- Somani, S. and Rogers, A. J. (2023). Advances in cardiac pacing with leadless pacemakers and conduction system pacing. *Current Opinion in Cardiology*, 39(1), 1-5. <https://doi.org/10.1097/hco.0000000000001092>
- Straily, A., Malit, A., Wanja, D., Kavere, E., Kiplimo, R., Aera, R., ... & Odiere, M. (2021). Use of a tablet-based system to perform abdominal ultrasounds in a field investigation of schistosomiasis-related morbidity in western kenya. *American Journal of Tropical Medicine and Hygiene*. <https://doi.org/10.4269/ajtmh.20-1175>
- Tetteh, E., Wang, T., Norasi, H., Bremer, M., Schmida, E., Kim, J., Koenig, J., Fortune, E., Kane, G., &

- Hallbeck, M. S. (2022). Comparison of physical workload in upper extremities between left- and right-hand ultrasound scanning. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 66(1), 651–655. <https://doi.org/10.1177/1071181322661144>
- Van Manen M. (1990). *Researching lived experience: Human science for an action sensitive pedagogy*. State University of New York Press. New York
- Vidal, A., & Montepio, R. (2024). # 2058 IVC diameter and collapsibility via point-of-care ultrasound among clinically euvolemic Filipinos in Victoriano Luna Medical Center, Philippines. *Nephrology Dialysis Transplantation*, 39(Supplement_1), gfae069-1113. <https://doi.org/10.1093/ndt/gfae069.1113>
- Wang, T., Hallbeck, M. S., Martineau, M., Bremer, M. L., Kane, G. C., Zoakafi, M., ... & Tetteh, E. (2024). Evaluation of a passive upper extremity exoskeleton on reducing discomfort and workload in cardiac sonographers. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 68(1), 527-531. <https://doi.org/10.1177/10711813241260317>
- Westhuizen, L. v. d., Naidoo, K., Casmod, Y., & Mdlethse, S. (2020). Sonographers' experiences of being a caring professional within private practice in the province of gauteng. *Health SA Gesondheid*, 25. <https://doi.org/10.4102/hsag.v25i0.1409>
- White, A., Humphreys, L., & Oomens, D. (2024). Building emotional resilience to foster well-being by utilising reflective practise in the sonography workplace. *Sonography*, 11(3), 243-250. <https://doi.org/10.1002/sono.12405>
- Wierda, E., Bouma, B. J., & Van Den Brink, R. B. A. (2022). Handheld echocardiography in patients with cardiovascular disease: to use or not to use, that is the question. *Netherlands Heart Journal*, 31(2), 47–51. <https://doi.org/10.1007/s12471-022-01741-4>
- Won, D., Walker, J., Horowitz, R., Bharadwaj, S., Carlton, E., & Gabriel, H. (2024). Sound the Alarm: The Sonographer Shortage is Echoing Across Healthcare. *Journal of Ultrasound in Medicine*, 43(7), 1289–1301. <https://doi.org/10.1002/jum.16453>
- Zahavi, D. (2020). The practice of phenomenology: The case of Max van Manen. *Nursing Philosophy*, 21(2), 12276. <https://doi.org/10.1111/NUP.12276>
- Zhang, Y., Liang, Y., Pan, C., Li, Y., Liu, Y., Ren, L., ... & Feng, Y. (2022). Emergency digital cholangioscope-assisted one-stage bedside endoscopic stone removal combined with biliary drainage for severe acute cholangitis in intensive care unit: experience from a tertiary chinese academic hospital.. <https://doi.org/10.21203/rs.3.rs-2140596/v1>