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An Introduction to Carotid Intima-Media Thickness Scan (CIMT)

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Abstract

Objective: Carotid intima-media thickness (CIMT) is utilized to predict cardiovascular risk. CIMT uses ultrasound to measure the thickness of the two innermost layers of the carotid artery. Increased plaque in the carotid arteries reduces the blood flow in the vessels, increasing the risk of cardiovascular disease. High patient satisfaction with CIMT testing may positively empower the patient to incorporate lifestyle changes to reduce the risk of experiencing a cardiovascular event. The study aims to determine the value of CIMT testing in primary care based on patient feedback.

Methods: The family practice staff in Central Indiana will email an electronic questionnaire to patients who completed a CIMT scan in the fall of 2022 or the spring of 2023. The current literature will be reviewed to compare the results with the results of this study to determine if patient satisfaction with the CIMT testing influences patient motivation to change lifestyle behavior and is suggestive that CIMT testing is beneficial in family practice.

Results: All respondents were extremely satisfied with the professional care they received during the procedure and the care and treatment they received afterward. One participant, or twenty-five percent, improved their dietary choices and medication compliance after the CIMT scan. None of the participants made any changes in their exercise routine.

Conclusion: Additional studies using a more extensive population base would be beneficial and recommended to provide statistically significant results. All participants were happy with the CIMT scan process and their results, which suggests its use benefits patient satisfaction with cardiovascular disease risk assessment.

Keywords: carotid intima-media thickness, patient satisfaction, demographics, family practice, CIMT

An Introduction to Carotid Intima-Media Thickness Scan (CIMT)

Heart disease is the leading cause of death in the United States (Tai & Lu, 2021). An at-risk individual in the United States will have a myocardial infarction approximately every 40 seconds (Webb, 2019). Newly diagnosed cases of coronary heart disease are projected to increase by about 26% from 2010 to 2040 (Odden et al., 2011). The annual cost of cardiovascular disease (CVD) in the United States was estimated at \$351.2 billion in 2014-2015 (Webb, 2019).

High costs of treating CVD can increase the price of insurance premiums, which are disproportionately high compared to wages, negatively impacting the general working population (Foy & Mandrola, 2018). Medicare and Medicaid are also negatively affected by the high cost of treating CVD draining the revenue income from payroll taxes (Foy & Mandrola, 2018).

A variety of elements contribute to the formation of atherosclerosis (AS). Atherosclerosis is a chronic inflammatory disease, making AS a significant risk factor associated with CVD (Zhu et al., 2018). Endothelial dysfunction, inflammatory and immunologic factors, plaque rupture, or erosion contribute to AS formation (Zhao, 2022). Unstable atherosclerotic plaque rupture, vascular stenosis, or occlusion caused by platelet aggregation and thrombosis are all factors that contribute to acute cardiovascular disease (Zhu et al., 2018). Atherosclerosis begins in childhood with the development of fatty streaks (Zhao, 2022). As the person ages, the initial atherosclerotic fatty streaks form a fibrous cap, fibrous plaques, and advanced lesions, ultimately leading to an increased risk of CVD (Zhao, 2022). Knowing who is at risk for cardiac disease through screening for AS can facilitate early detection of risks and, consequently, initiate appropriate interventions to prevent cardiac death, myocardial infarction, or stroke (Korcarz et al., 2008).

Some patient characteristics, such as age, gender, race, and family history of CVD, can increase the risk of cardiac disease and cannot be altered (Hajar, 2017). Addressing the comorbidities, such as weight, hypertension, hyperlipidemia, diabetes mellitus, lack of exercise, stress, and smoking, can be improved through intervention (Hajar, 2017). Screening asymptomatic individuals for CVD is instrumental in identifying those at risk of disability or death from stroke or myocardial infarction (Hajar, 2017).

With the knowledge gained from carotid intima-media thickness (CIMT) scans, the provider and patient can better understand the potential CVD risks and initiate corrective measures (Korcarz et al., 2008). This study aims to determine patient satisfaction with the CIMT scan process and test results and if the level of satisfaction experienced is a motivational force to encourage the patient to incorporate positive lifestyle changes (Korcarz et al., 2008).

Background

As CVD is the leading cause of death in the United States, early detection of its risks and initiation of interventions for those risks could improve an individual's length and quality of life (Tai & Lu, 2021). Early detection is essential because incorporating healthy lifestyle behaviors early on is more beneficial than treating advanced atherosclerotic vascular disease (Zyriax et al., 2021).

Three diagnostic tests used to detect AS are the percutaneous transluminal coronary angioplasty (PTCA), coronary artery calcium scan (CAC), and CIMT scan. Of these three tests, the PTCA is the gold standard for detecting AS in coronary arteries is the PTCA (Garber et al., 2022). PTCA is commonly performed on patients experiencing cardiovascular symptoms or as the result of positive noninvasive testing (Marwick et al., 2015).

This procedure is invasive, costly, and time-consuming and may be a source of anxiety for some individuals. (Garber et al., 2022). The PCTA is done under conscious sedation (Azura Vascular Care, 2019). A thin tube called a catheter is accessed through an artery in the groin or wrist and threaded through the vessels in the heart using imaging guidance (Azura Vascular Care, 2019). If a blockage is detected, a balloon at the tip of the catheter is inflated and compresses the plaque against the artery walls to restore blood flow to the heart (Azura Vascular Care, 2019). When the procedure is completed, the balloon is deflated and removed, along with the catheter (Azura Vascular Care, 2019).

The advantages of PTCA include that the procedure is much less invasive compared to open-heart surgery, the level of anesthesia is moderate compared to general anesthesia, reducing the time spent in the hospital, and the skin is punctured to access the arteries, so no surgical incision or sutures are needed (Azura Vascular Care, 2019). Disadvantages seldom occur but may include damage to the arteries during the procedure, blood clots, reoccurrence of the blockages, and excessive bleeding at the insertion site (Azura Vascular Care, 2019). The cost of a PTCA can vary depending on where the procedure is performed (Sanger-Katz, 2019). In the United States, the price of a PTCA averages \$32,000 and is typically covered by most insurance plans (Sanger-Katz, 2019).

The CAC scan is a noninvasive alternative diagnostic method to determine the potential risk for CVD from AS. It is a reliable tool for predicting CDV events in asymptomatic individuals at low or intermediate risk (Shreya et al., 2021). The CAC is a low-dose CT of the heart (Grayland-Leech, 2022). Images obtained from the CAC allow doctors to determine the amount of plaque in the coronary arteries (Grayland-Leech, 2022). The greater the amount of plaque present, the greater the risk of developing heart disease (Grayland-Leech, 2022). The

CAC scan demonstrates 88.6% sensitivity and 86.2% specificity (Moradi et al., 2017). The sensitivity and specificity vary dependent on the degree of calcium present (Moradi et al., 2017).

Table 1 shows CAC test scores and recommendations based on the test results.

Table 1

CAC Test Scores and Recommendations

Coronary calcium scan score	Plaque	Risk	Next steps
0	none present	<u>low risk</u> of CAD or heart attack	no treatment required
1–10	minimal amounts of plaque present	low risk of CAD or heart attack	lifestyle changes to help prevent the score from increasing
11–100	small amounts of plaque present	moderate risk of CAD or heart attack	may need lifestyle changes and sometimes medication
101–400	moderate amounts of plaque that may be blocking arteries	medium to high risk of CAD or heart attack	medical treatments, lifestyle changes, and follow-up testing
Over 400	extensive amounts of plaque that is likely to be blocking the arteries	high risk of CAD or a heart attack	immediate further testing and treatment to help prevent heart attack

*Note: This table shows the quantity of coronary artery plaque present, the risk level for heart attack, and recommended treatment based on the coronary calcium scan score (Grayland-Leech, 2022).

There are advantages to having a CAC; there is little to no preparation required for the test, the test only takes 10-15 minutes and does not require anesthesia, hospitalization is not needed, there is no recovery time, and there the test is relatively inexpensive (Grayland-Leech,

2022). Disadvantages include exposure to a minimal amount of radiation exposure during the test, and individuals on statin drugs or those who are pregnant are recommended not to have the test (Grayland-Leech, 2022). CAC cannot be performed on males younger than 40 or females younger than 50 (Soni et al., 2021). Individuals who cannot lie flat on their backs with arms above their heads without moving for 15 minutes should not have the test (Grayland-Leech, 2022). The average cost of a CAC scan is around \$100 (Grayland-Leech, 2022). This cost is not usually covered by insurance.

A CIMT scan is another noninvasive atherosclerosis imaging technique that can assist in identifying the status of plaque accumulation in vessels and predict the risk of future cardiovascular events (de Groot & Duivenvoorden, 2022). CIMT measurements are most frequently obtained using a high-resolution ultrasound, although magnetic resonance imaging (MRI) is also used (de Groot & Duivenvoorden, 2022). CIMT measurements demonstrate 78% sensitivity and 75% specificity to accurately diagnose the presence of atherosclerosis (Zaidi et al., 2020).

The advantages of having a CIMT are similar to having a CAC, other than it can be performed on anyone of any age (Soni et al., 2021). There is no preparation for the test; the test only takes 10-15 minutes and does not require anesthesia, hospitalization is unnecessary, and there is no recovery time (Soni et al., 2021). The US is non-radioactive, which is an advantage over using X-rays (Acebes et al., 2016). Many hospitals in other countries are not equipped to perform PTCAs. As a result, CIMT is performed across the globe and compared to the gold standard angiography as a diagnostic test (Zaidi et al., 2020). The disadvantages of having a CIMT scan include a moderate cost of about \$100 to \$250, which is not covered by insurance (Soni et al., 2021). Additionally, the test lacks standardized parameters, which limits the accurate

interpretation of the results, and it depends on the operator's skills in performing the test, which results in limited reproducibility and limited availability of facilities that can perform an accurate test (Acebes et al., 2016; Soni et al., 2021).

The coronary artery calcium score and carotid artery intima-media thickness indicate the presence of atherosclerosis. Pathakota et al. (2020) have conducted a study that determined a positive correlation between CACS and CIMT with the severity of CAD through SYNTAX and Gensini scores. SYNTAX and Gensini scores are two scales used to assess the severity of coronary artery disease (Safarian et al., 2014; Wang et al., 2022). This association suggests that CACS and CIMT can be noninvasive alternatives to angioplasty tests to determine atherosclerosis severity (Pathakota et al., 2020). Each test has value, and the most appropriate test for everyone can be determined through consultation between the healthcare provider and the patient. Cassola et al. (2022) caution if providers use CIMT as the only diagnostic testing method. Adding another diagnostic test may improve the accuracy of the carotid stenosis diagnosis and the risk of CVD (Cassola et al., 2022). Ultimately, the decision to pursue additional testing should be a joint decision between the patient and provider.

Problem Statement

In an Indianapolis-based family practice, adult patients 18 and older are provided an opportunity to voluntarily participate in CIMT testing at an out-of-pocket cost to participants. A CIMT scan with a vascular age higher than the patient's biological age may indicate that a person is at risk for CVD. CIMT scans impact the patient's perception of the need to adhere to the provider's recommended interventions, including lifestyle changes, prescription therapies, and scheduling regular follow-up appointments (Zyriax et al., 2021). Could patient satisfaction

with the CIMT testing experience at this Indianapolis clinic directly impact their motivation to consider adopting a healthier lifestyle through diet, exercise, and medication?

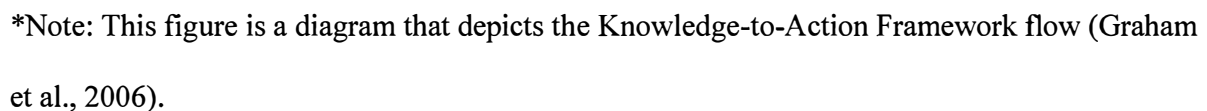
Needs Assessment and Gap Analysis

Adult patients in the Indianapolis family practice of interest are currently being screened for AS by CIMT. Knowledge gained from diagnostic testing that can improve the quality of life is referred to as planning value (Lee et al., 2010). Benefits from this diagnostic testing include providing a medical diagnosis, treatment planning, and patient peace of mind (Lee et al., 2010). The planning value of a CIMT scan is that it provides high-quality health information, which assists the individual in devising strategies for improving their lifestyle by eating nutritious foods, exercising, and taking medications as prescribed by their provider (Dorn et al., 2021). This study aims to determine if patients who are satisfied with the CIMT process, cost, and convenience are more motivated to consider lifestyle improvements based on their CIMT testing results and experience. Appendix A summarizes this study's internal and external strengths and weaknesses.

Theoretical Framework

Theories are a summary of knowledge used as a framework for research and practice (Khoshnood et al., 2020). The Knowledge-to-Action (KTA) framework was developed by Dr. Ian Graham and his colleagues in 2006 (Registered Nurses' Association of Ontario, 2023). The KTA framework shown in Figure 2 illustrates the process of synthesizing knowledge, which is then translated into an action that ideally results in a positive outcome (Registered Nurses' Association of Ontario, 2023).

The Knowledge-to-Action Framework



KTA framework consists of two parts, including knowledge creation and the action cycle, or application of the Knowledge (Graham et al., 2006). Knowledge creation begins with collecting the available knowledge on a topic of interest, summarizing the knowledge collected, and developing a tool to improve healthcare (Graham et al., 2006). The central portion of the framework is identified as “the funnel” because much knowledge is filtered and consolidated, forming the essence of an idea that is then used to create a tool to benefit healthcare (Graham et al., 2006).

The second component of the KTA framework is the action cycle which includes identifying an issue that needs to be changed, identifying the targeted population, identifying any barriers to change, selecting and implementing a personalized care plan for change, monitoring the knowledge application, evaluating outcomes, and maintaining the knowledge use (Graham et al., 2006).

The purpose of CIMT scanning is to identify individuals at risk of CVD. The responsibility of the healthcare provider is to ensure that the patient has a positive CIMT experience, which can include providing the test at a reasonable cost of the test, ease of scheduling the test, having no preparation before having the test, a painless test procedure, and simplicity of understanding the test results. The healthcare provider must also educate the patient on the risks associated with AS. An increase of 0.10 millimeters in CIMT has been shown to increase the risk of cerebrovascular events by 18% and a 15% increase in the risk of myocardial infarction (van den Munckhof et al., 2018). Abnormal CIMT scan results can provide individuals with concrete evidence of the formation of AS. Ideally, this knowledge and high patient satisfaction with the CIMT testing process will motivate individuals to adhere to their healthcare provider's recommendations tailored to their needs.

Review of the Literature

Literature Search

A literature search was conducted utilizing the Marian University library and health professions librarian. A search was conducted for English articles that are fifteen or fewer years old in the Ovid Medline database using a focused medical subject heading "medical interview satisfaction scale," which yielded 60 articles. Another search using the subject heading "patient satisfaction AND surveys and questionnaires" yielded 2359 articles. A third search using

“surveys and questionnaires AND physician-patient relations” yielded 243 articles. The total number of articles found was 2587. From this subset of 2587 articles, an additional search combining “primary health care OR family practice OR general practitioner” reduced the total number of articles to 193. A final search using the terms “ultrasonography AND patient satisfaction OR physician-patient relations” resulted in an additional 360 articles, resulting in 553 total articles. A summary of the literature search is shown in the PRISMA diagram in Appendix B.

Appendix C shows a brief synopsis of the twelve articles remaining after skimming the reports’ abstracts and eliminating those not pertinent to patient satisfaction with their ultrasonography experience or their consideration in modifying lifestyle choices based on their scan results. These remaining 12 articles consist of 3 systemic studies (Anokye et al., 2023; Radavelli-Bagatini et al., 2022; Rodondi et al., 2012), one prospective control trial (Mathews et al., 2018), six cross-sectional trials (Acebes et al., 2016; Anderson et al., 2021; Claret et al., 2016; Johnson, Einerson, et al., 2011; Johnson, Turke, et al., 2011; Korcarz et al., 2008), and two convenience trials (Bloch et al., 2015; Howard et al., 2014). The investigator selected these articles for their relevance to this investigation, which is to determine if patient satisfaction with CIMT ultrasound testing and whether high patient satisfaction translates to increased motivation to incorporate healthier lifestyle choices.

Review

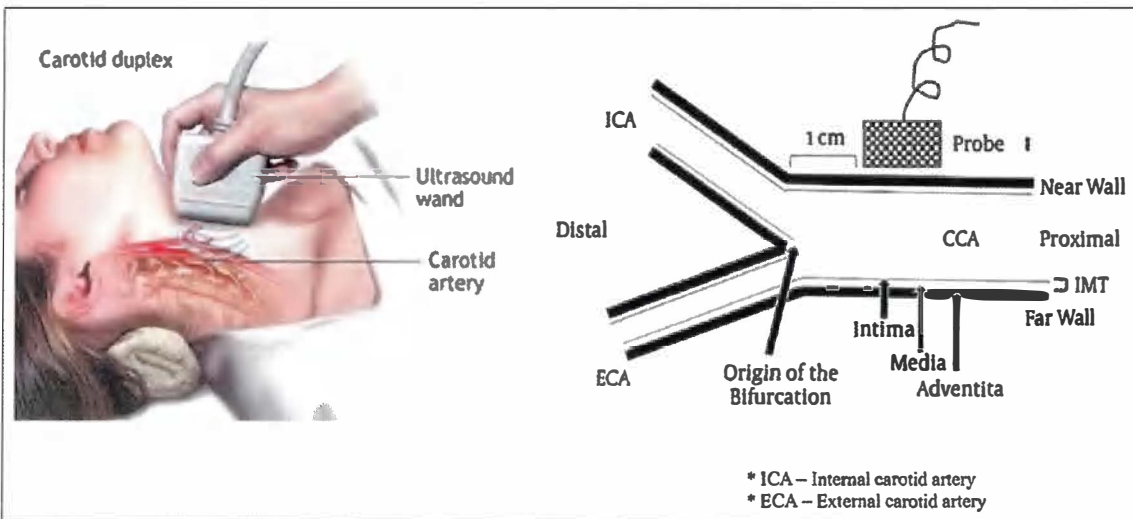
CIMT Scan Description

Healthcare providers incorporate various testing methods to predict risks for CVD in their patients. One test is the CIMT scan, which measures the thickness of the two innermost layers of the carotid artery (intima and media layers) by a B-mode ultrasound of the bilateral carotid

arteries, as shown in Figure 1 (Khatri et al., 2022). A greater thickness of the vessel lining indicates a concentration of calcified plaque deposits, which restricts blood flow (de Groot & Duivenvoorden, 2022). Typically, a CIMT scan is a collection of carotid intima-media thickness measurements of multiple arterial segments, including the right and left distal common carotid arteries, the carotid bifurcation, and the proximal internal carotid arterial segments (de Groot & Duivenvoorden, 2022).

Figure 1

Carotid Intima-Media Thickness Scan



*Note: This figure is a diagram that illustrates measuring the CIMT on the far wall of the common carotid artery (CCA) (Khatri et al., 2022).

The healthcare practice from this study chose CIMT scans provided by Vasometrics. The CIMT test is an approximately ten to twenty-minute safe and painless procedure. The technician applies a conductive gel to the skin on each side of the patient's neck and then uses a high-resolution B-mode ultrasound transducer to scan the carotid arteries. The images obtained are uploaded via a secure connection into a summary report. A sample report is shown in Figure 2

(Vasolabs, n.d.). After completing the scan, the physician reviews the results with the patient and discusses potential treatment options based on the report.

Figure 2

Carotid Intima-Media Thickness Scan Report by Vasometrics

VASOMETRICS: Arteriosclerotic inflammation tracking and atherosclerotic plaque assessment

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Vascular Age

Vascular age is a measurement of the apparent age of your arteries. If your vascular age is higher than your chronological age, you may be at higher risk for developing cardiovascular disease.

0.613_{mm}

Carotid Intima-Media Thickness Test (C-IMT)

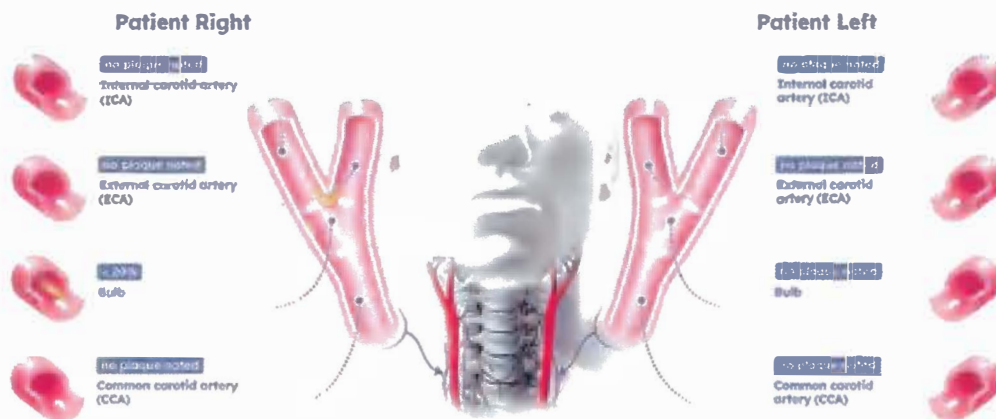
Carotid intima-medias thickness are sensitive layers of your arteries which become thick, inflame and become less flexible and useful.

1.390_{mm}

Largest Plaque

Calculated: The plaque has been secured and mineralized with calcium.

Artery Blockage



Carotid Intima-Media Thickness Test (C-IMT)



*Note: This figure illustrates a sample CIMT scan report. The data is on a 48-year-old female. Her vascular age is 53. (Vasolabs, n.d.).

Value of CIMT Scan

Point-of-care ultrasonography (POCUS) of the CIMT is one test used to determine if CVD is a potential health risk (Korcarz et al., 2008). de Groot and Duivenvoorden (2022) consider the ultrasound carotid intima-media thickness (CIMT) one of the most commonly and best-validated AS scanning methods. Carotid artery disease is an established risk factor for ischemic stroke, a surrogate marker of AS, and a predictor of CV events (Saba et al., 2022). When combined with a complete medical history, physical examination, and laboratory testing, imaging of the carotid arteries provides critical information for assessing CVD risk (Saba et al., 2022). CIMT scans are one of the most commonly used methods to study early structural changes in the artery walls and provide a valuable source of information that can also predict the presence of AS in arteries elsewhere in the body (Mardanshahi et al., 2020). Early detection of arterial structure changes is beneficial because treatment for AS can start before a significant cardiovascular event might occur. CIMT measurements provide a noninvasive and inexpensive screening for AS, determine risk for future CV events, and evaluate the effectiveness of drug therapies (de Groot & Duivenvoorden, 2022).

Evidence from the Literature

Not only does POCUS serve as a diagnostic tool, but it can also provide a source of increased patient satisfaction by improving the patient's confidence in the provider performing the POCUS, providing a real-time source of improved communication between patient and provider, enhancing the patient's understanding of the diagnosis, and give the patient the ability to share decision-making with the provider on the treatment plans (Acebes et al., 2016; Andersen et al., 2021; Bloch et al., 2015; Claret et al., 2016; Howard et al., 2014; Mathews et al., 2018).

The literature review determined that most studies resulted in positive patient feedback with their ultrasound testing. Anderson et al. (2021) reviewed patients' experiences with POCUS and found that most patients stated that the testing increased their service level and quality of care satisfaction. None of the patients in the study reported a negative experience (Anderson et al., 2021). A musculoskeletal ultrasound study concluded that nearly half of the participants scored their satisfaction an average of 9.5 out of 10 when evaluating the testing process and explaining their medication condition and its significance (Acebes et al., 2016). Patients rated their ultrasound testing experiences in the emergency department positively in three studies, citing that the testing increased the patient's confidence and satisfaction with the emergency physician's skill and ability to perform the test and provide real-time feedback on the test results (Bloch et al., 2015; Claret et al., 2016; Howard et al., 2014).

Screening for health-related conditions such as CVD using imaging does not always provide patients with high satisfaction levels, as determined by one systematic study (Anokye et al., 2023). A scoping review of 11 studies, including four randomized controlled trials and seven non-randomized studies, determined the level of psychological stress after vascular imaging was conducted of the coronary and carotid arteries by patient self-reporting measures (Anokye et al., 2023). In 56% of the studies, psychological stress was measured with multiple-item scales, including the Taylor Anxiety Score, Major Depression Inventory questionnaire, Beck Depression Inventory, PRIME-MD self-reported Patient Health Questionnaire, Perceived Stress Scale, and Impact of Event Scale (Anokye et al., 2023). The remaining 44% used a single-item measure, asking participants if they experienced worry following their screening (Anokye et al., 2023). The presence of anxiety, worry, depression, or quality of life was identified in all the studies after vascular screening (Anokye et al., 2023). Psychological distress could be minimized for

patients in the future by utilizing stress management techniques in combination with CVD screening and psychological evaluations to identify those individuals at risk for post-screening distress (Anokye et al., 2023).

Minimizing psychological distress and maximizing patient satisfaction when screening for CVD have been shown to provide another positive result in patient care. A study by Howard et al. (2014) suggests that patients satisfied with their POCUS exhibit greater compliance with post-discharge instructions. Findings from other studies indicate abnormal screening results for atherosclerosis can improve patients' intention to adopt healthier lifestyles and medication adherence (Howard et al., 2014; Johnson, Einerson et al., 2011; Johnson, Turke et al., 2011; Radavelli-Bagatini et al., 2022; Rodondi et al., 2012). Additionally, studies conducted by Korcarz et al. (2008) and Johnson et al. (2011) concluded that subjects who had US screening for atherosclerosis, regardless of the results, reported an increase in their motivation to improve their exercise and diet.

Goals and Objectives

This study aims to determine how the CIMT testing experience affects patient satisfaction and motivation to consider making lifestyle changes. Factors considered include the testing process, the interpretation and ease of understanding of the test results, and the likelihood that the patient will incorporate lifestyle changes to reduce the risk of CVD.

Methods

Data Security

The physician and nurse practitioner approved this study at their facility and provided the voluntary participants that received a CIMT scan in October 2022 or February 2023. The Marian

University Institutional Review Board (IRB) also approved the study. The investigator received permission to conduct the study in writing before collecting participant data.

The results from the completed surveys were compiled in the Qualtrics software package, which requires a password to access the account containing the survey. Survey results were accessed on a secure network in a secluded location to protect patient privacy. All data collected is kept on the investigator's password-protected laptop computer. All data related to this study will be cleared from the laptop computer one year after completion by the investigator.

Population

This study is conducted with participants from a family practice in central Indiana. Participants aged 18 to 80 who completed a CIMT scan in October 2022 or February 2023 are included in this study. Participants 17 years or younger or 81 years or older were excluded from this study. The younger group is considered minors, and the older group is likely to have multiple medical comorbidities and psychosocial or emotional conditions that could skew the study's results. Patients that do not speak and read English are also excluded due to their potential difficulty comprehending the survey questions.

Materials

The tool used to assess patient satisfaction with the CIMT screening process was adapted from the Patient Satisfaction Questionnaire Short Form (PSQ-18). The PSQ-18 was chosen as a model due to its adaptability to various applications, as well as the proven validity of the survey (Thayaparan & Mahdi, 2013). One question was added that allowed the respondent to provide a free-text response with any additional feedback regarding their experience with their CIMT scan. A 5-point Likert scale was used to record the patient responses. Appendix D shows the 23-

question CIMT-adapted patient satisfaction survey used in this study. The modified survey was created using Qualtric software accessed through Marian University.

Data Collection

The site administrator sent a message to participants at the family practice that had a CIMT scan in October 2022 or February 2023. Appendix E shows the letter sent to the participants, informing them of the study being conducted and requesting their participation. The message states that participation in the survey is voluntary, and the investigator conducting the study does not have access to any of the participant's personal protective information (PPI). A link is included in the message, which connects the participant to the survey. The first question of the survey verifies consent to participate in the study. The participant clicks "next" to confirm consent and to be taken to the survey questions.

The site administrator at the family practice participating in the study will compile a list of participants that are eligible to be included in the study. Participants who completed a CIMT scan in 2022 and 2023 and were aged 18 to 80 were sent a link through their patient portal, allowing anonymous access to the survey. The survey link is generated through the Qualtrics software and sent to the eligible participants by the practice staff via the patient portal. Data collected includes the participant's age, gender, race, and ethnicity. The participants will also rate their satisfaction with the CIMT testing process. No personal health information, such as name or date of birth, is requested. Responses from the survey by the participants are collected and stored in the Qualtrics software package.

Data Analysis and Results

A statistical analysis was run with the assistance of an offsite professional actuary. The analysis aims to determine if there is a correlation between participant satisfaction with the

CIMT process and the likelihood of considering lifestyle changes to reduce the risk or severity of CVD.

Questions 2 through 9 were analyzed using descriptive statistics from the Qualtrics software package summary. Questions 10 and 11 showed variances, which were analyzed using a Chi-squared test. The remaining questions were summarized using descriptive statistics, except for the last. The last question allowed the participants to write a free response for additional comments.

Twenty-three surveys were sent to patients who completed a CIMT scan from October 2022 to February 2023. Five surveys were returned; however, one was submitted but not completed, resulting in four completed surveys, or 17.4% of the surveys with data. The respondents were 100% female. The age distribution comprised 25% ages 18 to 29, 25% ages 60 to 69, and 50% ages 70 and older. Respondents were equally likely to have a CIMT score two or more years over their age as two or more years under their age.

All respondents were extremely satisfied with the professional care they received during the procedure and the care and treatment they received afterward. Concerns with scheduling the CIMT procedure did not impact professional care. Although 25% of the respondents expressed they had to wait more than 10 minutes before they were escorted to the exam room for the CIMT scan, 100% were still extremely satisfied with the help and treatment received and felt they benefited from the scan and follow-up care.

All respondents strongly disagreed that they were in any way given incorrect treatment based on their CIMT scan results. Based on their answer to this question confirms that the survey respondents' highly positive or positive responses appear genuine and not carelessly provided.

When questioned if the participants would recommend having a CIMT scan to their family and friends, 75% strongly agreed, while 25% agreed. The survey did not allow respondents to explain why the CIMT scan would not be recommended.

All respondents exercise weekly to some degree; 50% exercise 1-2 days a week, 25% exercise 3-4 days a week, and 25% exercise 5-6 days a week. Seventy-five percent of the respondents state they exercise at a moderate intensity, and 25% exercise at a light intensity. Of the respondents, 50% feel tired during the day, 25% neither agree nor disagree with feeling fatigued, and 25% somewhat disagree.

Twenty-five percent of the respondents indicated CIMT has led to nutritional lifestyle changes, while 75% responded that they had not made any changes. Similarly, twenty-five percent of the respondents noted that CIMT had encouraged medication compliance, with 75% who answered that they had not made any changes.

Twenty-five percent of the respondents included a free text response when asked if they had any additional comments regarding their CIMT scan experience. The participant stated, “My doctor regularly talks to me about exercise, sleep, and nutrition. It was very helpful to have the CIMT procedure.” The same participant indicated that she was pleased with her scan and the discussion provided by her provider regarding the benefits of a healthy lifestyle.

All participants responded they were extremely satisfied with the CIMT scan procedure. Although not everyone improved all aspects of considering adopting a healthier lifestyle due to the results of their scan, there was some improvement in eating habits and medication compliance. There were only reported indications of improvement rather than deterioration in lifestyles; this suggests that the CIMT scan can provide encouragement and motivation to improve dietary intake, medication compliance, and regular exercise.

Ethical Considerations/Protection of Human Subjects

This study was submitted to the Institutional Review Board (IRB) for approval before initiation. All information obtained will be used only for this study. The author of this paper does not have access to the electronic medical records of the study participants. The site administrator will electronically contact potential eligible participants at the practice to inform them of the study and ask if they are interested in participating. The Qualtrics questionnaire will not be linked to the individual who completes the survey, so there will be no compromise of personal information. All documents, including the questionnaire results and emails, will be removed from the password-protected laptop within one year after the study's conclusion and submission to the university.

Discussion

Due to the low response rate of patients who had CIMT scans in the designated time frame and those who were agreeable to participate, this study's rigor is not strong, suggesting further investigation is needed. The surveys were sent to 23 potential candidates three times over one week requesting participation in the study. There were five returned surveys; however, only four contained completed responses. The incomplete survey was not included in the final data analysis. If the volunteer request had been sent out additional times, the investigator may have obtained increased study participation.

The respondents that did participate in the study unanimously scored an extremely high satisfaction rating of the CIMT process, which demonstrates the clinic's protocol for scheduling, testing, providing feedback from the scan's results, and treatment suggestions from the provider were very well received by all respondents. The respondents' survey responses could indicate a correlation between a positive experience with their CIMT scan and their willingness to make

lifestyle improvements. All respondents reported they were highly satisfied with their CIMT scan procedure, which suggests that they believe it is a beneficial diagnostic tool and trust the test results. The participants' satisfaction and confidence in the test may indicate that their results were compelling due to their planning value by providing high-quality health information. This knowledge inspires the individual to devise strategies for improving their lifestyle by eating healthier, exercising, and taking medications as prescribed by their provider (Dorn et al., 2021).

One-fourth of respondents answered that they were more compliant with their medications and dietary modifications after their test. However, none are considering changing their exercise habits, possibly because all already exercise regularly and were satisfied with their current frequency and intensity. Additional patient education from the healthcare provider on the benefits of exercise could potentially improve the motivation of the participant to increase their physical activity.

When questioned if the participants would recommend having a CIMT scan to their family and friends, 75% strongly agreed, while 25% agreed. Correlation to other responses could suggest the respondent had reservations about recommending the procedure to others because of their wait time since it was the same person waiting more than 10 minutes before their procedure. A free text box would have been beneficial if added to the survey, allowing the participant to explain why they would not recommend the scan to their family and friends.

One-half of the participants indicated they are tired during the day after sleeping well. This question might have been more beneficial if the query included whether the subject has sleep apnea or other sleep disturbances that may cause daytime sleepiness or could be related to decreased blood flow due to vessel obstruction.

A more in-depth questionnaire could be beneficial in providing more insight into why the participants did or did not modify their lifestyle choices after the CIMT scan. Additional free-style text opportunities would allow the respondent to provide greater detail. The questionnaire used in this study was intentionally short, with the logic that a quick survey would be more likely to be completed than one requiring more time.

A CAC scan is an additional available test that can be used to determine CVD risks. The CAC scan checks the coronary arteries in the heart for blockages. The CAC scan can identify the risk for CVD when performed alone or in conjunction with the CIMT scan. Performing both tests allows a more thorough body analysis, as the CIMT detects plaque in the carotid arteries, and the CAC detects plaque in the coronary arteries. However, the CIMT scan provides valuable, accurate data when performed alone.

Conclusion

Within this study's small sample group, all participants were extremely pleased with their CIMT experience. Positive responses from the respondents indicated improvement post-testing in their diet and with medication adherence, although there was no change in their exercise level. The need for additional studies using a larger, more diverse population would be beneficial and recommended to provide statistically significant results.

The CIMT testing was a positive experience for all respondents in this study. A CIMT scan is a valuable test in identifying AS as a significant cause of CVD. The procedure is a relatively inexpensive, quick, noninvasive, painless, and easily accessible test that identifies the risk of CVD. The combination of regular provider education on the benefits of a healthy lifestyle and easy access to a CIMT scan can be beneficial tactics instrumental in reducing CVD risks.

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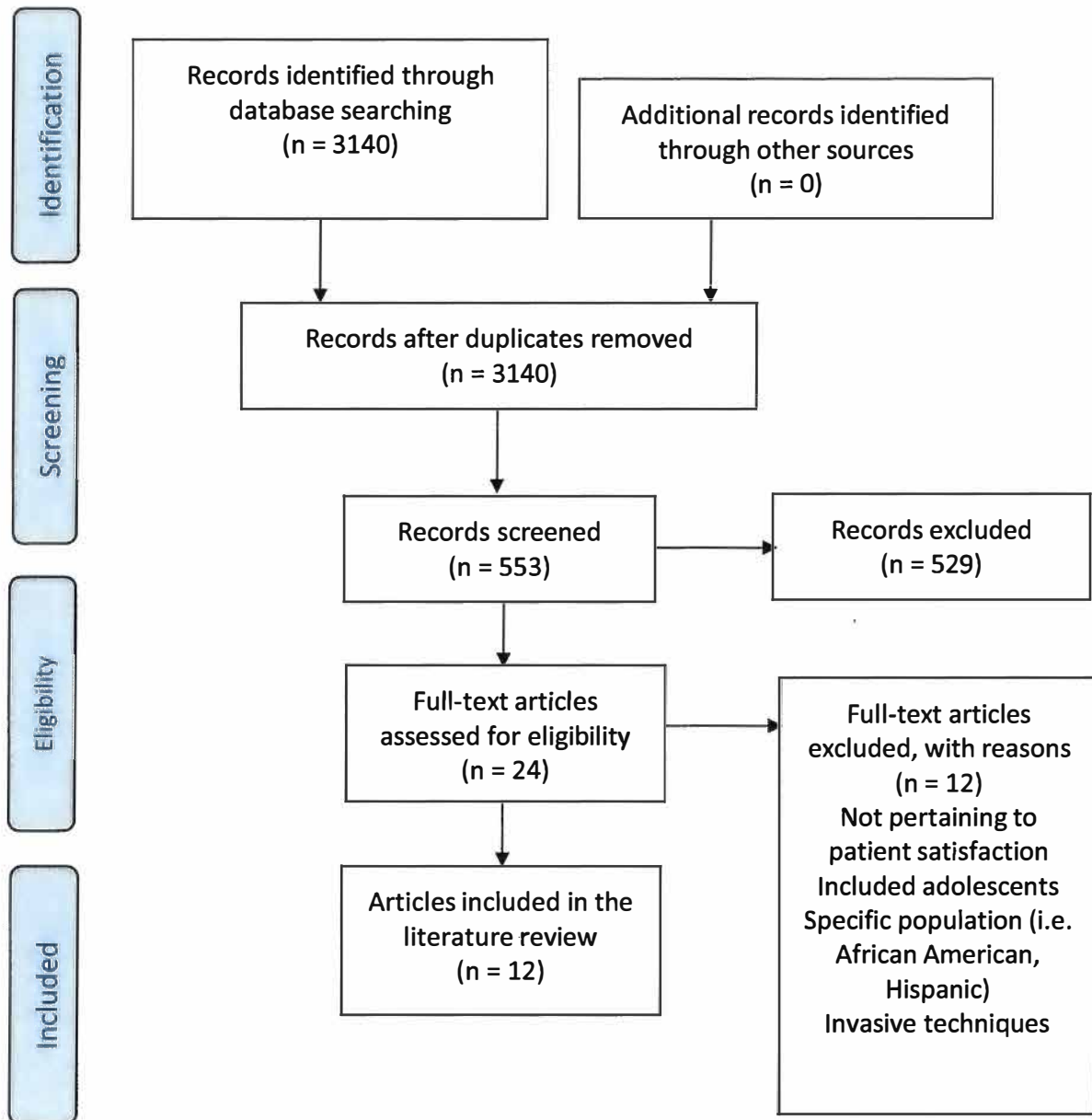
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Appendix A**SWOT Analysis**

INTERNAL FACTORS	
STRENGTHS +	WEAKNESSES -
<ul style="list-style-type: none"> • Short survey requiring little time to complete. • Ease of participation. • University staff support for assistance when needed. • Clinic accessibility in providing anonymous access to patients' opinions of CIMT scan testing. 	<ul style="list-style-type: none"> • Self-reporting potentially skews study results. • Short survey may restrict conclusions from statistical analysis of data. • Small number of respondents.
EXTERNAL FACTORS	
OPPORTUNITIES +	THREATS -
<ul style="list-style-type: none"> • Include additional clinics in the study. • Expand the search time window of literature for additional evidence. • Provide in person explanation of purpose of study and answer any questions for potential candidates. 	<ul style="list-style-type: none"> • Potential study candidates may not be interested in participating in study. • Short window of time to collect responses and data analysis. • Small pool of eligible study candidates available.

*Note: This diagram illustrates this study's internal and external strengths and weaknesses.

(Weller, 2022)

**Appendix B****PRISMA Diagram****PRISMA 2009 Flow Diagram**

*Note: This diagram illustrates the literature search conducted for this study. (Moher et al., 2009)

Appendix C

Literature Review Matrix

Reference	Research Design & Level of Evidence	Purpose	Population Size	Variables	Instruments/Data Collection	Results	Implications for Future Research	Implications for Future Practice
Clinical Usefulness and Patient Satisfaction with a Musculoskeletal Ultrasound Clinic: Results of a 6-Month Pilot Service in a Rheumatology Unit (Acebes et al., 2016).	Cross-Sectional Study Level 4	To test the perceived usefulness of musculoskeletal ultrasound (MSUS) for the management of inflammatory arthritis (IA) by providers and to evaluate patient satisfaction with MSUS procedure	n=43 patients	Value of MSUS for decision-making in treating patients with IA, the explanation thoroughness the patient received regarding the testing process, why the testing was ordered, the ultrasound findings, the patient's discomfort level during testing, and the waiting time for the appointment.	Patient Survey	MSUS positively influences providers' decision-making in diagnosing and treating IA. MSUS is well-accepted by patients and was highly rated in patient satisfaction.	Assess provider and patient satisfaction with MSUS to diagnose and treat additional types of arthritis	Establish an MSUS standard procedure in the rheumatology community to increase the use of MSUS in practice.
Patients' Experiences of the Use of Point-of-Care Ultrasound in General Practice: A Cross-Sectional Study (Anderson et al., 2021).	Cross-Sectional Study Level 4	Review patients' experiences with point-of-care ultrasonography (POCUS)	n=691	Age, gender, employment, level of education, previous recipient of ultrasonography, influence of POCUS on exam and outcome	Patient survey	Majority of patients stated they were well informed or informed regarding the purpose and the results of POCUS examinations. Half the patients stated they were informed or well informed when noting a difference between a general physician POCUS and an image specialist's US exam. POCUS greatly influenced patients' feelings regarding a more thorough and better understanding of imaging results. Majority of patients stated POCUS increased their level of service and quality of care satisfaction.	Additional high-quality studies needed to determine diagnostic accuracy of POCUS performed by GP	Quality training for GPs performing POCUS needed to assure accurate diagnostic results and increase patient satisfaction with care provided by GP.

Reference	Research Design & Level of Evidence	Purpose	Population Size	Variables	Instruments/Data Collection	Results	Implications for Future Research	Implications for Future Practice
						No patients had a negative experience with POCUS.		
Psychological Distress and Quality of Life in Asymptomatic Adults Following Provision of Imaging Results for Prevention of Cardiovascular Disease Events: A Scoping Review (Anokye et al., 2023).	Systematic Review Level 1	To determine patient distress and quality of life after providing imaging results for CVD screening. To determine knowledge gaps in previous studies.	n=4 Randomized controlled trials n=7 Non-randomized studies	Age, gender, nationality, type of psychological stress (worry, depression, perceived stress, and anxiety) and health-related quality of life (HRQoL)	Patient self-report of mental distress and HRQoL, Taylor Anxiety Score, Major Depression Inventory questionnaire, Beck Depression Inventory, PRIME-MD self-reported Patient Health Questionnaire, Perceived Stress Scale, Impact of Event Scale, and International Quality of Life Assessment Project (IQOLA).	Mixed results pertaining to level of psychological distress while waiting for screening test or test results. Mixed results regarding HRQoL.	Include more robust reporting on patient psychological distress. Replace self-reporting with clinical assessments or well-validated symptom severity reporting. Include stress management techniques and psychosocial interventions (Cognitive-Behavioural Stress Management) when sharing testing results with participants.	Incorporate stress management techniques for recipients of cardiovascular screening. Provide regular assessments of psychological distress and HRQoL at multiple time intervals.
Patient Satisfaction with Bedside Ultrasound Performed by Emergency Physicians (Bloch et al., 2015).	Convenience sample Level 6	Determine patient satisfaction with bedside ultrasound in the Emergency Department (ED)	n=86	Age, gender, type of ultrasound (US)	Patient survey	Patients are satisfied with US performed bedside in the ED, the physician performing test, and the explanation regarding the results.	Additional randomized studies needed with a larger sample size and control group for comparison	Provide quality training to physicians in performing and interpreting US to expedite patient care.
Point-of-Care Ultrasonography at the ED Maximizes Patient Confidence in Emergency Physicians (Claret et al., 2016).	Cross-Sectional Study Level 4	To determine the effect of point-of-care ultrasonography (POCUS) on patient confidence in the emergency physician (EP)	n=38 POCUS n=16 providers	Age, male sex, reasons for admission to the emergency department (ED), time to first medical contact, Area of ED, Inpatient, comparison of feeling ratings, confidence on the EP who performed POCUS, Perception of clinical examination duration, quality of	Patient survey	POCUS increases the quality of patients' confidence and satisfaction with ED provider.	Future studies could determine how to improve long-term satisfaction with POCUS beyond time spent with provider in ED.	Increasing communication skills of ED provider with patients could positively affect patient satisfaction with ED experience.

Reference	Research Design & Level of Evidence	Purpose	Population Size	Variables	Instruments/Data Collection	Results	Implications for Future Research	Implications for Future Practice
				information delivered, physician's amiability, perception of time to first contact, overall ED satisfaction, pain management quality, understanding of delivered information.				
Bedside Ultrasound Maximizes Patient Satisfaction (Howard et al., 2014).	Convenience sample Level 6	Determine patient satisfaction with bedside ultrasound (US) and Emergency Physician (EP) performing US in the Emergency Department (ED)	n=70 (35 participants received US in ED, 35 did not)	Age, gender, length of stay, chief complaint, need for additional imaging by radiologist	Patient Questionnaire using 5-point Likert scale	Increased satisfaction by patients having US compared to those who did not. Satisfied patients display greater compliance with discharge instructions. Patient satisfaction directly positively affects patients' perceived quality of care received.	Future randomized studies are needed with larger sample sizes to provide greater significance in results.	Maximize quality training for EPs providing US in ED to strengthen patient-physician relationships, expedite care, and improve patient satisfaction scores which increases patient compliance with discharge instructions.
Long-Term Effects of Carotid Screening on Patient Outcomes and Behaviors (Johnson, Einerson et al., 2011).	Cross-Sectional Study Level 4	Determine if patients with advanced subclinical atherosclerosis (AdvAthero) having a carotid ultrasonographic (CUS) are more likely to improve lifestyle behaviors	n=529	Age, gender, Framingham risk score, history of hypertension, dyslipidemia, Diabetes Mellitus, smoking, premature family cardiovascular death, medication therapies, BMI, CIMT score	Patient survey	AdvAthero present in 58.6% of participants. Presence of AdvAthero on CUS had no influence on use of lipid-lowering therapy to reach LDL-C goals. AdvAthero did not predict changes in healthy lifestyle improvements such as diet and exercise.	Additional studies are needed to evaluate long-term clinical outcomes of adherence to treatment for patients with CIMT testing.	Participants with AdvAthero risk perception of cardiovascular disease (CVD) decreased over time. Regular counseling on the importance of maintaining healthy lifestyle behaviors and medication compliance is needed to reinforce patient adherence.
Effects of an Office-Based Carotid Ultrasound Screening Intervention (Johnson, Turke et al., 2011).	Cross-Sectional Study Level 4	Prospectively determine effects of carotid ultrasound screening (CUS) results on physicians' decision-making concerning cardiovascular disease (CVD) risk assessment, treatment, and patient counseling and	n=355	Age, gender, common carotid artery carotid intima-media thickness (CIMT), number of CVD risk factors, waist circumference, systolic blood pressure (SBP), diastolic blood pressure (DBP), total cholesterol,	Patient survey	Presence of abnormal carotid ultrasound screening (ABNLCUS) resulted in lower targeted LDL cholesterol and systolic blood pressure goals, changed aspirin and lipid-lowering medication	Suggest performing randomized trials to provide more significant results. Direct measurements rather than patient surveys would also provide more accurate results regarding 30-day patient outcomes.	Patient follow-up beyond the 30-day cutoff would be beneficial in practice to provide continued support and motivation to adhere to healthy lifestyle behaviors after ABNLCUS.

Reference	Research Design & Level of Evidence	Purpose	Population Size	Variables	Instruments/Data Collection	Results	Implications for Future Research	Implications for Future Practice
		patients' resulting health-related behaviors (HRBs).		triglycerides, High-density lipoprotein cholesterol (HDL), Low-density cholesterol (LDL) Non-high-density lipoprotein cholesterol		prescriptions by physicians. Performing CUS increased patient perception of CVD risk and intention to change HRBs. (ABNLCUS) increased patients' intent to exercise, improve diet, smoking cessation, medication adherence, perceived CVD risk corresponding to hyperlipidemia and hypertension, chance of having CVD presently or in future, and perceived ability to modify lifestyle to reduce CVD risk.	Trials needed based on behavioral theory to pinpoint patients most influenced by imaging feedback.	
<p>Ultrasound Detection of Increased Carotid Intima-Media Thickness and Carotid Plaque in An Office Practice Setting: Does it Affect Physician Behavior or Patient Motivation?</p> <p>(Korcarz et al., 2008).</p>	Cross-Sectional Study Level 4	Determine if positive carotid intima-media thickness scan (CIMT) or carotid plaque influences physicians' treatment plans or patients' health-related motivation.	n=253	Age, gender, race, smoking, family history of premature cardiovascular disease, history of hypertension, prescription hypertension medications, dyslipidemia, diabetes mellitus, prescription glycemic control medication, blood pressure, waist circumference, body mass index, fasting glucose, total cholesterol, triglycerides, high-density lipoprotein cholesterol, low-density cholesterol, total/high-density lipoprotein cholesterol, Framingham score, right common carotid artery CIMT, left common carotid	Patient survey	Physicians more likely to prescribe aspirin, antiplatelet, and lipid-lowering medication with increased CIMT or carotid plaque. Screening process increased patients' motivation to make positive lifestyle changes, even if there was not an abnormal scan.	Additional studies with control group needed to provide greater validity of results.	Study reported patients' motivation after screening, not actual actions. Regular follow-up of patients' actions would be beneficial to promote long-term improvements in lifestyle modification.

Reference	Research Design & Level of Evidence	Purpose	Population Size	Variables	Instruments/Data Collection	Results	Implications for Future Research	Implications for Future Practice
				artery CIMT, right or left CIMT $\geq 75^{\text{th}}$ percentile, carotid plaque present				
Point of Care Ultrasound Improves Shared Diagnostic Understanding Between Patients and Providers (Mathews et al., 2018).	Prospective Controlled Trial Level 3	To determine if point-of-care ultrasound increases understanding of a patient's diagnosis between provider and patient	n=60 patients n=10 providers	Reason that brought patient to hospital, health problem, main contributors of health problem, how well patient understood health problem	Patient Survey	Point-of-care ultrasound (POCUS) use resulted in significantly higher agreement with provider regarding diagnosis. Increased interaction between provider and patient during POCUS contributes to greater understanding by patient of health problems and diagnostic process. POCUS increases the accuracy and efficiency of diagnosis by the provider.	Additional studies recommended strengthening the idea that POCUS improves the diagnostic process and patient's understanding of their diagnosis.	Increased patient participation in the diagnostic process could provide additional understanding of patient's disease
Provision of Noninvasive Coronary and Carotid Vascular Imaging Results on Changes in Diet and Physical Activity in Asymptomatic Adults: A Scoping Review (Radavelli-Bagatini et al., 2022).	Systematic Review Level 1	Analyze current literature to identify opportunities to incorporate patients' healthy lifestyle choices to reduce the risk of CVD	n=11,256 13 observational studies and 7 RCTs	Age, weight/BMI, diet, exercise, CVD risks, hypertension, CVD risk factor status, smoking, diabetes mellitus	Self-report or single-item questions	Majority of outcomes focused on medically treating hypertension (HTN) and smoking cessation techniques. Presence of coronary artery calcification (CAC) and CVD risk factors encourages greater motivation to adopt positive lifestyle changes, with medication adherence the primary focus, while there is weak evidence for improving diet and physical activity.	Have provision to provide clear advice on how to improve diet, exercise, and smoking cessation by a trained counselor. Include follow-up sessions to reiterate advice and assure understanding and compliance.	Providers need to recommend interventions that help motivate improvement in diet and exercise, with consistency and regular encouragement to be compliant.

Reference	Research Design & Level of Evidence	Purpose	Population Size	Variables	Instruments/Data Collection	Results	Implications for Future Research	Implications for Future Practice
Atherosclerosis Screening by Noninvasive Imaging for Cardiovascular Prevention: A Systematic Review (Rodondi et al., 2012).	Systematic Review Level 1	To determine if cardiovascular risk factors (CVRF) and patient outcomes are improved with atherosclerosis screening	n=12 Four randomized controlled trials (RCT) (n=709) Eight non-randomized studies (n=2,994)	Cardiovascular risk factors (smoking cessation, blood lipid control, diet change, weight loss, change in physical activities, change in adherence to medications), cardiovascular event	Individually determined by each study due to the wide variation of screening methods and outcomes	RCT-no improvement in CVRF, increased smoking cessation Non-RCT-increased coronary heart disease (CHD) risk perception Increased anxiety after screening, promote additional invasive procedures, false sense of reassurance after a negative scan.	Largescale RCTs are needed to make definitive recommendations for atherosclerosis screening	Further evidence is necessary before recommending widespread atherosclerosis screening for individuals

Appendix D

Carotid Intima-Media Thickness (CIMT) Scan Study Questionnaire

Q1 - By clicking “Next” you agree to participate in the Carotid Intima-Media Scan Patient Satisfaction Survey. All answers are anonymous and will not be traceable to your identity.

Q2 - What is your age?

- ☐ 18-29
- ☐ 30-39
- ☐ 40-49
- ☐ 50-59
- ☐ 60-69
- ☐ 70 and older

Q3 - What is your gender?

- ☐ Male
- ☐ Female
- ☐ Non-binary/third gender
- ☐ Prefer not to say

Q4 - Based on your carotid intima-media thickness (CIMT) score, how did your actual age compare to your arterial age?

- ☐ Actual age was 2 or more years younger than arterial age.
- ☐ Actual age and arterial age were the same.
- ☐ Actual age was 2 or more years older than arterial age.

Q5 - Did the technician performing your CIMT test talk to you in a way that was easy to understand?

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

Q6 - Did you have confidence in the technician's professional skills when performing your CIMT scan?

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

**Q7 - Did you get sufficient information about your diagnosis from your CIMT scan?
(Printed report and physician's explanation)**

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

Q8 - Do you believe the treatment is appropriate for your diagnosis?

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

Q9 - Were you involved in the decisions regarding your treatment?

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

Q10 - Do you believe the process of scheduling your CIMT scan was well organized?

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

Q11 - Did you have to wait more than 10 minutes before you were escorted to the exam room for the CIMT scan?

- ☐ Definitely not
- ☐ Probably not
- ☐ Might or might not
- ☐ Probably yes
- ☐ Definitely yes

Q12 - Overall, was the help and treatment you received on the day of your CIMT scan satisfactory?

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

Q13 - Overall, have you benefitted from the CIMT scan and follow-up care?

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

Q14 - Do you believe that you were in any way given incorrect treatment based on your CIMT scan results (according to your judgment)?

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

Q15 - Based on your experience, would you recommend having a CIMT scan for your family and friends?

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

Q16 - On average, how many days a week do you exercise?

- ☐ 7 days/week
- ☐ 5-6 days/week
- ☐ 3-4 days/week
- ☐ 1-2 days/week
- ☐ None

Q17 - At what intensity (how hard) do you usually exercise?

- ☐ I do not exercise
- ☐ Light (casual walk)
- ☐ Moderate (brisk walk)
- ☐ Vigorous (jog/run)

Q18 - On a scale of 1–5, where 1 is low and 5 is high, how ready, willing, and able are you to improve your nutrition habits and stick to it?

- ☐ Extremely low (1)
- ☐ Somewhat low (2)
- ☐ Undecided (3)
- ☐ Somewhat high (4)
- ☐ Extremely high (5)

Q19 - Do you often feel tired, fatigued, or sleepy during the daytime, even after a “good” night’s sleep?

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

Q20 - Has the CIMT procedure and the interpretation positively affected your dietary habits?

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

Q21 - Has the CIMT procedure and the interpretation positively affected your exercise habits?

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

Q22 - Has the CIMT procedure and the interpretation positively affected your medication compliance habits?

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neither agree nor disagree
- ☐ Somewhat disagree
- ☐ Strongly disagree

Q23 - Do you have any further comments or thoughts regarding your experience with CIMT? (Free text entry)

Appendix E**Introduction Letter**

We would appreciate feedback on your carotid intima-media thickness (CIMT) testing experience! A Marian University Doctor of Nursing Practice student will collect data from your completed survey responses for our benefit.

Please follow the link below for a 23-question, 10 to 15-minute survey to determine patient satisfaction with CIMT. Completion within three days of receiving the survey would be extremely helpful!

Thanks for your participation!

Please click on the control key and the link below simultaneously to begin the CIMT survey.

https://marian.co1.qualtrics.com/jfe/form/SV_6svuTvwrskW4yWO