

Transthoracic Echocardiography Real-Life workload: A Cross-Sectional Field Study

Alsrur, Hamad¹, Ahmed Goha¹, Arafa G Ibrahim², Mahmoud F Elshahat²

¹ Cardiac Center Hail, King Salman Specialist Hospital, Hail, Saudi Arabia

² Cardiology Department, Faculty of Medicine, Helwan University, Cairo, Egypt

***Corresponding Author: Alsrur, Hamad**
e-mails: ihamad888@gmail.com

ABSTRACT

Background: Transthoracic echocardiography (TTE) is a non-invasive diagnostic imaging modality for assessing cardiac structure and function. While its diagnostic value is well established, limited research has investigated the expected duration of outpatient adult TTE procedures in real-world settings.

Objective: To estimate the average duration of adult TTE examinations in an outpatient clinic and identify key factors influencing scan time.

Methods: A cross-sectional observational study was conducted at Hail Cardiac Center, Saudi Arabia, including 100 adult outpatients. Data collected included demographic variables (age, sex, and BMI), clinical history, technician experience, image quality, and scan start/end times. The primary outcome was total scan duration in minutes. Statistical analyses were performed using SPSS.

Results: The average scan duration was 32.5 ± 7.8 minutes. Increased BMI, lower image quality, and less technician experience were associated with longer scan durations ($p < 0.05$). No significant differences were observed based on age, sex, or device type.

Conclusion: The findings suggest that a realistic expectation for outpatient TTE duration is approximately 32.5 minutes per scan. Institutions should consider scheduling approximately 12 to 13 scans per technician per 8-hour shift, accounting for breaks and quality standards. Factors such as BMI, image quality, and technician expertise should guide workload distribution.

KEYWORDS: Transthoracic Echocardiography, Procedure Time, Image Quality, Technician Experience, BMI, Outpatient Workflow.

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INTRODUCTION

Transthoracic echocardiography (TTE) is a well-established integral non-invasive cardiac imaging tool for cardiac morphology and function assessment in acute and chronic settings, endorsed by the American Society of Echocardiography (ASE) and the European Association of Cardiovascular Imaging (EACVI). TTE is favored diagnostic modality due to its portability, cost-effectiveness, safety profile, and diagnostic accuracy (Nagueh et al., 2016).

The demand of routine and follow-up echocardiographic services has grown, due to the tremendous rise of cardiovascular disease in Saudi Arabia and other Middle Eastern countries, with increased prevalence of hypertension, diabetes, and obesity. Efficient utilization of echocardiography laboratories has thus become a crucial operational goal. However, despite technical standardization, there remains considerable variation in procedural timing for TTE across different institutions.

International guidelines recommend comprehensive TTE study to include standard parasternal long- and short-axis views, apical views, and subcostal or suprasternal imaging. Comprehensive study requires 40-60 minutes for proper image acquisition, measurement, and documentation (Mitchell et al., 2019). Scan time challenges, especially in high-volume outpatient settings have been noted in several studies. TTE duration may be prolonged with increased body mass index, with more time needed to achieve diagnostic-quality images (Goyal et al., 2024). Shorter TEE scan time is noted with experienced sonographers approximately 26 ± 5.4 minutes (Kimura & DeMaria, 2003).

Data for average outpatient TTE scan time remain scarce from the Gulf region, particularly Saudi Arabia. Defining realistic time benchmarks is crucial for optimized scheduling, equitable workload distribution, maintaining quality standards, and effective institutional resource planning.

Our study aimed to determine real-life duration of adult outpatient TTE examinations in Saudi Arabia, and the factors that may influence scan time. These region-specific findings could support the development of local guidelines and operational improvements.

METHODOLOGY

This cross-sectional field study was conducted between January and March 2025 at Hail Cardiac Center, a specialized tertiary care cardiac facility in Saudi Arabia. The study aimed to quantify the actual duration of routine TTE procedures in a high-volume outpatient clinical setting. The study protocol was reviewed and approved by the Institutional Review Board of Hail Cardiac Center (IRB Approval Code: 2025-68). All collected data were anonymized, and patient confidentiality was strictly maintained by institutional and ethical research standards.

Study Population and Sampling:

A total of 100 adult outpatients (aged ≥ 18 years) referred for routine TTE examinations were recruited using convenience sampling. Patients were excluded if they were hospitalized, underwent emergency, contrast, or stress echocardiography, or had missing scan time records. Additionally, patients referred to as complex echocardiographic indications such as significant valvular regurgitation or stenosis were excluded. All examinations included were routine in nature, primarily aimed at evaluating left ventricular function (LVF).

Echocardiographic Equipment and Protocol:

All TTE were performed using the Philips CVx ultrasound system (Philips Medical Systems, Netherlands), equipped with an X5-1 matrix-array transducer optimized for cardiovascular imaging. The examinations followed the 2018 ASE guidelines for comprehensive TTE, which include acquisition of standard parasternal long- and short-axis views, apical views, subcostal windows, and Doppler assessments (Mitchell et al., 2019).

Data Collection and Variables:

Data were collected prospectively using a structured case report form designed for this study. The recorded variables encompassed both patient-specific and technical factors.

Demographic data included age, sex, height, and weight, and body mass index (BMI). Clinical history was documented to identify chronic comorbidities such as hypertension and diabetes.

Technician experience was categorized into two groups: junior or entry-level technician (≤ 5 years) and senior-level technician (>5 years) of experience.

Image quality was assessed blindly by two expert sonographers and rated according to the classification of ASE/EAE consensus statement on echocardiographic image acquisition standards into Good, Moderate, or Poor (Mor-Avi et al., 2011).

Good: All standard echocardiographic views were acquired with well-defined endocardial borders and interpretable Doppler signals.

Moderate: Some views were suboptimal but remained clinically acceptable with minor limitations.

Poor: Major image degradation or missing standard views that hindered accurate interpretation.

TTE scan duration was the primary outcome of our study and included only the total elapsed time in minutes between the manually recorded start and end time stamps of the scan. Patient registration and preparation for scan was not included in the calculated time.

Statistical Analysis: All statistical analyses were performed using IBM SPSS Statistics, version 25. Descriptive statistics for demographic and clinical characteristics including means, standard deviations, frequencies, and percentages. Independent sample t-tests and one-way analysis of variance (ANOVA) were used to compare categorical variables such as technician experience, patient habitus and image quality. A p-value of <0.05 was considered statistically significant.

RESULTS

Our study included 100 adult TTE studies routinely done in outpatient settings. Demographic and clinical characteristics of Participants are presented in Table 1. The overall average duration for TTE procedures was 32.5 ± 7.8 minutes. The majority of scans $>50\%$ ranged from 25–35 minute (Figure 1), this interval represented a realistic benchmark for scheduling outpatient TTE procedures. Several factors affected scan duration. Obese participants had significantly longer scan duration compared to non-obese participants ($p = 0.003$). Also, scans with poor quality had significantly longer scan duration compared to scans with good quality ($p = 0.001$). The duration of TTE was significantly shorter when performed by experienced technicians (>5 years) ($p = 0.020$) Table 2.

Table 1. Demographic and Clinical Characteristics of Participants

Variable	Value
Sample Size	100
Age (mean ± SD)	54.2 ± 11.6
Sex (Male)	58%
Sex (Female)	42%
BMI (mean ± SD)	28.4 ± 4.9
Chronic Comorbidities	62%

Table 2. Scan Duration According to Clinical and Technical Factors

Category	Subgroup	N	Mean Scan Duration ± SD (minutes)	p-value
Technician Experience	≤5 years	55	35.1 ± 6.7	0.020
	>5 years	45	29.4 ± 5.8	
Image Quality	Good	38	30.2 ± 5.5	<0.001
	Moderate	34	34.6 ± 6.8	
	Poor	28	39.3 ± 5.2	
Patient Habitus	Non- obese BMI ≤30	63	30.1 ± 5.9	0.003
	Obese BMI >30	37	36.4 ± 6.3	
Sex	Male	58	32.2 ± 7.6	0.670
	Female	42	32.8 ± 7.9	
Age Group	<60 years	66	31.9 ± 7.4	0.490
	≥60 years	34	33.3 ± 8.1	

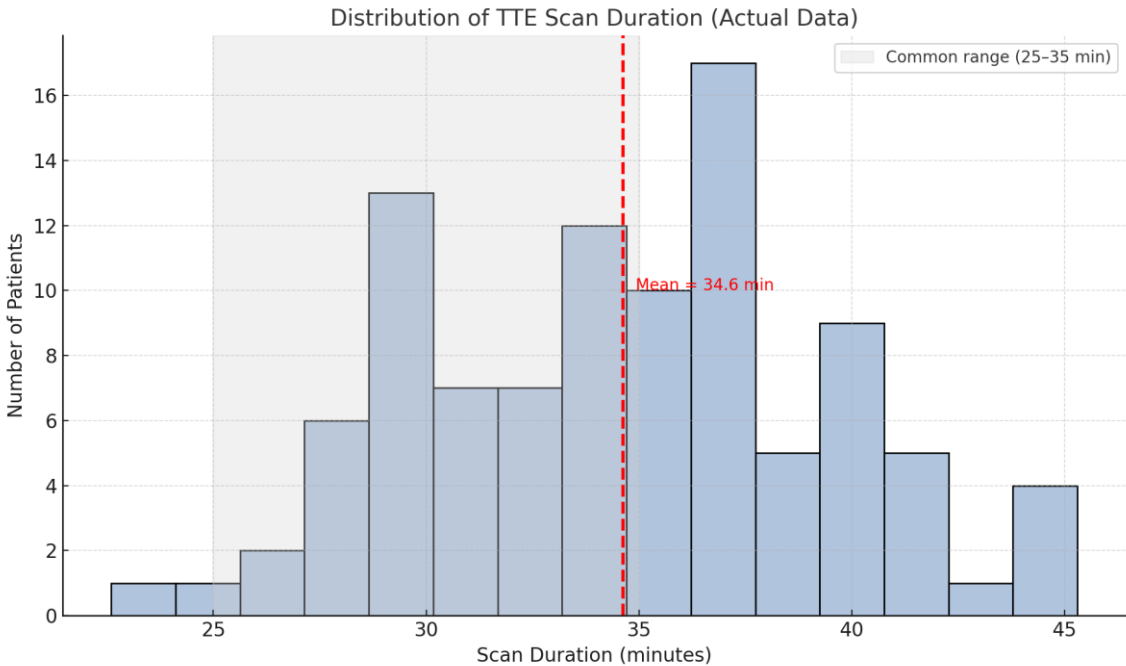


Figure 1. Histogram illustrates the distribution of transthoracic echocardiography (TTE) scan durations among 100 adult outpatients. Most examinations clustered between 25 and 35 minutes, as highlighted in gray. The red dashed line indicates the mean scan duration of approximately 34.6 minutes, demonstrating that a typical outpatient TTE procedure generally falls within this range.

DISCUSSION

The ASE and the British Society of Echocardiography (BSE) emphasize the acquisition of a standardized minimum dataset of views during every TTE examination. These standards improve diagnostic accuracy and reduce inter-observer variability.

The recorded average scan duration in our study was 32.5 ± 7.8 minutes per scan, which is shorter than the 45–60-minute recommended timeframe by the ASE comprehensive imaging guidelines (Mitchell et al., 2019) and the Intersocietal Accreditation Commission (IAC 2025) guidelines. This discrepancy likely reflects differences between idealized protocol-driven imaging and the more streamlined processes required in high-volume outpatient clinical settings. The relatively shorter scan duration observed in this study may also be attributed to the exclusion of patient preparation, reporting and documentation time. Our results are consistent with similar real-world observations in high-volume outpatient echocardiography settings, where workflow efficiency and streamlined imaging protocols were often emphasized (Kimura & DeMaria, 2003).

The ASE recommended 45-60 minutes for optimal comprehensive TTE study. TTE diagnostic yield rely on clear identification of structural and functional abnormalities, additional time is potentially necessary in cases of poor acoustic windows or complex clinical indications, which require extended interrogation and detailed measurements. Hence, adhering to this standard duration is not merely procedural, but essential to ensure diagnostic accuracy and uphold the integrity of echocardiographic practice (McIlwain, 2012).

Our study noted three major determinants of scan duration: technician experience, image quality, and body mass index (BMI). Junior technicians required approximately six additional minutes per scan compared to senior counterparts. This finding highlights the benefits of structured training and continuous skill development programs in echocardiographic practice, such as immediate feedback, hands-on repetition, and integration of theory with practice. Dieden et al. (2019)

Poor image quality was associated with longer TTE scan time, 10 minutes more than those with good scan quality. In such cases, additional time is needed to obtain better image quality and sometimes the use of ultrasound-enhancing agents to achieve diagnostic-quality images. Ellenberger et al. (2022). Obese participants in our study had longer scan time compared to non-obese. Several studies demonstrated the lower image quality in obese population with more time needed for scan and incorporating contrast-enhanced imaging. van Dalen et al. (2025)

Notably, this study found no significant associations between scan duration and either patient age or sex. Given the absence of direct evidence in the current literature linking these demographic variables to echocardiographic exam time, our findings suggest that operational planning should prioritize clinically relevant and technical factors rather than demographic attributes unrelated to procedural complexity.

A large-scale survey study conducted in the United States and Canada revealed that over half of sonographers reported moderate to severe work-related burnout, which was significantly associated with long hours and high workload intensity. Specifically, overtime and fewer breaks per week were linked to increased burnout scores. Moreover, lower job satisfaction and poor health status, including inadequate sleep, further exacerbated this condition (Walsh et al., 2024). These findings indicate that prolonged scan schedules without proper rest periods negatively impact both the well-being of sonographers and the procedural efficiency and image quality. Incorporating structured breaks and caps on daily scan volumes—especially in busy outpatient echo clinics—could help alleviate burnout, improve technician performance, and maintain diagnostic standards.

Sun et al. (2025) from Stanford University introduced a data-driven, discrete-event simulation model that optimizes scheduling of outpatient echocardiograms by accounting for patient no-shows, variable arrival times, and heterogeneous exam durations. Their findings show that maintaining a dynamic reservation buffer—i.e., pre-booked slots specifically held for complex or overrun cases—significantly improves system adaptability. The model demonstrated that allocating just 10–15% of daily slots as flex time reduced average patient wait times by 20% and decreased clinician idle time by 12%, compared to static reservation strategies. These results highlight how intelligent scheduling policies with built-in buffers can effectively balance scan volume, complexity, and resource use in busy echo clinics (Sun et al., 2025).

The categorization of scan durations into short, typical, and prolonged intervals provides meaningful insights into workflow dynamics. Over 50% of the examinations were completed within a 25–35-minute range, suggesting that this window may serve as a practical benchmark for clinical scheduling. Approximately 30% of patients require more than 35 minutes, underscoring the importance of adopting flexible scheduling strategies that consider individual patient characteristics such as BMI and anticipated image quality. Institutions may benefit from proactively identifying such cases to prevent scheduling congestion and minimize technician fatigue.

Limitations: Our study is a single center study with limitations such lack of validity among other populations or other settings. We excluded patients with complex heart diseases which may require prolonged scan times.

Implications for Practice and Policy

Outpatient cardiac centers with high patient throughput should anticipate average transthoracic echocardiographic (TTE) scan durations of approximately 30–35 minutes. Additional time should be allocated for patients with elevated body mass index (BMI) or anticipated suboptimal image quality.

Echocardiography scheduling systems and electronic health records (EHRs) could integrate pre-scan predictors such as BMI and technician experience level to

dynamically adjust appointment time slots and reduce workflow bottlenecks.

Quality improvement efforts may target reducing scan duration variability by implementing structured sonographer training workshops, promoting peer-to-peer feedback, and exploring AI-assisted image acquisition and interpretation.

Future Research

Future studies should explore multicenter data to validate the current findings and examine the influence of additional operational variables, such as room turnover time, reporting systems, and scanner generation. Incorporating time-motion studies and qualitative assessments from technicians may also enhance understanding of workflow barriers and lead to sustainable time-

saving interventions.

CONCLUSION

This study offers empirical insight into the average duration of adult transthoracic echocardiographic (TTE) examinations within an outpatient setting, reporting a mean scan time of approximately 34.6 minutes. Technician experience, image quality, and body mass index (BMI) emerged as the most influential factors contributing to extended scan times.

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