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Original Research Article

MODIFIED COMPUTED TOMOGRAPHY SEVERITY INDEX FOR EVALUATION OF PATIENT WITH ACUTE PANCREATITIS IN MANIPUR

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ABSTRACT

Background: Early and precise severity stratification is essential for guiding optimal clinical management, including decisions regarding intensive care admission, nutritional support, and surgical or endoscopic interventions for Acute pancreatitis (AP). The Modified Computed Tomography Severity Index (MCTSI) was introduced to improve prognostication in AP by incorporating additional criteria such as extra-pancreatic complications, which are often pivotal in determining patient outcomes. The local burden of severe AP in Manipur is not well documented, necessitating focused research to assess its impact and improve patient outcomes. Study aimed to evaluate the predictive accuracy of MCTSI in assessing acute pancreatitis severity in Manipur, a region with unique epidemiological characteristics. clinical outcomes of patients, including length of hospital stay, ICU admission, organ failure, infection, need for interventions and mortality and to correlate the MCTSI scores with clinical outcomes to evaluate its prognostic and management utility. **Materials and Methods:** A hospital-based prospective observational study was conducted in the Department of Radiodiagnosis. JNIMS, Manipur during the period June 2023 - May 2024 among 104 patients diagnosed with pancreatitis referred for CECT Scan. Pregnant patients, patients with renal impairment or known hypersensitivity to contrast media were excluded. Detailed findings were recorded by using a proforma. The form had sections on demographic details, clinical presentation, laboratory findings, CECT scan findings and MCTSI score and hospital course and outcomes. Participants were followed up for a maximum of 30 days for clinical progression, need for ICU admissions, interventions and mortality. **Result:** Based on the MCTSI grading, 24 patients (23.1%) had mild pancreatitis, 60 (57.7%) had moderate pancreatitis, and 20 (19.2%) had severe pancreatitis. Alcohol consumption was the most common associated condition in acute pancreatitis (58; 55.7%), with a strong male predominance (56 out of 58 cases). Gallstones, the second most common associated condition (39.4%), were predominantly observed in females (32 out of 41 cases. On radio-imaging, intrinsic pancreatic abnormalities with or without inflammatory changes in peripancreatic fat were observed in 45 cases (43.27%), while pancreatic or peripancreatic fluid collection or peripancreatic fat necrosis were the most common finding, occurring in 59 cases (56.7%). Pancreatic Necrosis Scoring (MCTSI) showed pancreatic necrosis in varying degrees. There was strong and statistically significant association between MCTSI score and extent of necrosis (p-value=7.99×10^{-17}). Regarding extra-pancreatic complications seen, in 60 (57.7%) patients, pleural effusion was observed, 20 (19.2%) had ascites. Regarding the outcome, while no deaths occurred among mild cases, 02 deaths occurred among moderate cases while 04 deaths happened among severe cases (p=0.0083). Infection was present in 8.33% of mild cases (2/24), 15% of moderate cases (9/60) and in 55% of severe cases (11/20), demonstrating a clear increase with higher MCTSI scores. There is strong and statistically significant association between MCTSI severity and both infection (p-value = 0.00017). The mean duration of hospitalization escalated in tandem with the severity of acute pancreatitis: mild cases had an average stay of 3.8 days, for moderate cases extended up-to 7.28 days, and

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severe cases reached 12.65 days (p-value< 0.005). Employing persistent organ failure lasting beyond 48 hours as the definitive criterion for diagnosing acute pancreatitis, the MCTSI demonstrated remarkable diagnostic performance. The sensitivity was recorded at 76.2%, while specificity reached 95.2% in identifying severe cases. Furthermore, the analysis yielded a PPV of 80.0% and a NPV of 94.0%. AUC was calculated at 85.7%, with an exceptionally significant p-value of 1.21×10^{-12}, confirming the robustness of the findings. **Conclusion:** MCTSI serves as a reliable and efficient instrument for evaluating the severity of acute pancreatitis and forecasting clinical outcomes among the population of Manipur. MCTSI demonstrated robust associations with various clinical indicators, including ICU admissions, organ dysfunction, infectious complications, length of hospitalization and the necessity for medical interventions.

INTRODUCTION

Acute pancreatitis (AP) is a prevalent condition marked by a widespread inflammatory response in the pancreas, resulting from the leakage and extravasation of activated pancreatic enzymes. This condition causes a variety of local and systemic pathophysiological changes, leading to significant differences in clinical presentation and prognosis.[1] It is one of the most common causes of hospitalization for gastrointestinal disorders, with a global incidence ranging from 13 to 45 cases per 100,000 individuals annually.[2]

Early and precise severity stratification is essential for guiding optimal clinical management, including decisions regarding intensive care admission, nutritional support, and surgical or endoscopic interventions.[3,4] Conventional severity scoring systems, such as Ranson's criteria and the Acute Physiology and Chronic Health Evaluation (APACHE II) score, have been widely utilized to assess the severity of AP. Nevertheless, these systems depend on various biochemical and clinical parameters that may take time to fully develop. Imaging techniques, particularly computed tomography (CT), play a crucial role in both diagnosing AP and assessing its severity. Contrast-enhanced computed tomography (CECT) is the gold standard for evaluating AP severity and identifying complications such as pancreatic necrosis, abscess and pseudocysts. The Balthazar Computed Tomography Severity Index (CTSI) is widely used to classify AP severity based on pancreatic and peripancreatic changes. However, due to its limited ability to predict mortality and clinical outcomes, modifications have been made to improve its scoring system.[5] The Modified Computed Tomography Severity Index (MCTSI) was introduced by Mortele KJ et al in 2004 to improve prognostication in AP by incorporating additional criteria such as extra-pancreatic complications, which are often pivotal in determining patient outcomes.[6] MCTSI enhances the original CTSI by incorporating a scoring system based on pancreatic inflammation, pancreatic necrosis, and extra-pancreatic complications such as ascites, pleural effusion, parenchymal abnormalities and vascular complications. Several studies have shown that the MCTSI correlates more accurately with clinical severity, organ failure, need for intervention, and mortality risk compared to the original CTSI.[7]

In severe AP, pancreatic necrosis often occurs within the first 72 hours, significantly increasing the risk of secondary infections and mortality. Early detection of necrotizing pancreatitis is essential for optimizing therapeutic interventions, including antibiotics, percutaneous drainage, and, in some cases, surgical necrosectomy.[8] The revised Atlanta Classification classifies acute AP into mild, moderately severe and severe forms, depending on the presence of local or systemic complications and persistent organ failure. Patients with pancreatic necrosis, infected necrosis, or sustained organ dysfunction are categorized as having severe AP, which carries a mortality rate exceeding 30%.[8] Several imaging-based prognostic markers have been proposed to refine severity assessment, including pancreatic perfusion deficits, extra-pancreatic inflammatory spread, and changes in pancreatic attenuation patterns on CT scans. The MCTSI has emerged as a superior alternative to the original CTSI due to its incorporation of extra-pancreatic complications, which are frequently associated with severe outcomes. A systematic review comparing CTSI and MCTSI demonstrated that the modified scoring system had higher sensitivity and specificity in predicting the need for intensive care unit (ICU) admission and mortality.[9]

Regional differences in the epidemiology and severity of AP have been observed worldwide. In India, the prevalence of gallstone-induced AP is higher in the northern regions, where it accounts for approximately 59% of cases. In contrast, alcohol-related AP is more frequently observed in the southern and northeastern states, contributing to 39.3% of cases.[10,11]

The local burden of severe AP in Manipur is not well documented, necessitating focused research to assess its impact and improve patient outcomes. Despite advances in severity scoring and imaging, there remain challenges in early and accurate risk stratification in AP. The current study aimed to evaluate the predictive accuracy of MCTSI in assessing acute pancreatitis severity in Manipur, a region with unique epidemiological characteristics.

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Aim & Objectives

The present study was done assess the role of the MCTSI in evaluating the severity of acute pancreatitis, aiding in clinical management, and predicting patient prognosis in Manipur. The specific objectives were (1) To assess the MCTSI in patients with AP (2) To assess the clinical outcomes of patients, including length of hospital stay, ICU admission, organ failure, infection, need for interventions and mortality and (3) To correlate the MCTSI scores with clinical outcomes to evaluate its prognostic and management utility.

MATERIALS AND METHODS

A hospital-based prospective observational study was conducted in the Department of Radiodiagnosis. Jawaharlal Nehru Institute of Medical Sciences, Imphal, Manipur during the period from June 2023 to May 2024 among patients diagnosed with pancreatitis (clinically or biochemically) and referred to Radiodiagnosis dept., JNIMS for CECT Scan. Only willing adult patients diagnosed with acute pancreatitis based on clinical, laboratory and imaging findings with no history of chronic pancreatitis or pancreatic malignancy and who underwent CECT between 3-7 days of symptom onset were included. Pregnant patients, patients with renal impairment or known hypersensitivity to contrast media were excluded.

A sample size of 100 was calculated by considering a 95% significance level, a sensitivity of 93% from a previous study,[12] and a precision error of 5%. Purposive sampling technique was employed to recruit the eligible participants.

After enrolment, detailed findings were recorded by using a pre-tested case proforma form. The form had sections on demographic details, clinical presentation, laboratory findings, CECT scan findings and MCTSI score and hospital course and outcomes. CECT scan was done by using GE Healthcare 50 Revolution ACT CT scanner, model 5858588-2, China by taking due precautions as per hospital standards.

Then, participants were followed up for a maximum of 30 days for clinical progression, need for ICU admissions, interventions and mortality.

The study parameters were (1) Clinical parameters (etiology & symptoms at presentation) (2) Imaging parameters (pancreatic & peri-pancreatic inflammation, extent of pancreatic necrosis and presence of extra-pancreatic complications) and (3) Outcome parameters (length of hospital stay, ICU admission rate, persistent organ failure > 48 hours, infections, need for surgical interventions and mortality within 30 days).

Collected data were entered into a MS Excel spreadsheet and then analyzed using SPSS (version 26.0; SPSS Inc., Chicago, IL, USA). Descriptive statistics, including mean, SD and frequency distribution were used to summarize demographic data and MCTSI score distribution.

For hypothesis testing, two-sample t-tests were conducted to compare means between independent groups, while paired t-tests were used when samples were dependent, offering greater statistical power. A χ^2 test was used to evaluate associations between categorical variables, such as MCTSI severity and clinical outcomes (hospital stay, ICU admission, and mortality).

To assess relationships between MCTSI scores and continuous variables, a Pearson correlation test was performed. Additionally, an ANOVA test was employed to analyze continuous variables, such as length of hospital stay across severity groups, to determine significant differences among them. A p-value <0.05 was considered statistically significant, allowing rejection of the null hypothesis in favor of the alternative hypothesis when applicable.

The study adhered to the principles outlined in the Declaration of Helsinki and received approval from the Institutional Ethics Committee (IEC) of JNIMS, Imphal. The ethical considerations taken into account included obtaining written informed consent, privacy during data collection, maintaining data confidentiality and not using any identifiers.

RESULTS

The study population comprised of 104 patients diagnosed with acute pancreatitis. The largest proportion of patients (30.8%) belonged to the 30-40 age group, followed by 26.9% in the 40-50 age group, 24% in the 50-60 age group, and 8.7% in the 20-30 age group. Their mean (SD) age was 42.77 (11.62) years. Males predominated in the group (67; 64.4%). Based on the MCTSI grading, approximately 24 patients (23.1%) had mild pancreatitis, 60 (57.7%) had moderate pancreatitis, and 20 (19.2%) had severe pancreatitis.

Alcohol consumption was the most common associated condition in acute pancreatitis (58; 55.7%), with a strong male predominance (56 out of 58 cases). Gallstones, the second most common associated condition (39.4%), were predominantly observed in females (32 out of 41 cases. Three patients had both cholelithiasis and history of alcohol intake. Other less common associated conditions include idiopathic cases (2.88%), drug-induced (1.92%), autoimmune (1.92%), and hyperlipidemia-related pancreatitis (0.96%), with no significant gender differences. These findings suggest that, alcohol abuse is a major contributing condition in males, while gallstone disease is the leading associated condition in females with acute pancreatitis [Table 1].

On radio-imaging, intrinsic pancreatic abnormalities with or without inflammatory changes in peripancreatic fat were observed in 45 cases (43.27%), while pancreatic or peripancreatic fluid collection or peripancreatic fat necrosis were the

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most common finding, occurring in 59 cases (56.7%). This distribution highlights that inflammatory changes and fluid collections are prominent features in the studied population, with no instances of a completely normal pancreas.

Pancreatic Necrosis Scoring (Modified CTSI) showed pancreatic necrosis in varying degrees. There was strong and statistically significant association between MCTSI score and extent of necrosis (p-value=7.99×10^{-17}). Notably, no cases of necrosis were observed in the mild category, while 5 cases (8.3%) with <30% necrosis appeared in the moderate category. In the severe category, 13 cases (65%) had <30% necrosis, and 7 cases (35%) had >30% necrosis. This pattern highlights a clear trend where the severity of the MCTSI score is strongly linked to the presence and extent of pancreatic necrosis [Table 2].

Table 1: Associated conditions

Associated condition	Male	Female	Frequency (%)
Alcohol Consumption	56	2	58 (55.7)
Gallstones	9	32	41 (39.4)
Idiopathic	2	1	3 (2.88)
Drug-induced	1	1	2 (1.92)
Autoimmune	1	1	2 (1.92)
Hyperlipidaemia	0	1	1

Table 2: Pancreatic Necrosis Scoring (Modified CTSI)

MCTSI Score	No Necrosis	<30% Necrosis	>30% Necrosis	Total
Mild (n=24)	24	0 (0%)	0 (0%)	24
Moderate (n=60)	55	5 (8.3%)	0(0%)	60
Severe (n=20)	0	13 (65%)	7(35%)	20
Total	79	18 (17.3%)	7 (6.73%)	104

p-value=7.99×10^{-17}

Regarding extra-pancreatic complications seen, in 60 (57.7%) patients, pleural effusion was observed, 20 (19.2%) had ascites. Gastro-intestinal involvement, vascular complications and parenchymal complications were seen in 03, 02 and 01 patients, respectively. This distribution highlights pleural effusion as the predominant complication, whereas parenchymal complications were the least encountered.

Regarding the outcome, while no deaths occurred among mild cases, 02 deaths occurred among moderate cases while 04 deaths happened among severe cases. With the updated group sizes (Mild = 24, Moderate = 60, Severe = 20), the p-value of 0.0083 confirms a strong association between MCTSI severity and mortality. Infection was present in 8.33% of mild cases (2/24), 15% of moderate cases (9/60) and in 55% of severe cases (11/20), demonstrating a clear increase with higher MCTSI scores. There is strong and statistically significant association between MCTSI severity and both infection (p-value = 0.00017). Mortality was absent in mild cases, occurred in 11.1% of moderate cases (1/9), and rose dramatically to 45.5% in severe cases (5/11) [Table 3].

Table 3: Correlation of MCTSI with mortality

MCTSI and mortality			
MCTSI Score	**Deceased**	**Recovered**	**P value**
Mild (n=24)	0	24	0.0083
Moderate (n=60)	2	58	x2 value: 9.57, df: 2
Severe (n=20)	4	16	
MCTSI and infection			
MCTSI Score	**Infection (%)**	**Mortality in infection**	**P value**
Mild (n=24)	2 (8.33%)	0	0.00016
Moderate (n=60)	9 (15%)	1 (11.1%)	x2 value: 16.8, df: 2
Severe (n=20)	11 (55%)	5 (45.5%)	

The mean duration of hospitalization escalated in tandem with the severity of acute pancreatitis: mild cases had an average stay of 3.8 days, for moderate cases extended up-to 7.28 days, and severe cases reached 12.65 days. The p-value (< 0.005) signifies a statistically meaningful association between the severity assessed by MCTSI and the length of hospital stay. In terms of length of hospital stay >7 days. patients with mild MCTSI scores had the lowest likelihood (8.3%) of prolonged hospitalization, while those with moderate and severe scores had 40% and 90% had prolonged stays, respectively. The extremely low p-value (<0.005) confirms that higher MCTSI scores strongly predict longer hospital stays, emphasizing its clinical value in risk stratification and resource allocation [Table 4].

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Table 4: Length of Hospital Stay Based on MCTSI

MCTSI Score	Average Length of Stay (days)	P value
Mild (n=24)	3.8	Pearson's r: 0.692, p-value: 4.22×10^{-16}, X2 value: 90.94
Moderate (n=60)	7.28	
Severe (n=20)	12.65	
Length of hospital stay >7 days		
MCTSI Score	**Frequency (%)**	**P value**
Mild (n=24)	2 (8.3%)	X2 value- 30.12, and the p-value: 2.88×10^{-7}
Moderate (n=60)	24 (40%)	
Severe (n=20)	18 (90%)	

Surgical intervention was required in none of the mild cases, approximately 1.7% of moderate cases (1 out of 60), and about 40% of severe cases (8 out of 20). This difference was found to be statistically significant (p-value of 1.01 x 10-7), indicating an association between higher MCTSI scores and the need for surgery.

No organ failure was observed in mild cases, while moderate cases had a low incidence (8.33%), with 02 respiratory, 01 cardiovascular, and 02 renal failures. In contrast, severe cases showed a dramatically higher incidence (80%), with 05 respiratory, 06 cardiovascular, and 05 renal failures. The p-value of 8.03 X 10-13confirms a significant association between MCTSI severity and organ failure. This association highlights the prognostic value of MCTSI in predicting organ failure risk.

No patients in the mild category required ICU care. In the moderate group, 07 out of 60 patients (11.67%) required ICU admission, while in the severe group, ICU admission was significantly higher, with 14 out of 20 patients (70%) needing intensive care. There was strong and statistically significant association between MCTSI score and the need for ICU admission (p-value = 2.56×10^{-9}, $\chi^2 = 39.57$, df = 2). This clear trend indicates that patients with higher MCTSI scores are at a significantly greater risk of requiring ICU admission, reinforcing the predictive value of MCTSI in identifying patients at risk of severe clinical outcomes.

Table 5: Sensitivity and Specificity of MCTSI in Predicting Severe Pancreatitis

Test	Severe AP (persistent organ failure >48 hours)	Non-severe AP	Total
Predicted Severe AP (MCTSI)	16	4	20
Predicted non-severe AP (MCTSI)	5	79	84
	21	83	104

Employing persistent organ failure lasting beyond 48 hours as the definitive criterion for diagnosing acute pancreatitis, the MCTSI demonstrated remarkable diagnostic performance. The sensitivity was recorded at 76.2%, while specificity reached 95.2% in identifying severe cases. Furthermore, the analysis yielded a Positive Predictive Value of 80.0% and a Negative Predictive Value of 94.0% (Table 5). The Area Under the Curve (AUC) was calculated at 85.7%, with an exceptionally significant p-value of 1.21×10^{-12}, confirming the robustness of the findings.

DISCUSSION

MCTSI exhibited a robust association with clinical outcomes in individuals suffering from acute pancreatitis. The results indicated that elevated MCTSI scores were significantly linked to heightened complication rates, prolonged hospitalization exceeding 7 days, increased frequency of ICU admissions, organ dysfunction, infections, and elevated mortality rates.

Alcohol consumption was identified as the most frequently associated condition in acute pancreatitis, accounting for 57.69% of cases, with a strong male predominance, highlighting the significant role of alcohol abuse in the disease. Gallstones, the second most common associated condition (39.4%), were predominantly observed in females. Furthermore, male predominance was evident in clinically suspected acute pancreatitis cases, representing approximately 64.4%, while females constitute the remaining 35.6%. This trend may be attributed to the higher prevalence of alcohol consumption among males.

A strong association between MCTSI severity and infection rates was observed. Mortality rate was seen significantly higher with high MCTSI score. The progressive increase in infection rates with higher MCTSI scores underscores the importance of early recognition and prompt management of patients at greater risk of infectious complications.

Moreover, ICU admissions were significantly higher in the severe MCTSI group (70%) compared to the other groups, reinforcing the predictive value of MCTSI in identifying patients requiring intensive care. The remarkable difference in ICU admission rates between severity groups highlights the index's ability to stratify patients effectively and optimize the allocation of critical care resources. Given the substantial healthcare burden associated with ICU admissions, early identification of patients likely to deteriorate is essential for implementing appropriate monitoring and intervention strategies.

Pancreatic necrosis exhibited a pronounced association with the severity measured by MCTSI affirming a clear relationship between escalating MCTSI scores and the extent of pancreatic necrosis.

The incidence of organ failure was also notably higher among patients with severe MCTSI scores.

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The development of organ failure in acute pancreatitis is a critical prognostic marker, as it significantly increases morbidity and mortality rates. The ability of MCTSI to predict this outcome enhances its clinical relevance and supports its integration into routine practice for risk stratification. Higher MCTSI scores correlated with an increased need for surgical intervention in acute pancreatitis, confirming that, MCTSI as a reliable predictor of surgical intervention needs. The analysis further highlighted that pleural effusion was the most common extra-pancreatic complication (60 cases), followed by ascites (20 cases), while gastrointestinal and vascular complications were less frequent. This pattern emphasizes the importance of recognizing extra-pancreatic complications when evaluating disease severity.

Regarding diagnostic precision, MCTSI exhibited a sensitivity of 76.2% and a specificity of 95.2% in forecasting severe pancreatitis. The PPV reached 80%, while the NPV was calculated at 94%. Additionally, the AUC was recorded at 85.7%, highlighting the robust predictive capability of MCTSI. These values highlight the strong discriminatory ability of MCTSI in identifying severe AP cases and guiding appropriate management strategies. These sensitivity and specificity values are comparable to those reported by Mortele et al. (2004), who documented a sensitivity of 79% and specificity of 92%.[6] Similarly, studies by Jain et al. (2018) and Banday et al. (2015) reported sensitivities ranging between 75-80% and specificities exceeding 90%, further reinforcing the reliability of MCTSI in predicting severe pancreatitis outcomes.[13]

The duration of hospital stays also correlated with MCTSI scores. These observations align with previous studies, including those by Mortele et al. (2004) and Apisarnthanark et al. (2022), which similarly documented longer hospital stays in patients with severe MCTSI scores.[6,14]

These results align with the findings reported by Mortele et al. (2004), who introduced the MCTSI as an enhanced variant of the original CTSI, highlighting its superior capability to predict severe acute pancreatitis cases, prolonged hospitalization, and the necessity for medical interventions.[6] Comparable outcomes were documented in studies conducted by Jain et al. (2018) and Banday et al. (2015), both of which validated the heightened sensitivity of MCTSI in forecasting severe AP progression.[13,15] Additionally, research by Delgado et al. (2019) and Liao et al. (2022) underscored the significant correlation between MCTSI scores and intensive care unit (ICU) admissions, as well as extra-pancreatic complications, further reinforcing its clinical utility and prognostic value.

In our investigation, the occurrence of pancreatic necrosis and systemic complications followed a pattern consistent with findings reported by Alberti et al. (2020) and Apisarmthanark et al,[14,16] (2022). Both studies demonstrated a significant association between elevated MCTSI scores, heightened mortality risk, and the requirement for surgical interventions. These parallels further substantiate the prognostic efficacy of MCTSI in accurately assessing the severity of acute pancreatitis (AP) cases.

This study has some limitations, including its single-centred design, which may limit the generalizability of findings to broader populations with different demographic and etiological patterns of acute pancreatitis. Additionally, the small sample size may not fully capture the full spectrum of disease severity, potentially affecting statistical power. Furthermore, the exclusion of patients with renal impairment and pregnant women may introduce selection bias, reducing the ability to generalize the results to the entire acute pancreatitis population.

CONCLUSION

This research finding establishes that, the Modified Computed Tomography Severity Index serves as a reliable and efficient instrument for evaluating the severity of acute pancreatitis and forecasting clinical outcomes among the population of Manipur. MCTSI demonstrated robust associations with various clinical indicators, including intensive care unit (ICU) admissions, organ dysfunction, infectious complications, length of hospitalization, and the necessity for medical interventions. These correlations underscore its practical value in guiding clinical decision-making.

Given the strong correlation between MCTSI scores and key clinical outcomes, this tool provides a valuable framework for early risk stratification, guiding appropriate interventions, and improving patient management. Future research should involve larger, multicentric studies to further confirm these findings and expand MCTSI's applicability in diverse populations.

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