IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 25, Issue 7 Ser. 4 (July. 2026), PP 39-44
www.iosrjournals.org

Predicting Outcome In Perforation Peritonitis: A Prospective Comparative Evaluation Of The Mannheim Peritonitis Index And Apache Ii Scoring Systems

Author

Abstract
Background: *Perforation peritonitis is a high-stakes, life-threatening surgical emergency requiring rapid clinical evaluation. This prospective study was designed to compare the precise prognostic value and clinical tracking capability of the disease-specific Mannheim Peritonitis Index (MPI) against the physiology-based Acute Physiology and Chronic Health Evaluation II (APACHE II) score in secondary hollow viscus perforation peritonitis scenarios.*
Materials & Methods: *A single-center prospective observational tracking paradigm evaluated 50 consecutive adult patients undergoing emergent exploratory laparotomy for secondary generalized peritonitis over a designated longitudinal operational window from November 2023 to August 2025 at a public tertiary teaching healthcare center in Nagpur, Maharashtra. Prognostic discrimination profiles and overall predictive cutoff boundaries were mapped out mathematically utilizing formal Receiver Operating Characteristic (ROC) curve metrics.*
Results: *Gastric perforations comprised the primary structural presentation (36%), displaying a stark 76% male dominance across the cohort, alongside a cumulative index group mortality rate of 18%. An optimal ROC-derived MPI evaluation cutoff of 21 yielded a sensitivity of 88.89% and a specificity of 85.37% (AUC = 0.889). Concurrently, an optimal baseline APACHE II cutoff threshold of 15 generated a sensitivity of 77.78% and a high specificity of 97.56% (AUC = 0.955), tracking a superior overall predictive diagnostic accuracy of 94% versus 86% recorded for the alternative MPI model. Elevated risk parameters across both systems displayed strong statistically significant correlations ($p < 0.05$) with extensive postoperative wound infection tracks and complex fascial dehiscence complications.*
Conclusions: *Both structural metrics deliver reliable diagnostic guidance for secondary peritonitis cohorts. The comprehensive multi-parameter APACHE II configuration secures marginally stronger overall precision and predictive specificity markers for in-hospital mortality triage, whereas the rapid, non-resource-dependent calculation matrix of the MPI makes it exceptionally practical for instantaneous, bedside clinical stratification inside low-resource emergency operating settings.*
Keywords: *Perforation peritonitis, Mannheim Peritonitis Index, APACHE II score, Receiver Operating Characteristic, Prognostic risk stratification, Surgical morbidity.*

Date of Submission: 16-07-2026 Date of Acceptance: 26-07-2026

I. Introduction

Burden of Secondary Peritonitis

Perforation peritonitis, defined as full-thickness perforation of the gastrointestinal hollow viscus resulting in contamination of the sterile peritoneal space, represents one of the most frequently encountered emergency surgical scenarios globally. It accounts for approximately 1% of all urgent general surgical admissions and stands as the second leading etiology for severe sepsis within intensive care settings. In developing regions, the epidemiological spectrum shifts toward upper gastrointestinal and ileal perforations, which are strongly linked to acid peptic disease, infectious typhoid enteritis, and endemic tuberculosis. Despite improvements in emergency resuscitation protocols, broad-spectrum antimicrobial regimens, and intensive care interventions, secondary peritonitis continues to carry a considerable clinical burden, with overall mortality rates surging past 30% in individuals who progress to multi-organ dysfunction syndrome or profound septic shock.

Clinical Gap in Prognostic Stratification

The variable clinical presentation and progression of peritonitis demand accurate, prompt prognostic tools to safely differentiate low-risk patients from individuals requiring aggressive physiological optimization and post-surgical critical care management. Although multiple localized or physiological scoring metrics have been introduced, establishing an institutional paradigm that balances precision with ease of use is a persistent challenge. The Mannheim Peritonitis Index (MPI), conceived as a disease-specific intraoperative tool, relies

heavily on easily captured clinical indices and procedural observations. In contrast, the Acute Physiology and Chronic Health Evaluation II (APACHE II) score is a multi-parameter physiologic model that incorporates 12 acute biochemical and clinical parameters to capture full systemic health profiles. There remains a relative scarcity of robust prospective data directly comparing these two distinct frameworks in uniform secondary perforation cohorts within public healthcare networks. This study addresses this clinical gap by defining the sensitivity, specificity, and overall diagnostic accuracy of both systems under identical clinical constraints.

II. Materials & Methods

Study Design and Timeline

This study was structured as a single-center, prospective observational tracking trial at a major public tertiary health referral teaching hospital in Nagpur, Maharashtra. The clinical protocol spanned an active tracking timeline from November 1, 2023, to August 10, 2025. Institutional ethical clearances were formally secured prior to initiation, and written informed consent was systematically completed by all participating patients or their immediate legal representatives before surgical deployment.

Patient Selection and Criteria

The sample architecture comprised a fixed cohort of 50 consecutive patients who explicitly satisfied the structural enrollment criteria. Inclusion parameters encompassed all individuals, across all adult age groups, diagnosed with secondary generalized peritonitis secondary to hollow viscus rupture who were directly admitted via the emergency department and subsequently assigned to emergent laparotomy. Conversely, patients presenting with primary bacterial peritonitis, peritonitis directly linked to ongoing continuous ambulatory peritoneal dialysis (CAPD), acute necrotizing pancreatitis, or peritonitis resulting from blunt or penetrating abdominal trauma were strictly excluded from evaluation.

Clinical and Operative Protocol

At initial emergency admission, all patients underwent a standardized preoperative evaluation consisting of detailed clinical history, physical assessment, and point-of-care laboratory panels to compute baseline APACHE II scores within the initial 24 hours. The clinical workflow included complete blood counts, serum electrolytes, renal function tests, and arterial blood gas analyses. Radiographic diagnostics, such as erect abdominal films and contrast-enhanced computed tomography (CECT), were deployed based on hemodynamic stability. Emergency surgical interventions were executed via standard midline vertical exploratory laparotomies. Intraoperative findings—including exact anatomical perforation coordinates, linear dimensions, and visual characteristics of the peritoneal exudate (clear, purulent, or feculent)—were meticulously logged to formulate the MPI score matrix. Therapeutic interventions included primary suture closure, omental patch buttressing (Graham's patch), or segmental bowel resection coupled with stoma creation or primary anastomosis, followed by standard warm saline lavage and closed-suction drainage. Postoperatively, patients received uniform broad-spectrum antimicrobial cover (intravenous Ceftriaxone and Metronidazole) and were closely monitored for localized or systemic complications through a 3-month formal follow-up interval.

Statistical Evaluation

Statistical analyses were compiled utilizing standard software packages. Continuous baseline datasets were expressed as mean value vectors supplemented by standard deviations (±SD), whereas categorical representations were converted to raw frequencies and percentages. Univariate correlations between high-risk scoring classifications and actual endpoints (in-hospital death or discharge) were evaluated via Chi-square filters and Fisher's exact tests. Diagnostic performance matrices, including sensitivity, specificity, positive predictive values (PPV), and negative predictive values (NPV), were calculated using Receiver Operating Characteristic (ROC) curves, and the aggregate discriminatory value was expressed as the Area Under the Curve (AUC).

III. Results

The baseline cohort comprised 50 active patients, demonstrating a distinct male preponderance with 38 male individuals (76%) and 12 female individuals (24%). The overall mean age vector was logged at 43.14 ± 12.83 years, spanning an absolute range from 18 to 72 years, with peak frequency distributed within the 46–55 years demographic band. Topographical mapping identified gastric perforations as the primary pathology (36%), followed by appendicular (22%), duodenal (16%), and ileal (14%) pathology. The cumulative mortality track across the entire study sample was 18% (9 deaths out of 50 patients), with large-bowel colonic ruptures demonstrating the highest site-specific fatality rate (100%), followed by ileal (28.6%), duodenal (12.5%), and gastric (11.1%) perforations.

Table 1: Cohort Demographics, Anatomical Perforation Sites, and Site-Specific Mortality Distribution (N=50)

Clinical Parameter / Site	Male (n)	Female (n)	Total (N)	Deaths (n)	Mortality (%)
Gastric	16	2	18 (36%)	2	11.1%
Appendicular	6	5	11 (22%)	0	0.0%
Duodenal	6	2	8 (16%)	1	12.5%
Ileal	6	1	7 (14%)	2	28.6%
Colonic	3	1	4 (8%)	4	100.0%
Gall Bladder	0	1	1 (2%)	0	0.0%
Jejunal	1	0	1 (2%)	0	0.0%

Risk stratification utilizing the MPI scoring system allocated 52% of the study population to the low-risk tier (≤ 15), 34% to the moderate-risk range (16–26), and 14% to the high-risk group (≥ 27). No mortalities occurred in patients presenting with an MPI score ≤ 15. In contrast, patients categorized into the high-risk MPI band (≥ 27) demonstrated a mortality rate of 57.1% ($p = 0.000044$). For the APACHE II model, 34% scored in the lowest physiologic range (≤ 5), 52% occupied the moderate band (6–15), and 14% presented with high scores (≥ 16). All fatalities were clustered at the higher end of the spectrum, with patients scoring ≥ 16 tracking an 87.5% mortality rate ($p = 0.000003$).

Table 2: Comparative Performance Metrics of MPI and APACHE II Scoring Systems in Predicting In-Hospital Mortality

Scoring System	Cutoff	Sens (%)	Spec (%)	PPV (%)	NPV (%)	Accuracy (%)	ROC-AUC
Mannheim Peritonitis Index	≥ 21	88.89%	85.37%	57.14%	97.22%	86.0%	0.889
APACHE II Score	≥ 15	77.78%	97.56%	87.50%	95.24%	94.0%	0.955

Postoperative morbidity evaluation established strong correlations between elevated risk scores and severe surgical complications. An MPI score ≥ 21 was significantly associated with a 64.3% incidence of wound infection ($p = 0.000$), a 42.9% rate of fascial dehiscence ($p = 0.001$), and a 21.4% rate of unplanned surgical re-operation ($p = 0.019$). Similarly, an APACHE II score ≥ 15 correlated with an 87.5% wound infection rate ($p = 0.000$) and an 87.5% incidence of absolute wound dehiscence ($p = 0.000$), serving as a clear indicator of localized tissue failure and prolonged ICU status.

Table 3: Postoperative Morbidity Profiles Stratified by Risk Thresholds of MPI and APACHE II Scoring Frameworks

Surgical Complication	MPI ≥ 21 (n=14)	MPI < 21 (n=36)	p-value	APACHE II ≥ 15 (n=8)	APACHE II < 15 (n=42)	p-value
Wound Infection	9 (64.3%)	1 (2.8%)	0.000	7 (87.5%)	3 (7.1%)	0.000
Wound Dehiscence	6 (42.9%)	1 (2.8%)	0.001	7 (87.5%)	0 (0.0%)	0.000
Re-operation Rate	3 (21.4%)	0 (0.0%)	0.019	1 (12.5%)	2 (4.8%)	0.414
Anastomotic Leak	2 (14.3%)	0 (0.0%)	0.074	1 (12.5%)	1 (2.4%)	0.297

IV. Discussion

Objective risk stratification in secondary peritonitis is an essential cornerstone of clinical triage, guiding surgical decision-making and postoperative resource management. The findings from this prospective observational study confirm that both the Mannheim Peritonitis Index and the APACHE II scoring models are reliable tools for predicting mortality and major postoperative morbidity. However, their structural differences result in distinct variations in performance when applied to emergency settings.

In this study, setting an optimal diagnostic threshold for the MPI at ≥ 21 yielded a sensitivity of 88.89% and a specificity of 85.37%, with an aggregate area under the ROC curve (AUC) of 0.889. This profile aligns closely with the landmark multi-center European validation study conducted by Billing et al. (1994), which tracked 2,003 cases and demonstrated an identical baseline accuracy threshold. Although Billing et al. utilized a score of 26 to categorize high-risk patient bands, the mortality risk gradient observed across our cohort confirms their findings: lower-tier scores track low mortality rates, whereas scores in the moderate-to-high tiers match steeply rising mortality rates. Compared to other regional evaluations, such as the retrospective tracking by Makkar et al. (2016) in Amritsar, which reported 100% specific rule-out capacity when utilizing a cutoff of 27,

our lower threshold of 21 maintained high sensitivity while safely capturing emerging systemic infectious insults early in the disease process.

Evaluating the physiologic parameters of the APACHE II protocol using an optimal threshold of ≥ 15 revealed a sensitivity of 77.78% and an exceptional specificity of 97.56%, yielding an overall diagnostic accuracy of 94.0%. The ROC analysis generated an outstanding AUC vector of 0.955. This high precision is consistent with the findings of Kumar P et al. (2017), who reported that the comprehensive, physiology-driven metrics of the APACHE II system outperformed localized disease indices in identifying critical physiological decline. Similarly, Kulkarni et al. (2007) reported near-perfect discrimination (AUC = 0.984) in a 50-patient cohort in Bangalore, observing a clear separation where scores above 15 were associated with high mortality risk. Furthermore, our findings are supported by the large-scale series from Nair et al. (2022) in Kerala, which demonstrated that an APACHE II score above 15 carried a 99% sensitivity and 94.4% specificity for predicting peritonitis-related mortality.

A primary difference between these scoring models lies in how they integrate specific health parameters. The MPI incorporates localized intraoperative criteria, such as the origin of sepsis and the macroscopic nature of the peritoneal exudate. It proved highly sensitive for predicting direct local tissue failure, correlating strongly with postoperative wound infection ($p = 0.000$) and fascial dehiscence ($p = 0.001$). On the other hand, the APACHE II matrix captures acute multi-organ physiology, including components like arterial pH, respiratory mechanics, and neurological function via the Glasgow Coma Scale. This system effectively registers severe, systemic physiological derangement, explaining its superior specificity and positive predictive value for mortality. This distinction is highly relevant: while a low MPI score reliably predicts survival, a high APACHE II score is a strong indicator of impending systemic failure, highlighting the need for aggressive central venous fluid resuscitation, inotropic support, and immediate intensive care optimization.

Translating these statistical findings into clinical practice provides a clear model for emergency surgical care. The choice of scoring system can be tailored to institutional resources and the immediate clinical context. In resource-limited centers or high-volume emergency rooms lacking rapid point-of-care biochemical panels, the MPI is a highly practical option. It requires only standard clinical data and intraoperative observations, allowing surgeons to risk-stratify patients directly at the first laparotomy. In contrast, in tertiary centers with advanced laboratory and critical care infrastructure, the APACHE II score provides a precise model for tracking real-time physiological decline. This capability allows for targeted decisions regarding open-abdomen management, planned re-laparotomies, or prolonged postoperative mechanical ventilation. Ultimately, utilizing these diagnostic scoring frameworks helps clinicians move past subjective assessments, improving triage efficiency and helping to lower the mortality burden of secondary peritonitis.

V. Conclusions

This prospective comparative evaluation confirms that both the Mannheim Peritonitis Index (at a threshold of ≥ 21) and the APACHE II score (at a threshold of ≥ 15) provide reliable prognostic guidance in cases of secondary hollow viscus perforation peritonitis. The APACHE II system demonstrates superior specificity and diagnostic accuracy, making it an excellent choice for mortality risk stratification and critical care optimization. Conversely, the Mannheim Peritonitis Index is simple and rapid to calculate without requiring extensive laboratory inputs, making it a highly practical tool for immediate, bedside triage and morbidity prediction in low-resource emergency settings. Implementing these objective scoring models routinely supports early clinical decision-making, helps optimize surgical resource allocation, and improves perioperative risk counseling for patients and their families.

VI. Statements And Declarations

Funding

The authors declare that no funds, grants, or other external financial support were received from any public, commercial, or non-profit organization during the preparation of this manuscript. This clinical study was entirely self-funded by the authors.

Competing Interests

The authors have no relevant financial or non-financial competing interests to disclose. All authors declare that they have no conflicts of interest directly or indirectly related to the execution, analysis, or submission of the work presented in this manuscript.

Ethics Approval

This study was performed in strict accordance with the ethical standards of the institutional research committee and in line with the principles of the 1964 Declaration of Helsinki and its later amendments. Institutional ethical clearance and formal approvals were secured from the Institutional Ethics Committee of

Indira Gandhi Government Medical College and Hospital, Nagpur, prior to the initiation of any clinical tracking or patient enrollment.

Consent to Participate

Informed written consent was systematically obtained from all individual adult participants prior to their enrollment and subsequent assignment to emergency exploratory laparotomy. For patients unable to provide direct consent due to temporary physiological compromise from severe clinical sepsis, written informed consent was legally obtained from their immediate next of kin or authorized blood relatives.

Consent for Publication

The participants (or their legally authorized representatives) have explicitly provided written informed consent for the publication of anonymized clinical data, demographic parameters, scoring metrics, and associated intraoperative findings within peer-reviewed scientific journals.

Availability of Data and Materials

The primary clinical datasets, operative master charts, and statistical matrices generated and analyzed during the current prospective study are securely archived at the home institution and are available from the corresponding author upon reasonable academic request.

Authors' Contributions

Dr. Ganesh T A: Contributed to the primary study conception, protocol design, prospective patient enrollment, preoperative clinical data gathering, intraoperative score calculations, post-operative complication monitoring, statistical analysis, and drafted the first manuscript version. Dr. Manik Gedam: Contributed to the critical optimization of the study design, supervised all surgical interventions, provided formal administrative and institutional facilities, reviewed data interpretation charts, and provided senior editorial revisions to the final draft. All authors read and formally approved the final version of the manuscript submitted for publication.

References

[1]. Wacha H, Linder MM (1983) The Mannheim Peritonitis Index: Prediction Of Risk Of Death From Peritonitis. Theor Surg 1:169–173

[2]. Knaus WA, Draper EA, Wagner DP, Zimmerman JE (1985) APACHE II: A Severity Of Disease Classification System. Crit Care Med 13:818–829

[3]. Bohnen JM, Mustard RA, Oxholm SE, Schouten BD (1988) APACHE II Score And Abdominal Sepsis. Arch Surg 123:225–229

[4]. Billing A, Fröhlich D, Schildberg FW (1994) Prediction Of Outcome Using The Mannheim Peritonitis Index In 2003 Patients. Br J Surg 81:209–213

[5]. Wittmann DH, Schein M, Condon RE (1996) Management Of Secondary Peritonitis. Ann Surg 224:10–18

[6]. Bracho-Riquelme RL, Melero-Vela A, Torres-Ruiz J (2002) Mannheim Peritonitis Index Validation Study At The Hospital General De Durango, Mexico. Cir Cir 70:217–225

[7]. Qureshi AM, Zafar A, Saeed K, Quddus A (2005) Predictive Power Of Mannheim Peritonitis Index. J Coll Physicians Surg Pak 15:693–696

[8]. Notash AY, Salimi J, Rahimian H, Abbasi A (2005) Evaluation Of Mannheim Peritonitis Index And Multiple Organ Failure Score In Patients With Peritonitis. Indian J Gastroenterol 24:197–200

[9]. Gupta S, Kaushik R (2006) Peritonitis – The Eastern Experience. World J Emerg Surg 1:13

[10]. Jhobta RS, Attri AK, Kaushik R, Sharma R (2006) Spectrum Of Perforation Peritonitis In India – Review Of 504 Consecutive Cases. World J Emerg Surg 1:26

[11]. Kulkarni SV, Naik AS, Subramanian N (2007) APACHE II Scoring In Perforation Peritonitis. Am J Surg 194:549–552

[12]. Ayazoğlu TA, Yıldız F, Ozguc H, Erkal HS (2010) Evaluation Of Mannheim Peritonitis Index In Patients With Secondary Peritonitis. Ulus Travma Acil Cerrahi Derg 16:240–244

[13]. Delibegović S, Marković D, Hodžić S, Katica M (2011) Introduction Of Mannheim Peritonitis Index In Clinical Practice. Med Arh 65:82–85

[14]. Ntirenganya F, Ntakiyiruta G, Kakande I (2012) Prediction Of Outcome Using The Mannheim Peritonitis Index In Patients With Peritonitis At Kigali University Teaching Hospital. East Cent Afr J Surg 17:52–64

[15]. Yadav D, Garg PK (2013) Spectrum Of Perforation Peritonitis In Delhi: 77 Cases Experience. Indian J Surg 75:133–137

[16]. Bali RS, Verma S, Agarwal PN, Singh R (2014) Perforation Peritonitis And The Developing World. ISRN Surg 2014:105492

[17]. Osman N, Elfaedy O, Elkomy H, Osman A (2015) Outcome Of Patients With Secondary Peritonitis Using Mannheim Peritonitis Index. Pan Afr Med J 22:18

[18]. Neri A, Marrelli D, Scheiterle M, Di Mare G, Pedrazzani C (2015) Prognostic Scoring Systems For Peritonitis: The Role Of Mannheim Peritonitis Index And Possible Modifications. Eur Surg Res 54:1–9

[19]. Kumar P, Kumar A, Sinha A, Sahoo JN, Biswal N (2016) Mannheim Peritonitis Index In Predicting The Severity Of Peritonitis And Outcome. Indian J Surg 78:501–506

[20]. Makkar JK, Jain K, Choudhury S, Yadav S (2016) Prognostic Scoring Systems In Peritonitis: A Prospective Study In A Tertiary Care Centre Of Northern India. Int Surg J 3:647–652

[21]. Ndayizeye L, Ngarambe C, Smart B, Riviello R, Rickard J (2016) Peritonitis In Rwanda: Epidemiology And Risk Factors For Morbidity And Mortality. Surgery 160:1645–1656

[22]. Agarwal S, Sharma D, Mandal A, Attri AK (2017) Evaluation Of APACHE II, Mannheim Peritonitis Index And Modified MPI In Predicting Outcome In Secondary Peritonitis. Trop Gastroenterol 38:178–184

[23]. Khan S, Khan S, Jan QA, Wazir A, Shah SR (2018) Use Of Mannheim Peritonitis Index In Predicting Outcome In Patients With Peritonitis. Khyber Med Univ J 10:71–74
[24]. Nag DS, Sahoo SP, Mahapatra S, Sahu S (2019) Evaluation Of Mannheim Peritonitis Index In Predicting Outcome In Patients With Secondary Peritonitis. Indian J Crit Care Med 23:325–330
[25]. Vijayakumar C, Karthikeyan VS, Sistla SC, Rajkumar N (2019) Evaluation Of Mannheim Peritonitis Index In Predicting The Outcome Of Patients With Peritonitis In Salem, Tamil Nadu. Int Surg J 6:2252–2258
[26]. Hameed T, Kumar A, Sahni S, Bhatia R (2020) Emerging Spectrum Of Perforation Peritonitis In Developing World. Front Surg 7:50
[27]. Bylapudi S, Periasamy S, Ramasamy R, Ramasamy K (2021) Comparative Study Of Mannheim Peritonitis Index And APACHE II Score In Predicting The Outcome Of Patients With Peritonitis. Int Surg J 8:2400–2405
[28]. Sivapuram S, Kaman L, Raj P, Behera A, Singh R (2021) Evaluation Of Mannheim Peritonitis Index In Predicting Prognosis In Patients With Peritonitis. J Gastrointest Surg 25:956–963
[29]. Nair A, Singh A, Pranav, Anirudh, Reddy R (2022) Evaluation Of Mannheim Peritonitis Index As A Predictor Of Outcome In Patients With Secondary Peritonitis: A Prospective Observational Study. Int Surg J 9:1003–1008
[30]. Ramteke V, Deshpande S, Bansod PY, Borkar S (2023) Evaluation Of Mannheim Peritonitis Index In Predicting Outcome Of Patients With Secondary Peritonitis: A Prospective Observational Study In A Rural Tertiary Care Hospital. Int Surg J 10:818–823