ISSN: 2584-0355
DOI: doi.org/10.51219/MCCRJ/Kaoutar-Zirhirhi/478

URF PUBLISHERS
connect with research world

Medical & Clinical Case Reports Journal

https://urfpublishers.com/journal/case-reports

Vol: 4 & Iss: 2

Research Article

Short-Term Outcomes and System-Level Gaps After Pancreaticoduodenectomy in a Resource-Limited Tertiary Center

Othmane Tahri Joutey, Kaoutar Zirhirhi*, Abdelhak Tissir, Lina Berrada, Sara Chabbar, Fatima Ezzahra Faouji, Anas Mounir, Mohamed Aziz Bouhouri

Department of Surgical Critical Care, Anesthesiology and Intensive Care, Ibn Rochd University Hospital, Casablanca, Morocco

Citation: Joutey OT, Zirhirhi K, Tissir A, et al. Short-Term Outcomes and System-Level Gaps After Pancreaticoduodenectomy in a Resource-Limited Tertiary Center. *Medi Clin Case Rep J* 2026;4(2):1771-1776. DOI: doi.org/10.51219/MCCRJ/Kaoutar-Zirhirhi/478

Received: 02 June, 2026; **Accepted:** 03 June, 2026; **Published:** 05 June, 2026

***Corresponding author:** Kaoutar Zirhirhi, Department of Surgical Critical Care, Anesthesiology and Intensive Care, Ibn Rochd University Hospital, Casablanca, Morocco

Copyright: © 2026 Zirhirhi K, et al., This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

A B S T R A C T

Background: Pancreaticoduodenectomy (PD) for pancreatic head adenocarcinoma carries substantial morbidity and mortality. In resource-limited settings, data on postoperative outcomes remain scarce. This study aimed to describe perioperative outcomes, quantify the gap between intended and actual resection and to generate hypotheses on the potential role of structured ICU care.

Methods: A retrospective descriptive cohort study was conducted on 60 consecutive patients with pancreatic head adenocarcinoma at Ibn Rochd University Hospital, Casablanca, Morocco (2016–2023). Variables included demographics, ASA status, TNM staging, SAPS II, SOFA score, Clavien-Dindo grading and overall survival. Factors associated with survival were analyzed using Chi-square and Fisher's exact tests ($p < 0.05$).

Results: Mean age was 60 ± 12 years (60% male). Although 73.3% were deemed operable, only 16.7% (n = 10) underwent PD, revealing a 57-percentage-point therapeutic gap. Among the resected subgroup (70% ASA ≥ III; SAPS II 38 ± 10; SOFA 6 ± 2), morbidity reached 60% (30% Clavien-Dindo ≥ III), yet 30-day mortality was zero. Median overall survival was 5 months. Age > 60 years was associated with decreased survival ($p = 0.03$).

Conclusion: In a highly selected cohort with substantial morbidity, zero 30-day mortality was observed within a structured ICU framework. The 57-percentage-point therapeutic gap represents the most actionable finding and supports systematic staging laparoscopy. These findings highlight system-level gaps and generate hypotheses on the role of structured postoperative care, requiring confirmation in larger prospective studies.

Keywords: Pancreatic adenocarcinoma; Failure to rescue; SAPS II; SOFA; Pancreaticoduodenectomy; Critical care; Therapeutic gap; Survival

Plain Language Summary

The Whipple procedure is major surgery for pancreatic head cancer. It carries a high risk of complications and in hospitals with limited resources, patients may have worse outcomes when complications occur. We studied 60 patients with pancreatic head cancer at Ibn Rochd University Hospital, Casablanca, Morocco (2016-2023). Only 10 of 44 patients initially deemed eligible for surgery actually underwent it, mainly because cancer had spread beyond what imaging showed. Among those 10 highly selected patients, 60% developed complications, but none died within 30 days. All were closely monitored in the ICU using a structured protocol, which may have helped detect and treat complications early, though we cannot prove this was the reason for the good short-term outcome. Long-term survival remained poor, mainly because fewer than half received chemotherapy after surgery. Our findings highlight the need for better preoperative staging, the potential value of organized intensive care and the importance of improving access to chemotherapy in resource-limited settings.

Introduction

Pancreaticoduodenectomy (PD) remains the only potentially curative treatment for pancreatic head adenocarcinoma. However, PD carries substantial morbidity rates ranging from 40% to 60% even at high-volume centers[1,2]. While perioperative mortality has decreased to 2-5% in specialized institutions in high-income countries, it remains considerably higher in low- and middle-income settings, where access to structured postoperative intensive care may be limited[3].

Pancreatic cancer represents the seventh leading cause of cancer-related death worldwide, with rising incidence globally[3]. In North Africa, although exact epidemiological data remain fragmented, pancreatic adenocarcinoma is increasingly recognized as a significant oncological burden, with patients frequently presenting at advanced stages due to diagnostic delays and limited access to cross-sectional imaging[4,5]. The surgical management of these patients in resource-limited settings therefore poses unique challenges that extend beyond the operating room and into the postoperative period.

Over the past two decades, the concept of failure to rescue (FTR) - mortality occurring after a postoperative complication - has emerged as a key surgical quality metric. Silber et al. proposed that outcome variation reflects institutional rescue capacity rather than complication occurrence alone[6]. Ghaferi, et al. confirmed that lower-mortality hospitals achieved this through reduced FTR rates, not lower complication incidence[7,8]. Dedicated critical care resources and early intervention protocols appear central to rescue capacity[8,9].

In high-income settings, high-intensity physician staffing[10] and standardized ICU protocols[11] have been associated with improved outcomes. However, most PD outcome data originate from high-volume centers in Europe, North America and East Asia, leaving resource-limited contexts largely unexplored. North African data are particularly scarce[4,12,13], despite the interplay of surgical complexity, limited ICU capacity and constrained adjuvant therapy access.

The present study was therefore conducted at Ibn Rochd University Hospital in Casablanca, Morocco, to describe 30-day mortality and postoperative morbidity following PD for pancreatic head adenocarcinoma in a resource-limited tertiary center. Secondary objectives were: (1) quantifying the gap between intended and actual surgical resection; (2) identifying factors associated with overall survival; and (3) generating hypotheses on the role of structured ICU management in failure-to-rescue prevention.

Materials and Methods

Study design and setting

This single-center retrospective cohort study was conducted at the Department of Surgical Critical Care, Anesthesiology and Intensive Care, Ibn Rochd University Hospital, Casablanca, Morocco (2016-2023). Ibn Rochd University Hospital is a tertiary referral center serving over 7 million inhabitants in the Casablanca-Settat region.

Surgical technique

All pancreaticoduodenectomies were performed using the classical Whipple technique with standard lymphadenectomy, including en bloc resection of the pancreatic head, duodenum, distal common bile duct, gallbladder and distal stomach when applicable. Reconstruction comprised pancreaticojejunostomy (duct-to-mucosa technique), hepaticojejunostomy and gastrojejunostomy. Two closed-suction drains were placed near both anastomoses. Drain fluid amylase levels were measured on postoperative days 1 and 3 to screen for pancreatic fistula according to the ISGPS criteria[14]. All procedures were performed by a single hepatobiliary surgical team.

Study population

All consecutive adults (≥ 18 years) with histologically or radiologically confirmed pancreatic head adenocarcinoma during the study period were included. Exclusion criteria were: (1) incomplete medical records; (2) non-adenocarcinoma histology; and (3) pancreatic body or tail tumors. Sixty patients met inclusion criteria.

Data collection

Data were extracted from electronic medical records, operative reports, pathology records, ICU charts and follow-up files:

- **Demographic variables:** age, sex.
- **Clinical variables:** comorbidities, ASA physical status.
- **Oncological variables:** TNM staging, operability, reason for non-resection, procedure type, adjuvant chemotherapy receipt.
- **ICU variables:** SAPS II[15] and SOFA[16] scores, mechanical ventilation duration, ICU length of stay.
- Postoperative outcomes: Clavien-Dindo–graded complications[17], including pancreatic fistula[14], delayed gastric emptying[18], hemorrhage, surgical site infection and pulmonary complications; and complication management.

Structured ICU management protocol

All PD patients were admitted to the surgical ICU postoperatively. The protocol included: (1) daily SOFA-based organ function reassessment; (2) protocolized ventilation with daily spontaneous breathing trials; (3) early enteral nutrition (24-48 hours); (4) systematic monitoring of surgical drain output for early detection of pancreatic fistula; (5) daily clinical and

laboratory surveillance (blood count, renal and hepatic function, CRP, procalcitonin); (6) early mobilization protocol; and (7) multidisciplinary rounds (intensivist, surgeon, nutritionist). Escalation was triggered by hemodynamic instability, new organ dysfunction or signs of surgical complications.

Endpoint definitions

The primary outcome was 30-day mortality. Secondary outcomes included morbidity (overall and by Clavien-Dindo grade), ICU length of stay, overall survival and factors associated with survival.

Statistical analysis

Continuous variables were expressed as mean ± SD or median (IQR); categorical variables as frequencies and percentages. Survival associations were tested using Chi-square or Fisher's exact test (when expected counts < 5). Given the small sample, all analyses are exploratory. Overall survival was estimated by Kaplan-Meier analysis[19] from diagnosis to death or last follow-up. Statistical significance was set at two-sided $p < 0.05$. Multivariable analysis was precluded by the limited sample size.

Ethical considerations

This study used anonymized data in accordance with institutional regulations; an ethics board waiver was obtained given the retrospective, non-interventional design. The study complied with the Declaration of Helsinki.

Results

Overall population characteristics

Sixty patients were included (mean age 60 ± 12 years, range 38-82; 60% male). Common comorbidities included hypertension (46.7%), smoking (41.7%), diabetes (30%) and chronic liver disease/jaundice (23.3%). ASA III and IV status was present in 46.7% and 10%, respectively. Most patients (65%) had advanced disease (stage III–IV) at diagnosis **(Table 1)**.

Therapeutic gap

Of 60 patients, 44 (73.3%) were deemed operable on preoperative imaging, yet only 10 (16.7%) underwent PD, yielding a 57-percentage-point gap. Non-resection reasons (n = 34): occult metastases (n = 15, 44.1%), unresectable vascular invasion (n = 12, 35.3%) and peritoneal carcinomatosis or intraoperative deterioration (n = 7, 20.6%). These findings underscore the limitations of preoperative imaging and support systematic staging laparoscopy[20,21].

Characteristics and ICU management of resected patients

Among 10 resected patients, 7 (70%) were ASA ≥ III. At ICU admission, mean SAPS II score was 38 ± 10 and mean SOFA score was 6 ± 2. Seven patients (70%) required mechanical ventilation (mean 3 ± 2 days); mean ICU stay was 5.5 ± 3 days. All were managed per the structured ICU protocol with daily SOFA reassessment.

Postoperative morbidity and mortality

Morbidity was 60% (6/10 patients). Grade ≥ III complications occurred in 30% (n = 3). Pancreatic fistula (grade B-C[14]) and delayed gastric emptying[18] each occurred in 2 patients (20%), surgical site infection and pulmonary complications each in 2 (20%) and hemorrhage in 1 (10%) **(Table 2)**.

Table 1: Baseline characteristics of the study population (N = 60).

Characteristic	Value (n = 60)
Sex	
Male	36 (60%)
Female	24 (40%)
Age (years), mean ± SD	60 ± 12
Range	38–82
ASA Physical Status	
ASA I	6 (10%)
ASA II	20 (33.3%)
ASA III	28 (46.7%)
ASA IV	6 (10%)
TNM Stage at diagnosis	
Stage I–II	21 (35%)
Stage III–IV	39 (65%)
Comorbidities	
Hypertension	28 (46.7%)
Diabetes mellitus	18 (30%)
Smoking history	25 (41.7%)
Chronic liver disease / jaundice	14 (23.3%)
Operability	
Deemed operable	44 (73.3%)
Actually resected (PD with curative intent)	10 (16.7%)

ASA, American Society of Anesthesiologists; TNM, tumor-node-metastasis; PD, pancreaticoduodenectomy; SD, standard deviation.

Complications were managed with radiological drainage (n = 2), reoperation (n = 1), prolonged ICU care (n = 3) and targeted antibiotics (n = 4).

Thirty-day mortality was zero despite the high-risk profile. This may reflect strict patient selection (10/60), the ICU protocol, surgical team experience or chance. These findings are consistent with the failure-to-rescue paradigm but do not establish causality.

Table 2: Postoperative complications and management among resected patients (n = 10).

Complication	n (%)	Management
Overall complications	6 (60%)	
Clavien-Dindo ≥ III	3 (30%)	
Pancreatic fistula (Grade B–C)	2 (20%)	Radiological drainage
Delayed gastric emptying	2 (20%)	Prolonged ICU care, nutritional support
Postoperative hemorrhage	1 (10%)	Reoperation
Surgical site infection	2 (20%)	Antibiotic therapy
Pulmonary complications	2 (20%)	Prolonged ventilation, physiotherapy
30-day mortality	0 (0%)	—

ICU, intensive care unit; ISGPS, International Study Group of Pancreatic Surgery. Some patients experienced more than one complication; percentages may therefore exceed 100%.

Adjuvant chemotherapy and survival

During close postoperative ICU monitoring, postoperative

complications were identified and managed. In the two patients who developed pancreatic fistula (grade B-C), the diagnosis was established within the first 48 hours based on elevated drain fluid amylase levels and confirmed by cross-sectional imaging, allowing percutaneous drainage to be performed before the development of sepsis. The patient who experienced postoperative haemorrhage was identified through hemodynamic monitoring and a decrease in haemoglobin levels, prompting emergent reoperation on postoperative day 2. The two patients with delayed gastric emptying were managed conservatively with prolonged nasogastric decompression and early initiation of total parenteral nutrition, with resolution achieved within 10-14 days. These cases illustrate the role of close postoperative ICU monitoring in the recognition and management of complications.

Among the 10 resected patients, only 4 (40%) received adjuvant chemotherapy. The low rate was attributable to prolonged postoperative recovery from complications, access barriers to oncological services, patient refusal and loss to follow-up. This is notably lower than the rates reported in landmark adjuvant trials such as ESPAC-4 and PRODIGE 24, where protocol adherence exceeded 70%[22,23].

Among the 10 resected patients, Kaplan-Meier analysis yielded a median overall survival of 5 months **(Figure 1)**. Estimated survival rates were 50% at 6 months, 25% at 12 months and 0% at 24 months. Given the small sample size, this survival estimates should be interpreted cautiously. On exploratory univariate analysis, age > 60 years was associated with decreased overall survival (p = 0.03); however, given the small sample size, this association should be considered hypothesis-generating only and requires validation in larger cohorts. These survival estimates are fragile due to the very small number of patients and should be interpreted with extreme caution.

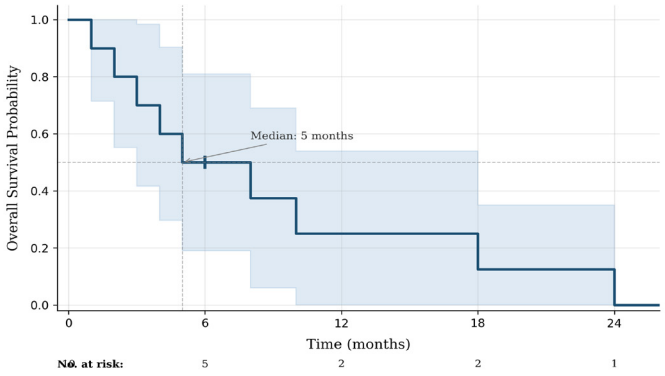

Figure 1: Kaplan-Meier overall survival curve for resected patients (n = 10). Vertical tick marks indicate censored observations. Shaded area represents 95% confidence interval. Median overall survival was 5 months

Discussion

Principal findings

The most actionable finding of this study is the substantial discrepancy between intended and actual resection: although 73.3% of patients were deemed operable, only 16.7% ultimately underwent pancreaticoduodenectomy, revealing a 57-percentage-point therapeutic gap. This gap is concrete, measurable, reproducible and directly actionable through improved staging strategies. Additionally, in this small but high-risk surgical cohort (SAPS II 38, SOFA 6, 70% ASA ≥ III), zero 30-day mortality was observed within a structured ICU framework despite an overall postoperative morbidity of 60%. This finding should be interpreted in the context of the highly selective nature of the cohort: the very low resection rate implies that only the most favourable surgical candidates ultimately underwent PD. The coexistence of zero mortality and high morbidity is consistent with the failure-to-rescue (FTR) paradigm. Our findings suggest that structured ICU organization may play a role in postoperative outcomes, consistent with the failure-to-rescue framework; however, alternative explanations including patient selection, surgical team experience and chance cannot be excluded.

Comparison with the literature

Published morbidity after PD (40-60%) is consistent with ours[1,2]. Reported 30-day mortality ranges from 1–3% at high-volume centers to 5-15% in resource-limited settings[2,24]. A meta-analysis of PD outcomes in low- and middle-income countries reported pooled mortality of 4.4%, with higher major complication rates than high-income settings[24]. The zero mortality in our cohort is noteworthy given the high severity scores and resource constraints.

The failure-to-rescue paradigm[6-8] provides a useful interpretive framework. In pancreatic surgery, lower-mortality institutions had comparable morbidity but lower FTR rates, linked to higher ICU nursing ratios and earlier escalation[7]. Dimick, et al. similarly linked dedicated ICU physician coverage to reduced mortality[9].

Our findings are compatible with this paradigm but do not demonstrate it. All resected patients received protocolized ventilation, daily SOFA reassessment and early multidisciplinary involvement. This framework may have facilitated timely recognition and treatment of complications. Without a non-ICU control group, the independent contribution of the ICU protocol cannot be determined. ERAS guidelines similarly advocate structured postoperative monitoring[25], but our design precludes quantifying any single component's contribution.

Unlike high-income centres with advanced monitoring and specialized staffing, our institution relies on a protocol-driven approach to compensate for resource limitations. Daily SOFA scoring, for instance, provided low-cost early organ dysfunction detection without continuous electronic monitoring. This observation raises the possibility that the quality of postoperative care organization - rather than technology or volume alone - may be an important determinant in this context. Although causation cannot be demonstrated, this approach represents a reproducible framework testable in similar settings[26]. The ICU protocol described here should be understood as an organizational signal rather than a proven intervention; its contribution to outcomes remains a hypothesis requiring formal evaluation.

The therapeutic gap

The 57-percentage-point therapeutic gap constitutes a system-level deficit with direct implications for resource allocation. Unnecessary laparotomies consume scarce surgical resources and expose patients to avoidable risk. Occult metastases (44.1%) and unresectable vascular invasion (35.3%) drove the gap, confirming that cross-sectional imaging alone was insufficient.

Gudmundsdottir et al. found that staging laparoscopy identified unresectable disease in 18% of over 1,000 patients[20].

Fong, et al. reported staging laparoscopy prevented unnecessary laparotomy in 24-44% of 1,001 patients[21]. In resource-limited settings, systematic staging laparoscopy could optimize both patient selection and resource allocation.

Adjuvant chemotherapy and oncological outcomes

Only 40% received adjuvant chemotherapy, well below the 60-80% in ESPAC-4 and PRODIGE 24[22,23]. Barriers included prolonged recovery, limited oncological access, patient refusal and loss to follow-up - challenges typical of resource-limited systems.

Given that adjuvant chemotherapy improves median survival by 10-20 months in resected pancreatic cancer[22,23,27], the low chemotherapy rate likely contributed to the poor long-term survival (25% at 1 year, 0% at 2 years). This underscores the need for integrated perioperative pathways ensuring timely transition to oncological care, particularly where geographical, financial and logistical barriers exist.

Implications for resource-limited settings

Zero 30-day mortality in this highly selected cohort, despite significant resource constraints, raises the possibility that postoperative care organization may matter alongside volume and technology. This aligns with quality improvement literature emphasizing process measures over structural resources alone[11,26].

In many LMICs, pancreatic surgery is concentrated in tertiary centers with limited ICU beds and suboptimal nurse-to-patient ratios. Simple, reproducible ICU protocols - daily SOFA scoring, structured ventilation weaning, systematic drain monitoring - may offer a pragmatic strategy for improving outcomes. The WHO Surgical Safety Checklist demonstrates how low-cost standardized interventions can reduce complications globally[28]. Protocol-based critical care may similarly be adaptable without substantial technological investment, although prospective validation is needed.

The therapeutic gap further highlights the need for comprehensive pancreatic cancer management beyond surgical technique: staging laparoscopy, multidisciplinary tumour boards and integrated surgical-oncological pathways.

Selection bias considerations

The zero mortality must be interpreted cautiously given substantial selection bias. The low resection rate (16.7%) excluded most patients, including those with highest operative risk. The 10 resected patients likely represent the most favorable candidates, biasing mortality downward. Zero mortality may reflect: (1) strict patient selection by the surgical team; (2) the structured ICU protocol; (3) the experience and skill of the operating surgeons; and (4) chance, given the very small sample size. The absence of a control group, lack of local benchmarks and retrospective design preclude causal inference.

Limitations

The single-center retrospective design introduces selection and information biases. The small sample (n = 10 resected) limits statistical power; all analyses are exploratory and causality cannot be established. Kaplan-Meier estimates from 10 patients are fragile with wide confidence intervals. The absence of multivariate analysis precludes identification of independent survival predictors. Unmeasured confounders (surgeon experience, case complexity) may have influenced outcomes. The single-center design limits external validity.

Perspectives

A prospective multicenter study is warranted to evaluate the potential role of structured ICU management in relation to failure-to-rescue outcomes after PD in resource-limited settings. Future research should evaluate standardized staging laparoscopy and integrated perioperative oncological pathways. Cost-effectiveness analyses of ICU protocols in LMICs would inform resource allocation decisions. Collaborative registries across North African and sub-Saharan institutions could provide the sample sizes needed for meaningful outcome analysis.

Conclusion

In a highly selected cohort with substantial morbidity, zero 30-day mortality was observed following pancreaticoduodenectomy within a structured ICU framework in a resource-limited setting. The 57-percentage-point therapeutic gap - the most actionable finding - supports systematic staging laparoscopy to optimize patient selection and resource allocation. Structured postoperative care organization may contribute to favourable short-term outcomes, an observation aligned with the failure-to-rescue paradigm. The low adjuvant chemotherapy rate (40%) underscores the need for integrated perioperative oncological pathways. Given the small sample, selection bias and lack of a control group, confirmation in larger prospective multicentre studies is needed. These findings should be regarded as a hypothesis-generating signal warranting further investigation.

Declarations

Conflict of interest statement

The author declares no conflicts of interest related to this work.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

Data availability statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request. Due to patient privacy and ethical restrictions, the raw data cannot be made publicly available.

Author contributions

Othmane Tahri Joutey: conceptualization, data collection, writing of the original draft. Kaoutar Zirhirhi: conceptualization, data collection, analysis, writing of the original draft and critical revision of the manuscript. Abdelhak Tissir: data collection, critical revision. Sara Lamghari: data collection, critical revision. Lina Berrada: data collection, critical revision. Sara Chabbar: data collection, critical revision. Fatima Ezzahra Faouji: data collection. Anas Mounir: data collection. Mohamed Aziz Bouhouri: supervision, critical revision of the manuscript.

Ethical approval

This retrospective study was conducted in accordance with the regulations of the institutional ethics committee of Ibn

Rochd University Hospital, which granted a waiver of formal ethical approval and informed consent given the retrospective, non-interventional design and the use of fully anonymized data. The study was conducted in compliance with the Declaration of Helsinki.

References

1. Winter JM, Cameron JL, Campbell KA, et al. 1423 pancreaticoduodenectomies for pancreatic cancer: a single-institution experience. J Gastrointest Surg 2006;10(9):1199-1211.
2. Nimptsch U, Krautz C, Weber GF, Grützmann R, Combs SE. Nationwide in-hospital mortality following pancreatic surgery in Germany is higher than anticipated. Ann Surg 2016;264(6):1082-1090.
3. Rawla P, Sunkara T, Gaduputi V. Epidemiology of pancreatic cancer: global trends, etiology and risk factors. World J Oncol 2019;10(1):10-27.
4. Amri F, Koulali H, Jabi R, et al. Pancreatic cancer: experience from an emerging country in North Africa. J Cancer Res Clin Oncol 2023;149:14297-14302.
5. Hamdi Cherif M, Serraino D, Mahnane A, et al. Time trends of cancer incidence in Setif, Algeria, 1986–2010: an observational study. BMC Cancer 2014;14:637.
6. Silber JH, Williams SV, Krakauer H, Schwartz JS. Hospital and patient characteristics associated with death after surgery: a study of adverse occurrence and failure to rescue. Med Care 1992;30(7):615-629.
7. Ghaferi AA, Osborne NH, Birkmeyer JD, Dimick JB. Hospital characteristics associated with failure to rescue from complications after pancreatectomy. J Am Coll Surg 2010;211(3):325-330.
8. Ghaferi AA, Birkmeyer JD, Dimick JB. Hospital volume and failure to rescue with high-risk surgery. Med Care 2011;49(12):1076-1081.
9. Dimick JB, Pronovost PJ, Heitmiller RF, Lipsett PA. Intensive care unit physician staffing is associated with decreased length of stay, hospital cost and complications after esophageal resection. Crit Care Med 2001;29(4):753-758.
10. Pronovost PJ, Angus DC, Dorman T, Robinson KA, Dremsizov TT, Young TL. Physician staffing patterns and clinical outcomes in critically ill patients: a systematic review. JAMA 2002;288(17):2151-2162.
11. Checkley W, Martin GS, Brown SM, et al. Structure, process and annual ICU mortality across 69 centers: United States critical illness and injury trials group critical illness outcomes study. Crit Care Med 2014;42(2):344-356.
12. Bharadwaj R, Nishimura A, Kiruthu C, et al. The current landscape of pancreatic cancer management in sub-Saharan Africa: a perspective review. Health Sci Rep 2025;8(10):e71330.
13. Musyoka PM, Keter AK, Laving GN, et al. Clinicopathologic characteristics and treatment outcomes of pancreatic cancer patients at a tertiary referral hospital in Kenya. BMC Cancer 2023;23(1):1138.
14. Bassi C, Marchegiani G, Dervenis C, et al. The 2016 update of the International Study Group (ISGPS) definition and grading of postoperative pancreatic fistula: 11 years after. Surgery 2017;161(3):584-591.
15. Le Gall JR, Lemeshow S, Saulnier F. A new Simplified Acute Physiology Score (SAPS II) based on a European/North American multicenter study. JAMA 1993;270(24):2957-2963.
16. Vincent JL, Moreno R, Takala J, et al. The SOFA (Sepsis-related Organ Failure Assessment) score to describe organ dysfunction/failure. Intensive Care Med 1996;22(7):707-710.
17. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg 2004;240(2):205-213.
18. Wente MN, Bassi C, Dervenis C, et al. Delayed gastric emptying (DGE) after pancreatic surgery: a suggested definition by the International Study Group of Pancreatic Surgery (ISGPS). Surgery 2007;142(5):761-768.
19. Kaplan EL, Meier P. Nonparametric estimation from incomplete observations. J Am Stat Assoc 1958;53(282):457-481.
20. Gudmundsdottir H, Yonkus JA, Alva-Ruiz R, et al. Yield of staging laparoscopy for pancreatic cancer in the modern era: analysis of more than 1,000 consecutive patients. J Am Coll Surg 2023;237(1):49-57.
21. Fong ZV, Alvino DML, Fernández-Del Castillo C, et al. Reappraisal of staging laparoscopy for patients with pancreatic adenocarcinoma: a contemporary analysis of 1001 patients. Ann Surg Oncol 2017;24(11):3203-3211.
22. Neoptolemos JP, Palmer DH, Ghaneh P, et al. Comparison of adjuvant gemcitabine and capecitabine with gemcitabine monotherapy in patients with resected pancreatic cancer (ESPAC-4). Lancet 2017;389(10073):1011-1024.
23. Conroy T, Hammel P, Hebbar M, et al. FOLFIRINOX or gemcitabine as adjuvant therapy for pancreatic cancer (PRODIGE 24). N Engl J Med 2018;379(25):2395-2406.
24. Khan MA, Sherwani M, Ahmed KS, et al. Morbidity and mortality following surgery for pancreatic cancer in low- and middle-income countries: a systematic review and meta-analysis. J Surg Oncol 2025;131(3):435-442.
25. Melloul E, Hübner M, Scott M, et al. Guidelines for perioperative care for pancreatoduodenectomy: Enhanced Recovery After Surgery (ERAS) Society recommendations. World J Surg 2020;44(7):2056-2084.
26. Beane A, De Silva AP, De Silva N, et al. Evaluation of the feasibility and performance of early warning scores to identify patients at risk of adverse outcomes in a low-middle income country setting. BMJ Open 2018;8(4):e019387.
27. Neoptolemos JP, Dunn JA, Stocken DD, et al. Adjuvant chemoradiotherapy and chemotherapy in resectable pancreatic cancer: a randomised controlled trial (ESPAC-1). Lancet 2001;358(9293):1576-1585.
28. Haynes AB, Weiser TG, Berry WR, et al. A surgical safety checklist to reduce morbidity and mortality in a global population. N Engl J Med 2009;360(5):491-499.