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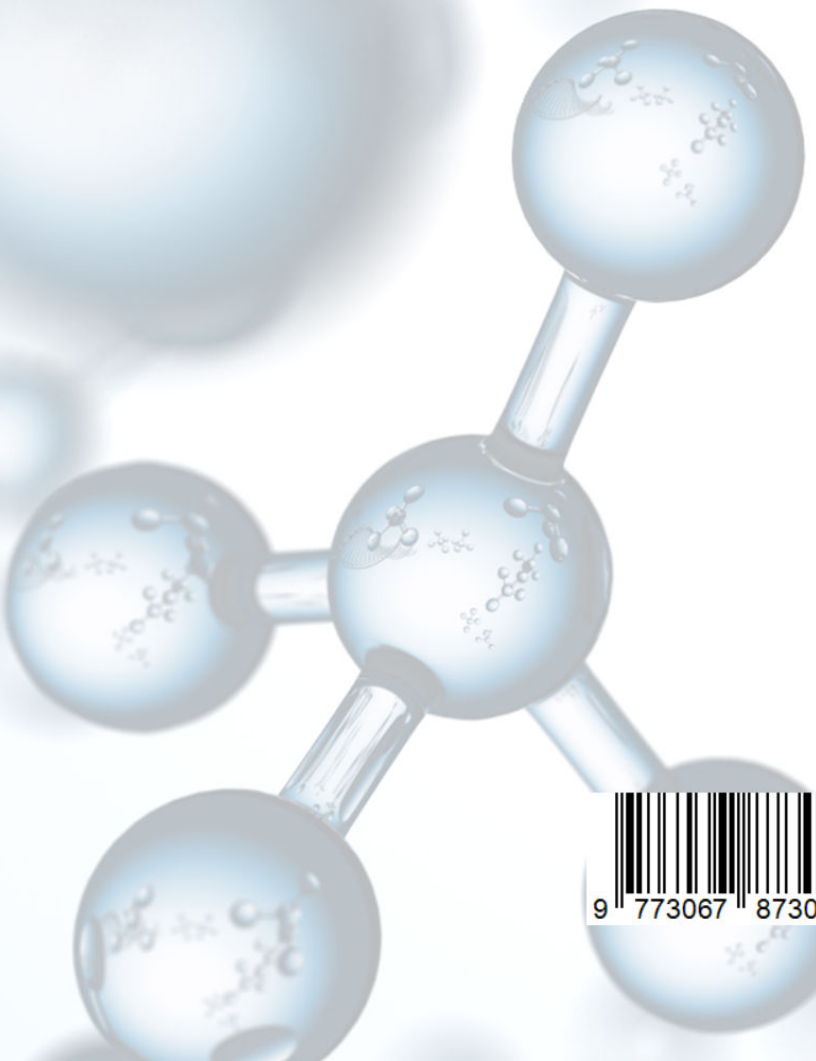

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Original Article

Robotic Versus Laparoscopic Hysterectomy for Extremely Large Uteri: A Systematic Review

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ABSTRACT

Introduction: Hysterectomy for very large uteri is technically challenging and often requires open surgery. Minimally invasive approaches, such as robotic and laparoscopic techniques, provide alternatives, but their comparative safety and effectiveness for extremely large uteri remain uncertain.
Methods: A systematic review was conducted following PRISMA 2020 guidelines. "PubMed and Scopus were searched through June 2025 using predefined keywords (e.g., 'hysterectomy,' 'robotic,' 'robot-assisted,' 'laparoscopic,' 'uterus,' 'large,' 'enlarged,' 'size,' 'weight'); no prospective or randomized trials were identified." for studies comparing robotic and laparoscopic hysterectomy in women with large or extremely large uteri.
Results: Robotic hysterectomy (RH) showed advantages in selected outcomes for extremely large uteri. One study reported a 70-minute reduction in operative time with RH for uteri >1000 g. RH was also associated with lower conversion rates (0–4.3%) compared to laparoscopic hysterectomy (LH) (5.3–10.9%). In moderately large uteri (500–750 g), RH reduced hemoglobin drops but had longer operative times. Complication rates were generally low, although ureteral injury was more frequent with RH in two studies. Length of hospital stay was similar across approaches.
Conclusion: Robotic hysterectomy may offer clinical and economic advantages over conventional laparoscopy for extremely large uteri but the impact of surgical experience should be carefully considered. Limitations include the retrospective design of all four cohorts, small sample sizes, the absence of randomized trials, and clinical and methodological heterogeneity precluding meta-analysis.

1. Introduction

Uterine fibroids are the most common benign gynecologic tumors, [1] with ultrasound-based lifetime prevalence approaching 70% in White women and over 80% in women of African descent by age 50, underscoring marked racial disparities in burden and presentation[2, 1, 3]. Globally, the age-standardized incidence varies widely by region—from approximately 85.6 per 100,000 in Australasia to 582.0 per 100,000 in Eastern Europe—highlighting substantial geographic heterogeneity and public health impact. Although many fibroids are asymptomatic, an estimated 25–30% of affected women experience clinically significant symptoms such as abnormal uterine bleeding, pelvic pain/pressure, urinary frequency, and fertility issues, driving care seeking and resource use [2, 4].

About 30% of women with uterine fibroids develop clinically significant symptoms, including abnormal uterine bleeding, pelvic pain and pressure, urinary frequency, anemia, and fertility issues, which drive most care seeking and procedures. In the United States, fibroids impose a substantial annual societal cost, which includes direct medical spending and significant productivity losses. Estimates for 2010 range from approximately $ 6 to $ 34 billion, with updated analyses suggesting increases to around $ 41–42 billion by 2022–2023 [5]. Large uterine fibroids have historically presented considerable surgical challenges. Because of the technical difficulties given by the uterine size and distorted anatomy, conventional methods frequently require an open abdominal hysterectomy [6]. Large fibroids, especially those weighing more than 1000g, provide special surgical challenges because of their restricted pelvic area, elevated vascularity, and anatomical distortion that makes it difficult to see and reach vital organs like the ureters and main blood vessels. Even with these technical advancements, it is still uncertain whether a minimally invasive procedure is best for larger or extremely big uteri: robotic vs conventional laparoscopic hysterectomy.[4]. Hysterectomy is one of the most commonly performed gynecological procedures worldwide, yet optimal surgical approaches continue to evolve in response to patient needs, technological advancements, and clinical outcomes [5]. Regarding operating time, blood loss, conversion rates, complications,

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and costs, prior research has produced conflicting findings. While some have suggested that robotic surgery may be advantageous in complex cases, others have pointed out that it is more expensive or yields results comparable to those of laparoscopy.

There is limited high-quality evidence comparing long-term outcomes of robotic-assisted hysterectomy versus conventional laparoscopic hysterectomy, particularly in complex or high-risk patient populations. Decision-making in the presence of an enlarged uterus—particularly uteri exceeding 250–500 grams—lacks standardized guidelines [7]. The impact of surgeon experience and learning curves on perioperative outcomes across different MIS modalities is underexplored. Additionally, there is a lack of exploration of patient-reported outcomes and satisfaction related to different surgical routes. Disparities in access to robotic surgery and their implications for surgical equity have not been adequately studied. The influence of anatomical challenges such as dense adhesions, distorted pelvic anatomy, or coexisting pathologies on the feasibility of MIS remains understudied in current comparative analyses [8].

Our rationale for Minimally Invasive Procedures for Large Uteri —Robotic vs. Conventional Laparoscopy Managing hysterectomy in patients with large or extremely enlarged uteri poses technical challenges that can compromise the feasibility and safety of conventional laparoscopy. In such cases, robotic-assisted hysterectomy has emerged as a potentially superior alternative due to enhanced visualization, greater instrument dexterity, and improved ergonomics.

This systematic review aims to synthesize the current evidence comparing robotic and laparoscopic hysterectomy for large and extremely large uteri, focusing on key clinical outcomes, including operative time, blood loss, conversion rates, complications, hospital stay, and cost. This study aims to improve patient care and surgical decision-making for women who need a hysterectomy by elucidating the relative advantages and disadvantages of each approach.

2. Methods

2.1. Search Strategy

The review was conducted and reported following the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) 2020 guidelines [9]. To clearly define the clinical question addressed in this review with Prospero registration CRD420 251086621

2.2. The PICO framework was applied as follows

Population: Women undergoing hysterectomy for large or extremely large; Intervention: Robotic-assisted hysterectomy; Comparison: Conventional laparoscopic hysterectomy; Outcomes: Key endpoints included operative time, estimated blood loss or hemoglobin drop, conversion rate to open surgery, intraoperative and postoperative complications, length of hospital stay, and cost.

A comprehensive literature search was conducted in PubMed and Scopus using broad and specific search strings designed to capture studies comparing robotic and laparoscopic hysterectomy for large or extremely large uteri. The search included terms such as "hysterectomy," "robotic," "robot-assisted," "laparoscopic," "uterus," "large," "enlarged," "size," and "weight." Both databases were searched up to June 2025 to identify relevant studies.

2.3. Eligibility and Exclusion Criteria

Studies were eligible for inclusion if they directly compared robotic hysterectomy with laparoscopic hysterectomy, included women undergoing hysterectomy for large or extremely large, and reported on at least one relevant outcome such as operative time, estimated blood loss (EBL) or hemoglobin drop, conversion rate, complications, hospital stay, or cost. Only studies published in English were considered, and studies were retrospective in nature Studies were excluded if they did not provide a direct comparison between robotic and laparoscopic hysterectomy, involved only open or vaginal approaches without a minimally invasive comparator, failed to report relevant outcomes or sufficient data for extraction, or were case reports, reviews, editorials, or conference abstracts without complete data. No prospective cohort or randomized controlled trials meeting criteria were identified; all included studies were retrospective cohorts.

2.4. Study Selection

All records identified through the database searches were exported to Rayyan [10]. Qatar Computing Research Institute for screening. Titles and abstracts were independently reviewed for eligibility. All records identified through the database searches were exported to Rayyan for screening. Duplicate records were removed prior to screening. Two independent reviewers screened all titles and abstracts, with disagreements resolved by consensus or by consulting a third reviewer. Full-text screening was then performed to confirm inclusion based on the above criteria. Discrepancies were resolved by consensus.

2.5. Data Extraction

Data were extracted into a standardized Excel sheet. Extracted variables included study design, total number of patients, and number in each intervention group (robotic and laparoscopic), median uterine weight, median age, median BMI, and proportion with prior abdominal surgery. Outcomes extracted were operative time (minutes), estimated blood loss (mL) or hemoglobin drop (g/dL), conversion rate (%), complication rate (%), hospital stay (days), and cost (USD).

2.6. Risk of bias

A formal ROBINS-I assessment was not conducted because the evidence base comprised a small number of heterogeneous retrospective cohorts with variable outcome definitions, and the review used a narrative (non-pooled) synthesis; instead, risks related to confounding, selection, and outcome measurement were qualitatively appraised and incorporated into interpretation. Consistent with this rationale, a meta-analysis was not undertaken due to between-study clinical and methodological heterogeneity and inconsistent outcome metrics, and results are presented as a structured narrative synthesis.

2.7. The primary outcomes

Assessed were operative time (in minutes), estimated blood loss (in mL) or hemoglobin drop (in g/dL), conversion rate to open surgery (%), intraoperative and postoperative complications (%), length of hospital stay (in days), and cost (in USD).

These outcomes were chosen to reflect key clinical and resource-related endpoints relevant to the comparison of minimally invasive hysterectomy techniques for extremely large uteri.

Due to the small number of eligible studies ($n = 4$) and the considerable heterogeneity in study designs, populations, and outcome measures, quantitative pooling of data through meta-analysis was not appropriate. Instead, a qualitative (narrative) synthesis was

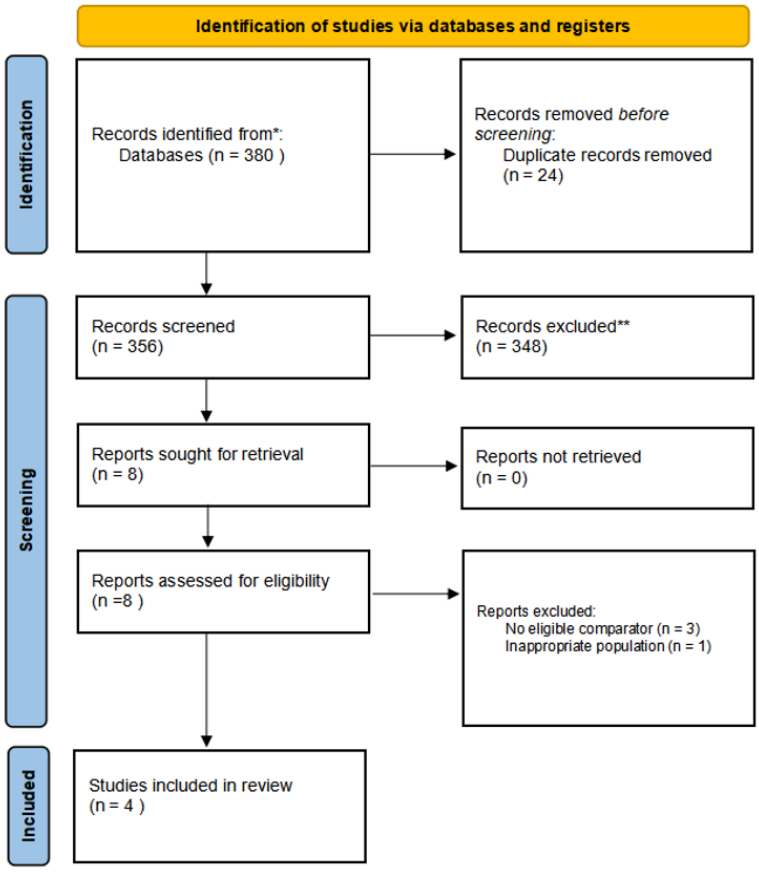

Figure 1: PRISMA flowchart.

undertaken to summarize and compare the findings across studies, highlighting areas of consistency and divergence. Given the limited number of included studies, assessing publication bias (e.g., using a funnel plot or statistical methods) was not possible. Given only four included studies, assessment of publication bias (e.g., funnel plot) was not feasible. No prespecified subgroup or sensitivity analyses could be conducted due to inconsistent thresholds and definitions across studies.

3. Results:

A total of 380 records were identified through database searches, 356 from PubMed and 24 from Scopus. After removing 24 duplicates, 356 unique records remained for screening.

Titles and abstracts were screened for relevance, resulting in the exclusion of 348 records that did not meet the eligibility criteria. The full texts of 8 articles were then assessed for eligibility.

Of these, 4 articles were excluded for the following reasons: three articles did not directly compare robotic and laparoscopic hysterectomy. One article did not include patients with large or extremely large uteri Ultimately, 4 studies met all inclusion criteria and were included in the final review [11, 12, 13, 14].

The study selection process is illustrated in the PRISMA 2020 flow diagram **(Figure 1)**, which details the number of records identified, screened, assessed for eligibility, included, and excluded at each stage, along with reasons for exclusion at the full-text review phase.

3.1. Study Characteristics

The included studies comprised four retrospective cohort studies and no prospective studies, published between 2017 and 2022. Sample sizes ranged from 95 to 397 patients, with a total of 853 women undergoing hysterectomy for large or extremely large uteri (median uterine weight >1000 g in two studies [Ito et al., 2017; Moawad et al., 2017] [11, 12], and >250 g in the others [Jeong et al., 2022; Sinha et al., 2019] [13, 14].

3.2. Baseline Characteristics

The four included studies encompassed a total of 853 patients undergoing minimally invasive hysterectomy for large uteri, with uterine weights ranging from 250g to over 4800g. All studies were retrospective cohort analyses published between 2017 and 2022. The median patient age across studies was 45-47 years, with similar age distributions between robotic and laparoscopic groups. Body mass index (BMI) values were generally elevated, ranging from a median of 23.6 kg/m² in Jeong et al. (2022) [14] to 32.9 kg/m² in the robotic cohort of Moawad et al. (2017) [11], reflecting the typical patient population requiring hysterectomy for large fibroids **(Table 1)**.

Prior abdominal surgery rates varied from 13.4% to 46.3% across studies, with no significant differences between surgical approaches.

Table 1: Baseline Characteristics

Study	Total R/L**	Median Uterine Weight (g)	Median Age (years)	Median BMI (kg/m^2)	Prior Abdominal Surgery (%)
Ito et al. (2017) [11]	12/83	1326 (1000–4800)	45 (27–64)	32 (19.8–49.9)	33.70%
Sinha et al. (2019) [14]	46/119	∼750–1000* (≥16-week size)	45.7 (RH), 44.5 (LH)	30.2 (RH), 27.8 (LH)	15.2% (RH), 13.4% (LH)
Jeong et al. (2022) [15]	197/200	400 (250–2720)	46 (35–74)	23.6 (15.4–42.7)	46.3% (≥1 prior surgery)
Moawad et al. (2017) [16]	101/95	365 (RH), 330 (LH)	45.3 (RH), 42.3 (LH)	32.9 (RH), 30.4 (LH)	21.8% (RH), 16.8% (LH)

* Sinha et al. [14] used clinical size (weeks) rather than weight; estimated conversion: 16 weeks ≈ 500–750 g. ** R, robotic; L, laparoscopic; RH, robotic hysterectomy; LH, laparoscopic hysterectomy; EBL, estimated blood loss; Hb, hemoglobin; LOS, length of stay; BMI, body mass index; OR, odds ratio.

Uterine weights showed considerable variation, with median values of 400g in Jeong et al. (2022), 1326g in Ito et al. (2017) [12], and comparable ranges in other studies. The largest uteri (>1000g) were specifically examined in two studies (Ito et al., 2017; Moawad et al., 2017) [12], while others included broader ranges with subgroup analyses. All procedures were performed by experienced minimally invasive surgeons, with case numbers per surgeon exceeding 200 for their respective approaches, suggesting technical proficiency in both robotic and laparoscopic techniques.

3.3. Outcomes

3.3.1. Operative Time

Operative times varied significantly based on uterine size and surgical approach. For uteri >1000 g, Moawad et al. (2017) reported a 70-minute reduction in operative time with RH compared to LH (161 vs. 231 min, *p* < 0.005). In contrast, Sinha et al. (2019) [13] found RH took longer (131 vs. 110.6 min, *p* = 0.006) for uteri ≥16 weeks (∼500–750 g), while Jeong et al. (2022) observed no difference (120 min for both) **(Table 2)**.

3.3.2. Blood Loss and Transfusion Rates

Estimated blood loss (EBL) was lower in RH for uteri ≥16 weeks (hemoglobin drop: 1.0 vs. 1.8 g/dL, *p* < 0.001) (Sinha et al., 2019) [13]. However, no significant differences were observed in other studies, including those with uteri weighing more than 1000 g (Ito et al., 2017; Moawad et al., 2017) [12]. Transfusion rates were low overall (3.0–6.3%), with no clear advantage for either approach.

3.3.3. Conversion to Laparotomy

Conversion rates were higher in LH (5.3–10.9%) than in RH (0–4.3%), although statistical significance was not consistently achieved. Notably, Ito et al. (2017) reported no conversions after 2011 in their RH cohort, suggesting a learning curve effect.

3.3.4. Complications

Ureteral injuries were more frequent in RH (2.0% vs. 0.5–1.1% in LH) (Jeong et al., 2022; Sinha et al., 2019) [14]. Hemorrhage requiring intervention occurred in 7.3% of cases (Ito et al., 2017) [12], with no significant differences between approaches. Other complications (e.g., infection, ileus) were rare (<3%) and similar across groups.

3.3.5. Hospital Stay and Cost

The length of stay (LOS) was shorter for RH in Moawad et al. (2017) (OR 2.94, *p* = 0.007), whereas other studies reported comparable stays (1–5 days). Cost: RH was significantly cheaper for uteri >1000 g ($4,880 vs. $9,390, *p* = 0.004) due to reduced operative time (Moawad et al., 2017). In contrast, Jeong et al. (2022) noted RH costs were >10× higher at their institution, though uterine weights were smaller (median 400 g).

4. Discussion

4.1. Summary of Findings

This systematic review examining robotic versus laparoscopic hysterectomy for large or extremely large uteri encompassed 853 patients across four retrospective cohort studies. For extremely large uteri, robotic hysterectomy demonstrated superior operative efficiency with a 70-minute reduction in operative time compared to laparoscopic hysterectomy (161 vs. 231 minutes). However, for moderately large uteri (≥16 weeks in size or ∼500–750 g), robotic hysterectomy required longer operative times (131 vs. 110.6 minutes). Blood loss patterns favored robotic hysterectomy in the moderate size category, with significantly reduced hemoglobin drop (1.0 vs. 1.8 g/dL), while no differences were observed for extremely large uteri. Conversion rates consistently favored robotic hysterectomy across all size categories, though statistical significance was not uniformly achieved.

4.2. Clinical Significance and Justification

The size-dependent results that have been found indicate that the therapeutic advantages of robotic hysterectomy could be greatest at the most extremities of surgical complexity. This result is consistent with established surgical ergonomics principles, which state that as technical demands increase, the advantages of advanced technology become more obvious. Although it doesn't always achieve statistical significance, the steady decline in conversion rates across all size groups raises the possibility that robotic technology might provide surgeons with greater confidence and the capacity to handle challenging cases with less invasive techniques. From a clinical standpoint, special consideration should be given to the reported variations in blood loss patterns. The notable preservation of hemoglobin in robotic instances for moderately sized uteri is probably due to the better viewing capabilities and increased accuracy of robotic instrumentation. The lack of this effect in patients with very large uteri, however, raises the possibility that surgical skill and experience, rather than technical advancements, may be more important in controlling bleeding in these situations.

4.3. Comparison with Previous Literature

The findings from this review demonstrate both concordance and divergence with existing literature on robotic versus laparoscopic hysterectomy. Large-scale meta-analyses have consistently shown that robotic hysterectomy is primarily comparable to laparoscopic hysterectomy in terms of major perioperative outcomes [7], which aligns with our findings for most outcome measures. However,

Table 2: Summary of Outcomes

Study	Operative Time (min)	EBL (mL) / Hb Drop (g/dL)	Conversion Rate (%)	Complications (%)	Hospital Stay (days)	Cost (USD)
Ito et al. (2017) [11]	191 (75–478)	200 (20–2000)	5.3% (all LH)	7.3% intraoperative (hemorrhage)	1 (0–6)	Not reported
Sinha et al. (2019) [14]	RH: 131, LH: 110.6*	Hb drop: RH 1.0, LH 1.8*	RH: 4.3%, LH: 10.9%	Ureteral injury: RH 2.0%, LH 0.5%	1.4 (both)	Not reported
Jeong et al. (2022) [15]	120 (both)	RH: 100, LH: 150	RH: 0%, LH: 0.5%	Ureteral injury: RH 2.0%, LH 0.5%	5 (both)	RH >10× LH (institution data)
Moawad et al. (2017) [16]**	RH: 161, LH: 231* (≥1000 g)	No difference	0% (both)	Transfusion: RH 3.0%, LH 3.0%	RH shorter (OR 2.94*)	RH: $4880, LH: $9390* (≥1000 g)

* Statistically significant ($p<0.05$). ** Operative time and cost outcomes reported by Moawad et al. (2017) [16] specifically apply to the ≥1000 g uterine weight stratum. EBL, Estimated blood loss; Hb, Hemoglobin; LOS, Length of stay; RH, Robotic Hysterectomy; LH, Laparoscopic Hysterectomy.

the size-specific advantages observed in this review for extremely large uteri represent a novel finding that extends beyond general population studies.

Given that they appear higher than the 0.02%–0.4% documented in the broader literature on laparoscopic hysterectomy, the ureteral injury rates found in this review (2.0% for RH vs. 0.5–1.1% for LH) demand special consideration[15, 16]. The greater complexity of situations with large uteri, where anatomical distortion and surgical difficulties are intrinsically enhanced, may be the cause of this disparity. Concerns expressed in recent work regarding the learning curve of robotic surgery and the potential for overconfidence in complex situations are consistent with the higher injury rates associated with robotic surgeries [5].

Regarding cost-effectiveness, the dramatic cost reduction observed for extremely large uteri in robotic cases ($4,880 vs. 9,390$) contradicts the general literature trend showing higher costs for robotic procedures [11, 17, 18]This data implies that cost-effectiveness may vary depending on the complexity of the case rather than being generally applicable, since it probably reflects the significant surgical time savings and decreased complication rates in the most complicated cases.

Cost findings are not generalizable across health systems because total costs depend on local pricing and reimbursement structures, accounting practices for operating room time, inclusion and amortization of capital and maintenance costs for robotic platforms, case volume and utilization, and institutional access to technology; consequently, relative costs of RH versus LH can differ widely by setting.

4.4. Learning curve and volume confounding

None of the included studies adjusted for surgeon or institutional volume or for learning-curve phase—factors known to affect operative time, blood loss, complications, and costs—so unmeasured confounding from experience and case volume may bias RH versus LH comparisons.

Consistent with prior learning-curve research, operative time for robotic hysterectomy tends to plateau after approximately 50 cases, with some larger series suggesting further improvements in complications with experience up to around 150 cases.[16]. According to earlier studies, robotic technology may decrease the barrier for undertaking complex minimally invasive operations, as seen by the reported improvements in conversion rates in robotic cases. Our results, however, regarding operative time advantages for extremely large uteri, contradict several studies that have repeatedly demonstrated that robotic operations need longer operative times[16, 19, 7]. This review's safety profile, especially the low conversion rates in robotic cases, is consistent with high-volume surgeon studies showing better results when skilled operators perform robotic procedures [20]. This agreement highlights the importance of institutional volume and surgeon expertise in determining the outcomes of complex robotic procedures. Accordingly, any practice recommendations from this review remain provisional and should be revisited as prospective comparative studies, ideally randomized trials, become available.

4.5. Study Strengths and Limitations

This review offers several strengths, most notably its focused evaluation of a high-complexity patient group—women undergoing minimally invasive hysterectomy for large or extremely large uteri. By examining a range of clinical, safety, and economic outcomes across studies with varying uterine size thresholds, the review provides valuable insights into how surgical results may change depending on uterine size. Notably, all included studies involved experienced surgeons, which helps make the findings relevant to specialized centers that routinely perform advanced minimally invasive gynecologic surgery.

However, there are significant limitations to consider. All included studies were retrospective cohort designs, which can introduce selection bias and limit the ability to draw firm cause-and-effect conclusions. The review is also limited by the small number of eligible studies and the differences in how each defined "large" or "extremely large" uteri. Notably, no randomized controlled trials were identified till the time this review was done, and the lack of prospective data means that unmeasured factors could have influenced the results. Furthermore, differences in surgical techniques and institutional practices may have affected the outcomes, and the learning curve for advanced minimally invasive surgery could also play a role. A key methodological limitation of this systematic review is the absence of a formal quality assessment of the included studies. Without such appraisal, the risk of bias within individual studies could not be systematically evaluated, which may affect the reliability and strength of the overall conclusions.

4.6. Future Research Directions

The findings of this review highlight several highly critical areas for future research. Prospective randomized controlled trials specifically designed for large uteri populations are urgently needed to eliminate selection bias and provide definitive evidence regarding the comparative effectiveness of robotic versus laparoscopic approaches. Such studies should stratify patients by uterine size categories to better understand the size-dependent nature of outcomes observed in this review. Additionally, Cost-effectiveness analyses should be conducted across diverse healthcare systems to validate the surprising cost advantages observed for extremely large uteri.

4.7. Limitation

The major limitation of our study is the retrospective design of all included studies, the small number of studies (n=4) and sample sizes, the absence of prospective or randomized trials, and substantial heterogeneity in populations, definitions, and outcomes, which precluded meta-analysis and tempered the certainty of conclusions.

5. Conclusions

This systematic review demonstrates that the comparative effectiveness of robotic versus laparoscopic hysterectomy for large uteri is highly dependent on uterine size, with robotic approaches showing particular advantages for extremely large uteri in terms of operative efficiency and cost-effectiveness. While robotic hysterectomy shows real promise—especially in lowering conversion rates and making surgery more feasible for complex, large uteri—there are important caveats to keep in mind. Notably, the risk of ureteral injury appears to be somewhat higher with the robotic approach, and the skill and experience of the surgeon remain critical to achieving good outcomes. Based on the current body of evidence, which is drawn from retrospective studies, robotic hysterectomy may be a valuable option for carefully selected patients with extremely large uteri, but ideally only when performed by highly experienced surgeons in specialized, high-volume centers. To truly know which approach is best for which patients, we need more high-quality, prospective research that can provide stronger, evidence-based guidance for this challenging clinical scenario. The choice between RH and LH should prioritize patient selection (uterine size/adhesions), surgeon experience, and case volume, as well as institutional resources/robot access.

Conflicts of Interest

The authors declare no competing interests that could have influenced the objectivity or outcome of this research

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None

Informed consent

This article is based on previously conducted studies and does not contain any new studies with human participants or animals performed by any of the authors.

Large Language Model

None

Authors Contribution

AMA contributed to the conception and design of the study, data collection, and drafting of the manuscript. MW performed data analysis, interpretation of results, and critical revision of the manuscript. FRE provided supervision, methodological guidance, and manuscript editing. HS was responsible for the literature review, data validation, and preparation of tables and figures. AMQ conducted statistical analysis, offered technical support, and gave final approval of the manuscript.

Data Availability

All data generated or analyzed during this study are included in this published article and its supplementary files.

References

1. Donnez J, Taylor HS, Marcellin L, Dolmans MM. Uterine fibroid-related infertility: mechanisms and management. Fertil Steril. 2024;122(1):31-9. [PMID: 38453041, https://doi.org/10.1016/j.fertnstert.2024.02.049].
2. Borah BJ, Nicholson WK, Bradley L, Stewart EA. The impact of uterine leiomyomas: a national survey of affected women. Am J Obstet Gynecol. 2013;209(4):319 e1-319 e20. [PMID: 23891629, PMCID: PMC4167669, https://doi.org/10.1016/j.ajog.2013.07.017].
3. Eltoukhi HM, Modi MN, Weston M, Armstrong AY, Stewart EA. The health disparities of uterine fibroid tumors for African American women: a public health issue. Am J Obstet Gynecol. 2014;210(3):194-9. [PMID: 23942040, PMCID: PMC3874080, https://doi.org/10.1016/j.ajog.2013.08.008].
4. Li B, Wang F, Chen L, Tong H. Global epidemiological characteristics of uterine fibroids. Arch Med Sci. 2023;19(6):1802-10. [PMID: 38058724, PMCID: PMC10696973, https://doi.org/10.5114/aoms/171786].
5. Hazimeh D, Coco A, Casubhoy I, Segars J, Singh B. The Annual Economic Burden of Uterine Fibroids in the United States (2010 Versus 2022): A Comparative Cost-Analysis. Reprod Sci. 2024;31(12):3743-56. [PMID: 39455488, https://doi.org/10.1007/s43032-024-01727-0].
6. Do TK, Estevez JP, Canlorbe G, Gonthier C, Koskas M. Robotic versus open hysterectomy for very large uterus (more than 1000 g): A bicentric retrospective study of 150 patients. Int J Gynaecol Obstet. 2025. [PMID: 40515535, https://doi.org/10.1002/ijgo.70310].
7. Yadav P, Agrawal M, Chaudhari K, Sindhu A. Challenging Surgical Management of Giant Uterine Leiomyomas With Ileal Resection: A Clinical Case Study. Cureus. 2024;16(8):e66017. [PMID: 39221356, PMCID: PMC11366259, https://doi.org/10.7759/cureus.66017].
8. Soomro NA, Hashimoto DA, Porteous AJ, Ridley CJA, Marsh WJ, Ditto R, et al. Systematic review of learning curves in robot-assisted surgery. BJS Open. 2020;4(1):27-44. [PMID: 32011823, PMCID: PMC6996634, https://doi.org/10.1002/bjs5.50235].
9. Lenfant L, Canlorbe G, Belghiti J, Kreaden US, Hebert AE, Nikpayam M, et al. Robotic-assisted benign hysterectomy compared with laparoscopic, vaginal, and open surgery: a systematic review and meta-analysis. J Robot Surg. 2023;17(6):2647-62. [PMID: 37856058, PMCID: PMC10678826, https://doi.org/10.1007/s11701-023-01724-6].
10. Wright JD, Ananth CV, Lewin SN, Burke WM, Lu YS, Neugut AI, et al. Robotically assisted vs laparoscopic hysterectomy among women with benign gynecologic disease. JAMA. 2013;309(7):689-98. [PMID: 23423414, https://doi.org/10.1001/jama.2013.186].
11. Ito TE, Vargas MV, Moawad GN, Opoku-Anane J, Shu MK, Marfori CQ, et al. Minimally Invasive Hysterectomy for Uteri Greater Than One Kilogram. JSLS. 2017;21(1). [PMID: 28352147, PMCID: PMC5346020, https://doi.org/10.4293/JSLS.2016.00098].

12. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan-a web and mobile app for systematic reviews. Syst Rev. 2016;5(1):210. [PMID: 27919275, PMCID: PMC5139140, https://doi.org/10.1186/s13643-016-0384-4].
13. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. Rev Esp Cardiol (Engl Ed). 2021;74(9):790-9. [PMID: 34446261, https://doi.org/10.1016/j.rec.2021.07.010].
14. Sinha R, Bana R, Sanjay M. Comparison of Robotic and Laparoscopic Hysterectomy for the Large Uterus. JSLS. 2019;23(1). [PMID: 30675091, PMCID: PMC6328360, https://doi.org/10.4293/JSLS.2018.00068].
15. Jeong SY, Kim K, Ryu JW, Cha J, Park ST, Park SH. Comparison of Surgical Outcomes of Robotic versus Conventional Laparoscopic Hysterectomy of Large Uterus with Gynecologic Benign Disease. J Pers Med. 2022;12(12). [PMID: 36556262, PMCID: PMC9783652, https://doi.org/10.3390/jpm12122042].
16. Moawad GN, Abi Khalil ED, Tyan P, Shu MK, Samuel D, Amdur R, et al. Comparison of cost and operative outcomes of robotic hysterectomy compared to laparoscopic hysterectomy across different uterine weights. J Robot Surg. 2017;11(4):433-9. [PMID: 28144809, https://doi.org/10.1007/s11701-017-0674-4].
17. Manoucheri E, Cohen SL, Sandberg EM, Kibel AS, Einarsson J. Ureteral injury in laparoscopic gynecologic surgery. Rev Obstet Gynecol. 2012;5(2):106-11. [PMID: 22866190, PMCID: PMC3410510].
18. Tang FH, Tsai EM. Learning Curve Analysis of Different Stages of Robotic-Assisted Laparoscopic Hysterectomy. Biomed Res Int. 2017;2017:1827913. [PMID: 28373977, PMCID: PMC5360940, https://doi.org/10.1155/2017/1827913].
19. Paul-Dehlinger R, Vappereau A, Bras AL, Oliveira J, Favier A, Belghiti J, et al. Cost-effectiveness of robot-assisted total hysterectomy for benign pathologies compared to laparoscopic surgery: A retrospective study with propensity score. J Gynecol Obstet Hum Reprod. 2024;53(9):102821. [PMID: 39038739, https://doi.org/10.1016/j.jogoh.2024.102821].
20. Chen C, Zhang M, Tang J, Pu K. Cost-effectiveness of robotic surgery compared to conventional laparoscopy for the management of early-stage cervical cancer: a model-based economic evaluation in China. BMJ Open. 2024;14(11):e087113. [PMID: 39572093, PMCID: PMC11580275, https://doi.org/10.1136/bmjopen-2024-087113].

ASIDE Health Sciences

Original Article

Environmental Monitoring in a Class D Pharmaceutical Facility: Microbial Load and Hygiene Practices, a Risk-Based Cross-Sectional Study

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ABSTRACT

Background: Environmental monitoring is a crucial current Good Manufacturing Practice (cGMP) tool for assessing the status of the working environment in a Pharmaceutical Manufacturing Facility.
Methods: The test was conducted between May 20 and 25, 2025. 90 mm Diameter Settle Plates methods, 4 hours exposure under dynamic conditions, were used as a test method to study the microbial load in controlled and classified areas. The finger dab test was used to assess hygiene and sanitization practices in the plant. The non-viable count was excluded from the study due to limitations, including a lack of facilities for conducting the tests.
Result: The result of the environmental monitoring test was below 100 colony-forming units (CFU) in the rooms. The mean value of Total Aerobic Microbial Count and Total Yeast and Mold Count show a higher microbial count at the Near Return air loop. The p-value of Total aerobic microbial count and Total Yeast and Mold Count was found to be 0.8685 and 0.8716 respectively. The result is not significant at $p<0.05$. The result of the Finger dab test was below 100 CFU/5 fingerprints in both hands and complies with the internal action limit.
Conclusion: The result of the study suggests that the higher load of organisms was found at the "near return loop area". The result of the Finger dab test was satisfactory according to the in-house limit (100 CFU). The result can serve as a basis for selecting a sample spot for regular Environmental Monitoring in a Manufacturing Facility.

1. Introduction

The purpose of microbiological environmental monitoring is to assess the cleanliness of pharmaceutical (sterile and non-sterile) and medical device manufacturing environments. Environmental monitoring involves the collection of data relating to the numbers or incidents of microorganisms present on surfaces, in the air, and from people. [1]. The primary goal of environmental monitoring in cleanrooms is to regulate the numbers of airborne viable and non-viable particles within defined limits, predict the risk to the environment, and regularly assess the efficacy of cleaning and disinfecting processes [2].

Pharmaceutical manufacturing involves a complex, multi-phase processing system that is associated with significant risks of microbial contamination from various sources. The quality of the product is significantly influenced by microbial contamination in several processing steps [3]. To obtain a pharmaceutical product free of contamination, you need an adequate environmental monitoring system. The system includes identification, testing, and removal of bioburden to ensure the quality of the product [4].

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Risk assessment approaches are used to determine the location of environmental monitoring [5]. Risk-based approaches include Failure Mode and Effects Analysis (FMEA), Fault Tree Analysis (FTA), Hazard Analysis and Critical Control Points (HACCP), and Quantitative Microbiological Risk Assessment (QMRA) [6, 7]. The scope of this study is to fix the sampling spot based on risk assessment for performing environmental monitoring and to correlate the results of the Finger dab test and the non-viable count report with the sanitization of the area and the cleanliness of Personnel.

2. Method

2.1. Study Design

The study was designed as a cross-sectional pilot study and conducted between May 20 and 22, 2023. Test conditions were Dynamic and Temperature less ($\leq$ 25 °C), and Humidity ($\leq$ 60%) was maintained during study periods. Statistical analysis of the obtained data was done using the chi-square test, and the p-value was calculated. The test was performed by exposing 90 mm presterilized Petri plates containing Soyabean Casein Digest Agar and Sabouraud Dextrose Agar at a height of 40 cm on the Petri plate stands for 4 hours at each location. After 4 hours of exposure time, the Petri plates were covered with a lid and transported to the Microbiology Lab aseptically in a closed container. Soybean Casein Digest Agar plates were incubated at 35 °C for 72 hours, and Sabouraud Dextrose Agar Petri plates were incubated at 25 °C for 5 days. The Equipment used during the study was well-calibrated, and a sterility check of the used media was done prior to conducting the test.

Figure 1: Petri plate Exposed Near the Return Air Loop on the Stand.

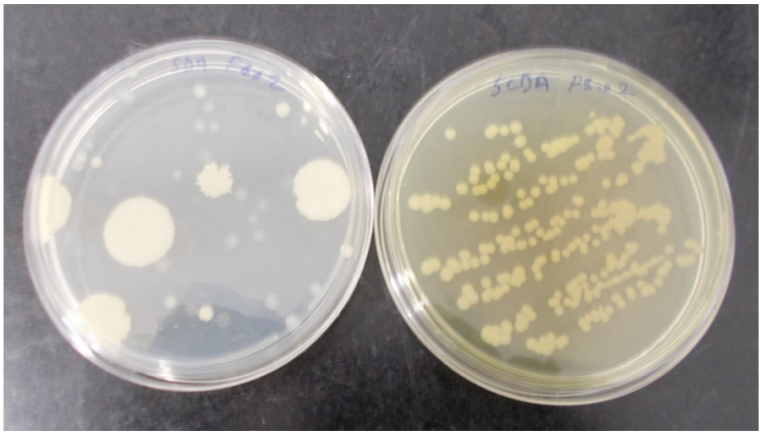

Figure 2: Petri plates after incubation (cfu per 4-hr settle plate).

Table 1: Materials used during the study

S. No	Materials and Equipment	Manufacturer
1	Pre-sterilized Petri plates	Tarsons
2	Soyabean Casein Digest Agar (SCDA)	Hi Media
3	Sabouraud Dextrose Agar (SDA)	Hi Media
4	Hot Plate	Lab Quest
5	Autoclave	Equitron
6	Bio-safety Cabinet	Thermolab
7	Incubators	Allyone
8	Colony Counter	Lapiz
9	Stainless Steel Petri Plate Stand	Sanitt
10	70% IPA	Qualigens

SCDA, Soyabean Casein Digest Agar; SDA, Sabouraud Dextrose Agar; IPA, Isopropyl Alcohol.

Table 2: Study area

S. No	Sampling rooms	Sampling location in the Room
1	Dispensing Room	Near Machine
2	Granulation Room	Area with maximum man movement
3	Punching Room	Difficult to clean area
4	Coating Room	Near return air loop
5	Blister Packing	Near the Drainage area

The Finger Dab test was performed in the Dispensing Room, Granulation Room, punching room, Coating room, and Blister Packing room by the personnel working in the respective areas. The in-house limit of the Finger Dab test was set at 100 CFU/5-finger print, as the production area was classified as a Class D area and non-sterile solid dosages were formulated in the area. Personnel working in areas were selected randomly, and the finger DAB test was evaluated for each of them. All the fingers, including the thumb of personnel's gloves, were gently imprinted, and impressions of all these workers were obtained on labeled Petri plates containing Soyabean casein digest agar. All the plates were incubated at 35°C for 72 hours, and the results were recorded. The finger dab test

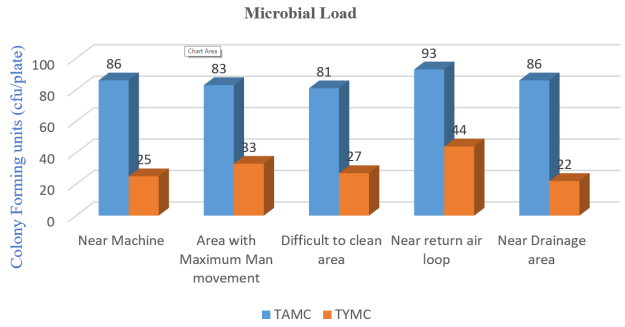

Figure 3: Bar Diagram of Dispensing Room (CFU per 4-hrs settle plate).

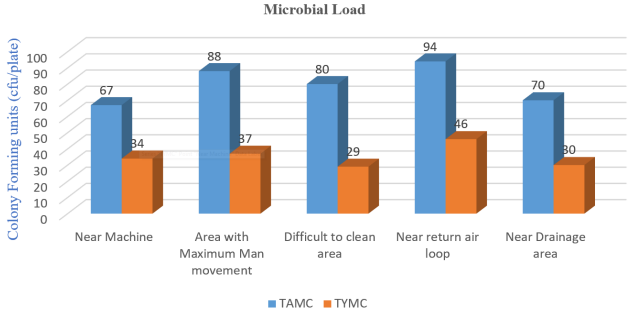

Figure 4: Bar Diagram of Granulation Room (CFU per 4-hrs settle plate)

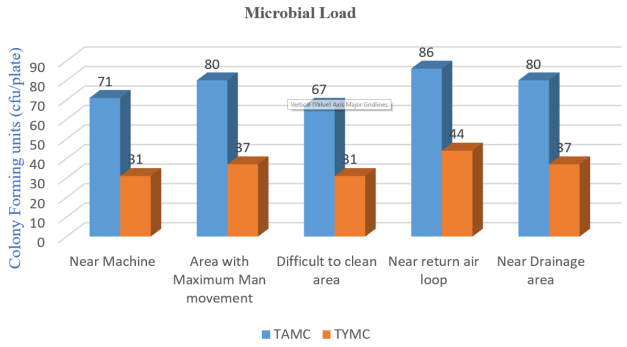

Figure 5: Bar Diagram of Punching Room (CFUper 4-hrs settle plate).

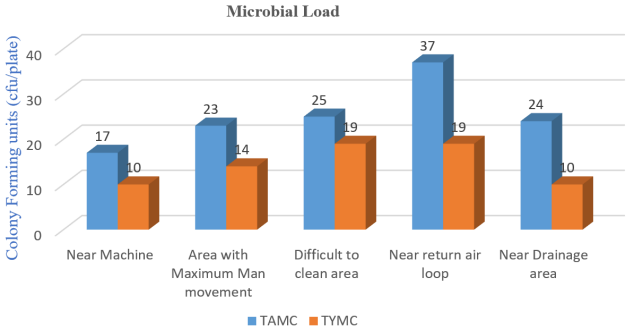

Figure 6: Bar Diagram of Coating Room (CFUper 4-hrs settle plate)

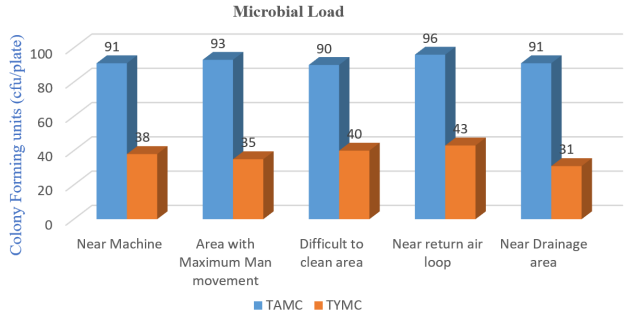

Figure 7: Bar Diagram of Blister Packing Room (CFU per 4-hrs settle plate).

in class D was proposed in a study to screen operator hygiene in non-sterile areas, and a 100 CFU in-house limit was selected as the internal action limit by analogy to the Class D Settle plate method. In the Class D area, the limit for the finger dab test is not defined in the WHO Technical Report Series No. 961. 2011, 100 CFU is an internal action limit, not a regulatory limit.

2.2. Procedure

25 plates of Soyabean Casein Digest Agar (SCDA) and 25 plates of Sabouraud Dextrose Agar (SDA) were exposed for 4 hours in all sampling points. The study was conducted for three successive days. Sterile Culture media plates of Soybean Casein Digest Agar and Sabouraud Dextrose Agar were exposed on Petri plates, placed at their respective sampling sites in each room, for four hours. After the completion of the exposure time, the Petri plates were aseptically transported to the Microbiology laboratory. Soybean Casein Digest Agar plates were incubated in an incubator for 72 hours, and Sabouraud Dextrose Agar Petri plates were incubated in a Biological Oxygen Demand (BOD) Incubator for 5-7 days. After the completion of the incubation period, colonies on Petri plates were counted using a Colony Counter, and the results were interpreted.

3. Result

3.1. Microbial count in different areas

The results obtained for the different locations of five rooms were counted, and the mean CFU was calculated for each sample location and sampling point within the room. The obtained data suggest that a higher Microbial load was observed in the "Near Return Air Loop" sample spot in each room. The higher count near the return loop warrants a study of grill cleanliness, personal proximity, and equipment, as well as heat plumes around the return filters. The p-value of Total aerobic microbial count was 0.8685, and the p-value of Total Yeast and Mold Count was 0.8716. The result is not significant at $p<0.05$.

Table 3: Observation of the Dispensing Room

S. No	Sampling Location	Total Aerobic Microbial Count (CFU/Plate)				Total Yeast and Mold Count (CFU/Plate)			
		Day-I	Day-II	Day-III	Mean	Day-I	Day-II	Day-III	Mean
1	Near Machine	84	90	84	86	21	28	26	25
2	Area with maximum man movement	92	75	82	83	30	31	38	33
3	Difficult to clean area	84	81	78	81	24	26	31	27
4	Near return air loop	96	93	90	93	43	47	42	44
5	Near the Drainage area	91	77	90	86	16	26	24	22

CFU, Colony Forming Units.

Table 4: Observation of the Granulation Room

S. No	Sampling Location	Total Aerobic Microbial Count (CFU/Plate)				Total Yeast and Mold Count (CFU/Plate)			
		Day-I	Day-II	Day-III	Mean	Day-I	Day-II	Day-III	Mean
1	Near Machine	65	67	69	67	32	36	34	34
2	Area with maximum man movement	85	89	90	88	33	39	39	37
3	Difficult to clean area	80	76	84	80	26	31	30	29
4	Near return air loop	90	94	98	94	45	45	48	46
5	Near the Drainage area	75	65	70	70	32	25	33	30

CFU, Colony Forming Units.

Table 5: Observation of the Punching Room

S. No	Sampling Location	Total Aerobic Microbial Count (CFU/Plate)				Total Yeast and Mold Count (CFU/Plate)			
		Day-I	Day-II	Day-III	Mean	Day-I	Day-II	Day-III	Mean
1	Near Machine	74	71	68	71	25	32	36	31
2	Area with maximum man movement	82	78	80	80	38	33	40	37
3	Difficult to clean area	65	67	69	67	26	35	32	31
4	Near return air loop	84	86	88	86	46	42	44	44
5	Near Drainage area	80	78	82	80	37	40	34	37

CFU, Colony Forming Units.

Table 6: Observation of the Coating Room

S. No	Sampling Location	Total Aerobic Microbial Count (CFU/Plate)				Total Yeast and Mold Count (CFU/Plate)			
		Day-I	Day-II	Day-III	Mean	Day-I	Day-II	Day-III	Mean
1	Near Machine	17	12	22	17	11	10	9	10
2	Area with maximum man movement	23	26	20	23	12	14	16	14
3	Difficult to clean area	31	24	20	25	17	17	23	19
4	Near return air loop	34	37	40	37	14	18	28	20
5	Near the Drainage area	21	29	22	24	7	10	13	10

CFU, Colony Forming Units.

Table 7: Observation of the Blister Packing Room

S. No	Sampling Location	Total Aerobic Microbial Count (CFU/Plate)				Total Yeast and Mold Count (CFU/Plate)			
		Day-I	Day-II	Day-III	Mean	Day-I	Day-II	Day-III	Mean
1	Near Machine	90	95	88	91	36	37	41	38
2	Area with maximum man movement	95	94	90	93	40	35	30	35
3	Difficult to clean area	95	96	97	96	42	40	38	40
4	Near return air loop	90	88	92	90	42	45	42	43
5	Near Drainage area	90	93	90	91	38	40	22	31

CFU, Colony Forming Units.

Table 8: Statistical Analysis for Total Aerobic Microbial Count (Chi-Square Test)

Room	Near Machine	Area with maximum Mean value	Difficult to clean area	Near return air loop	Near the Drainage area	Row Total
Dispensing room	86 (79.17) (0.59)	83 (87.53) (0.23)	81 (81.79) (0.01)*	93 (96.82) (0.15)	86 (83.70) (0.06)	429
Granulation room	67 (73.63) (0.60)	88 (81.40) (0.54)	80 (90.05) (0.17)	94 (90.05) (0.17)	70 (77.85) (0.79)	399
Punching room	71 (70.87) (0.00)*	80 (78.38) (0.04)*	67 (86.66) (0.01)*	86 (86.66) (0.01)*	80 (74.92) (0.34)	384
Coating room	17 (23.25) (1.68)	23 (25.70) (0.28)	25 (24.02) (0.04)*	37 (28.44) (2.58)	24 (24.58) (0.01)*	126
Blister packing room	91 (85.08) (0.41)	93 (94.05) (0.01)*	90 (87.89) (0.05)	96 (104.04) (0.62)	91 (89.94) (0.01)*	461
Column total	332	367	343	406	351	1779

(*) Statistically Significant. P-value: 0.8685. The result is not significant at $p < 0.05$

Table 9: Statistical Analysis for Total Yeast and Mold Count (Chi-Square Test)

Room	Near Machine	Area with maximum Mean value	Difficult to clean area	Near return air loop	Near the Drainage area	Row Total
Dispensing room	23 (26.49) (0.46)	33 (30.38) (0.23)	27 (28.44) (0.07)	44 (38.37) (0.83)	22 (25.32) (0.44)	149
Granulation room	34 (31.29) (0.23)	37 (35.89) (0.03)*	29 (33.59) (0.63)	46 (45.32) (0.01)*	30 (29.91) (0.00)*	176
Punching room	31 (32.00) (0.03)*	37 (36.71) (0.00)*	31 (34.35) (0.33)	44 (46.35) (0.12)	37 (30.59) (1.34)	180
Coating room	10 (12.98) (0.68)	14 (14.89) (0.05)	19 (13.93) (1.84)	20 (18.80) (0.08)	10 (12.41) (0.47)	73
Blister packing room	38 (33.24) (0.68)	35 (38.13) (0.26)	40 (35.69) (0.52)	43 (48.16) (0.55)	31 (31.78) (0.02)*	187
Column total	136	156	146	197	130	765

(*) Statistically Significant. P-value: 0.8716. The result is not significant at $p < 0.05$.

Table 10: Limit of 90 mm Diameter Settle Plate [2].

Grade	Air Sample (CFU/m^3)	90 mm Diameter Settle Plates (CFU/4 hours)	55 mm Diameter Contact Plates (CFU/plate)	Gloves Print (5 fingers) CFU/Glove
Class A	<1	<1	<1	<1
Class B	10	5	5	5
Class C	100	50	25	-
Class D	200	100	50	-

CFU, Colony Forming Units.

Table 11: Observation of Finger Dab Test

S. No.	Sample Code No.	Sampling Location	TAMC (Right Hand, CFU/Plate)	TAMC (Left Hand, CFU/Plate)
1	09	Dispensing Room	30	22
2	19	Dispensing Room	47	29
3	24	Granulation Room	24	48
4	51	Granulation Room	30	41
5	62	Punching Room	58	48
6	28	Punching Room	59	48
7	42	Coating Room	46	47
8	11	Coating Room	58	45
9	36	Blister Packing Room	32	30

TAMC, Total Aerobic Microbial Count; CFU, Colony Forming Units.

The result of a higher count near the return air loop may be due to the airflow path. The result aligns with a similar study by Shrawan et al. (2025), who reported a higher load at the return loop [8]. The Finger Dab test was conducted in the Class D area to screen operator hygiene in a non-sterile environment, with a limit of 100 CFU/5 fingerprints, as the internal action level was selected as a limit in analogy to the Class D Settle plate method, but not a regulatory limit.

The result was satisfactory, but the study warrants consideration of whether it can be done or not, as no guidelines suggest the finger dab test in a Class D area.

4. Discussion and Conclusion

The result of the study suggests that the pharmaceutical industry is operating in compliance with the standard for viable particles. Although the study is a single-site pilot study, all viable counts were within expectation for Class D. Seasonal variability and inter-site comparability study remain the major aspects to be concluded in further studies. So far, the results of the viable count of microorganisms indicate that higher counts are found near the Return loop areas. This result can serve as a basis for selecting the sample spot for the regular environmental monitoring Program in Class D areas of the pharmaceutical industry. Operator hygiene should be considered at higher Personnel Proximity in a Pharmaceutical Manufacturing Facility. Although 100 CFU/5 fingerprint is not a regulatory limit, it can be considered an internal action limit to maintain hygiene within a Class D pharmaceutical manufacturing facility.

Conflicts of Interest

The authors declare that they have no competing interests that could have influenced the objectivity or outcome of this research.

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Informed consent

This study did not involve human participants, human data, or human tissue. Therefore, approval from an IRB or ethics committee was not required. All procedures were conducted in accordance with the relevant guidelines and regulations for laboratory-based research.

Large Language Model

No large language model was used in the preparation of this

Authors Contribution

SKS contributed to conceptualization, methodology, investigation, data collection, analysis, and writing of the original draft and final manuscript.

Data Availability

No datasets were generated or analyzed for this study beyond the summary results presented in the article; therefore, no additional data are available. Data sharing does not apply to this research. For reasonable queries about the summarized results or methods, please contact the corresponding author listed in the manuscript.

References

1. Sandle T, Tidswell W, Saghee MR. Microbiology and sterility assurance in pharmaceuticals and medical devices. 2011.
2. Organization WH. WHO good manufacturing practices for sterile pharmaceutical products. World Health Organization; 2011. [PMCID: PMCID].
3. Ratajczak M, Kubicka MM, Kaminska D, Sawicka P, Dlugaszewska J. Microbiological quality of non-sterile pharmaceutical products. Saudi Pharm J. 2015;23(3):303-7. [PMID: 26106278, PMCID: PMC4475860, https://doi.org/10.1016/j.jsps.2014.11.015].
4. Mehdi A, Mehmood M, Usman Ghani M, Ghani, Ismail M, Ameen F. Environmental Monitoring and Risk Assessment of Cleanrooms within Pharmaceutical Industry. International Journal of Pharmacy. 2018;8:38-69.
5. Sandle T. The use of a risk assessment in the pharmaceutical industry – the application of FMEA to a sterility testing isolator: a case study. European Journal of Parenteral and Pharmaceutical Sciences. 2003;8(2):43-9.
6. Whyte W, Eaton T. Microbial risk assessment in pharmaceutical cleanrooms. European Journal of Parenteral and Pharmaceutical Sciences. 2004;9(1):16-23.

7. Whyte W, Eaton T. Microbiological contamination models for use in risk assessment during pharmaceutical production. European Journal of Parenteral and Pharmaceutical Sciences. 2004;9(1):11-5.
8. Singh SK, Dutta K, Chaudhary R. Risk Based Study of Sample Spot Fixing for Conducting Environmental Monitoring Test in Classified Areas of Pharmaceutical Industry. Int J of Pharm Sci. 2025;3(2):146-52. [https://doi.org/10.5281/zenodo.14793799].

ASIDE HEALTHCARE

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Original Article

Improving Compliance with the National Early Warning Score 2 (NEWS2) in an Egyptian Central Hospital Emergency Department: A Two-Cycle Clinical Audit

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Triage

ABSTRACT

Background: NEWS2 is a standardized assessment tool used to determine illness severity and identify patients at risk of deterioration. However, its effectiveness is limited by systemic barriers. This audit primarily aims to evaluate NEWS2 compliance in an emergency department and implement targeted interventions to address recognized gaps.
Methods: A two-cycle clinical audit was conducted at ShubraKhit Central Hospital's ED over a period of three weeks. Cycle 1 (August 18–25, 2025) established a baseline by assessing vital sign documentation, NEWS2 calculation, and escalation practices in 50 patients. The analysis of the root causes successfully identified the key barriers. Targeted interventions were implemented. Cycle 2 (September 1–8, 2025) re-audited the other 50 patients to evaluate the impact of the intervention. Data were analyzed using chi-square or Fisher's exact tests as appropriate, with effect sizes and 95% CIs.
Results: Cycle 1 showed serious and critical drawbacks, with only 2% of patients having a complete set of vital signs documented, and NEWS2 calculated in only 2% of cases. The primary barriers were a lack of equipment (96%) and a 100% lack of awareness of the escalation protocol. Following the suitable intervention, Cycle 2 demonstrated a significant improvement, with 100% of patients having all vital signs documented, and NEWS2 calculated in 96% of cases.
Conclusions: A targeted intervention focuses on addressing specific root causes, leading to compliance with the NEWS2 scoring system. This ensures that evidence-based quality improvement can bridge the gap between clinical guidelines and practice.

1. Introduction

Preliminary recognition of physical deterioration is a fundamental pillar of patient safety in the acute care pathway. Standardized clinical early-warning systems were developed to ensure consistent, comparable, and actionable physiological monitoring. Thus, once that deterioration is detected, immediate escalation pathways are triggered without any delay.

However, the implementation of these systems often fails to meet expectations. Empirical and qualitative studies in emergency and acute settings report that incomplete or missing vital-sign sets are common [1], and implementation research has repeatedly identified system-level barriers—such as limited availability or accessibility of functioning monitoring devices [2], workflow constraints and interruptions [3] burdensome documentation processes, and variable staff awareness or training about escalation procedures, as major contributors to incomplete measurement and inappropriate escalation, respectively [4].

The most suitable tool for this setting is the widely adopted and NHS-endorsed scoring system: the National Early Warning Score 2 (NEWS2), developed by the Royal College of Physicians [5]. It is an established track and proper system to assess illness severity and risk of deterioration for patients in acute episodes of care [6]. Previous studies have stated the NEWS2 value in the prediction of septic patients [7] and other patients with cardiac arrest, unplanned ICU admission, emergency surgery, and acute kidney injury in the emergency department [8, 9].

The Egyptian Central Hospitals' ED typically employs a local triage assessment protocol that requires documentation of pulse rate, blood pressure, respiratory rate, random blood glucose level, and temperature. However, vital sign monitoring remains inconsistent and is often performed selectively based on perceived clinical urgency rather than systematically for all patients, as recommended by early warning score protocols [10]. This audit aims mainly to assess the completeness of the core physiological observations on ED presentation (the vital signs), determine whether escalation protocols were appropriately triggered and followed when indicated, and identify and classify the principal obstacles to correct monitoring and escalation (process/resource factors versus knowledge gaps). The ultimate objective is to translate findings into pragmatic, system-focused interventions to improve surveillance and escalation.

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Parameter \ Score	3	2	1	0	1	2	3
Respiration rate (per minute)	≤8		9–11	12–20		21–24	≥25
SpO_2 Scale 1 (%)	≤91	92–93	94–95	≥96			
SpO_2 Scale 2 (%)	≤83	84–85	86–87	88–92 (≥93 on air)	93–94 on oxygen	95–96 on oxygen	≥97 on oxygen
Air or oxygen?		Oxygen		Air			
Systolic blood pressure (mmHg)	≤90	91–100	101–110	111–219			≥220
Pulse (per minute)	≤40		41–50	51–90	91–110	111–130	≥131
Consciousness				Alert			CVPU
Temperature (°C)	≤35.0		35.1–36.0	36.1–38.0	38.1–39.0	≥39.1	

Figure 1: Representation of the NEWS2 Scoring System Chart.
This figure was redrawn based on publicly available information from the Royal College of Physicians (RCP) NEWS2 chart (© RCP 2017). No copyrighted materials were reproduced or modified. [11]

2. Methods & Participants

2.1. Study Design

This clinical audit was conducted at ShubraKhit Central Hospital and employed a two-cycle design. In Cycle 1 (as a baseline), data were collected on the documentation of the standardized vital signs, calculation of NEWS2 scores, and the escalation decisions in the emergency department and triage areas. The audit followed the SQUIRE 2.0 framework for structured reporting of quality improvement. Following the identification of key gaps, interventions targeted the barriers in staff awareness, equipment availability, and workflow efficiency. Two 45-minute educational sessions were held with emergency physicians and triage nurses. The sessions were supported by visual aids summarizing the NEWS2 scoring and the escalation thresholds. Learning posters were displayed in the clinical areas, and the necessary monitoring devices were provided to ensure that all vital signs could be accurately recorded and monitored. The implementation of fidelity was confirmed through the participants' registers and direct observation. The second cycle (Cycle 2) was then attempted to reassess practice after these interventions, allowing for an evaluation of their impact and comparison with the initial findings of Cycle 1.

2.2. Data Collection

Patients' data were collected using a standardized data collection form in accordance with established clinical audit standards, as shown in **(Table 1)**. All authors involved in the audit were conveniently trained to systematically document the data and perform accurate analysis in line with audit methodology. Vital signs documentation, calculation, and charting of the NEWS2 score [5]As shown in **(Figure 1)**, the timeliness of monitoring, senior review, and escalation (where indicated), as well as reasons for non-performance or missed escalation, and final patient outcomes following ED evaluation, are outlined in **(Table 1)**.

Appropriate escalation was defined a priori according to the RCP NEWS2 policy. Patients with NEWS2 scores of 0–4 required routine monitoring. Any patient scoring 3 in a single parameter warranted a clinical review within 60 minutes. Scores of 5–6 mandated an urgent review by a clinician or team competent in assessing acutely ill patients within 30 minutes, while those with a NEWS2 score of 7 or higher required an immediate senior review and consideration for critical care activation. Patients receiving supplemental oxygen were reassessed after titration, and any AVPU response other than "Alert" triggered immediate escalation irrespective of the aggregate score. These thresholds formed the audit standards and pass/fail criteria.

(Table 1) shows a robust framework for systematically evaluating the application of vital signs monitoring and NEWS2 in emergency care.

2.3. Sampling Technique & Population

This clinical audit was conducted at ShubraKhit Central Hospital's Emergency Department and included patients presenting to the Accident and Emergency Unit (A&E) during two audit cycles. A consecutive sampling approach was used to include all triaged adult patients (aged 18 years or older) presenting to the Emergency Department during the defined one-week audit periods.

The sample size was estimated using the standard formula for proportions at a 95% confidence level and a ±5% margin of error, assuming maximum variability ($p = 0.5$). This yields an initial estimate of $n_0 \approx 385$. Applying the finite population correction for an expected population of 50–100 eligible ED cases per audit cycle yields an adjusted $n \approx 44$–80. Therefore, including 50 patients per cycle exceeded the minimum requirement for achieving adequate statistical precision. Such a sample size is also consistent with the recommended standard mentioned in the UHBristol NHS "How To: Set an Audit Sample & Plan Your Data Collection" guideline for clinical audits (2022), ensuring both methodological rigor and feasibility [12].

Cycle 1 was conducted retrospectively, using archived medical records of patients who had already been presented to the emergency department from August 18th to August 25th, 2025, while Cycle 2 was conducted prospectively from September 1st to September 8th, 2025.

Inclusion criteria covered almost all adult patients (≥ 18 years) presenting to the ED during the audit period. Exclusion criteria were clear: patients younger than 18 years, patients who were already dead on arrival, cases with improper documentation preventing reliable data extraction, and patients transferred immediately to another facility before triage could be completed.

Table 1: Audit Parameters and Descriptions

Parameter	Description	Standard / Compliance Definition
Patient ID	—	—
Age	—	—
Gender	Biological sex (M/F)	—
Initial NEWS2 score	If calculated	Score must be documented in EMR; compliant = recorded
Documented vital signs	Systolic BP, HR, RR, SpO_2, Temp, AVPU, O_2 supplementation	Compliant = all 6 core vitals recorded within 15 minutes of arrival
NEWS2 documented	Whether score recorded	Compliant = NEWS2 documented for patients with complete vitals
Escalation triggered if NEWS2 ≥ 5	Urgent senior review / rapid response	Compliant = protocol triggered within the recommended timeframe
Assessor	Who measured vitals (doctor / nurse / paramedic)	—
Timeliness of vitals	Within 15 minutes	Compliant = recorded $\leq$ 15 min from arrival
Time to senior review	Minutes from triage	Compliant = $\leq$ 30 min if NEWS2 ≥ 5
Escalation appropriateness	Followed NEWS2 policy	Compliant = correct escalation according to score and policy
Reasons for missing NEWS2	Workflow / equipment / knowledge gaps	Documented reasons provided for non-compliance
Patient disposition	Discharged / Ward / ICU	—

ID, Identification; NEWS2, National Early Warning Score 2; AVPU, Alert-Verbal-Pain-Unresponsive; EMR, Electronic Medical Record; ED, Emergency Department; ICU, Intensive Care Unit.

The sample comprised patients from diverse sociodemographic backgrounds, ensuring a realistic representation of cases. This design enabled the audit to identify existing gaps in practice in Cycle 1 and then evaluate the impact of targeted interventions during prospective reauditing in Cycle 2.

2.4. Root Cause Analysis

Following Cycle 1, a structured root cause analysis was conducted using the 5 Whys technique, an iterative method for drilling down from a surface-level problem to its underlying system cause through five successive "why" questions. The analysis was facilitated by the audit data collection lead, in coordination with the hospital's Quality Office, and involved all 12 emergency physicians who performed triage during the audit period. After narrowing down the problem to incomplete vital sign documentation, the team came up with the following series of questions: (1) Why were vital signs incomplete? Because, for example, respiratory rate and oxygen saturation were rarely recorded. (2) Why were these parameters not recorded? Because pulse oximeters and timing devices were unavailable at triage stations. (3) Why were these tools unavailable? Because the department possessed only two functional oximeters for three triage bays, with no fixed assignment. (4) Why was equipment allocation insufficient? Because no formal inventory or preventive maintenance protocol existed for triage monitoring devices. (5) Why was such a protocol absent? Because equipment management had never been incorporated into the Emergency Department's quality assurance processes

2.5. Data & Statistical Analysis

Data were analyzed using JASP version 0.19.2. Categorical variables were summarized as frequencies and percentages, while continuous data were summarized as means or medians. Between-cycle comparisons were performed using chi-square or Fisher's exact tests, as appropriate, with absolute risk differences and the same 95% confidence intervals reported to reflect statistical precision ($\alpha = 0.05$). The primary outcome was completion of all six core vital signs within 15 minutes; NEWS2 calculation, documentation, and escalation were secondary outcomes to avoid multiple testing bias.

2.6. Ethics Approval/IRB Statement

The Directorate of Health Affairs in Beheira, Egypt, gave the green light for this clinical audit. Besides that, the local ethical committee at Mansoura National University gave its clearance for the same with an official approval (no. 1908/25). The audit adhered to the ethical principles outlined in the Declaration of Helsinki and followed the guidelines of Good Clinical Practice (GCP). The Quality Office of ShubraKhit Central Hospital looked after institutional governance and supervision.

3. Results

3.1. Descriptive Analyses

A total of 100 acute patients were analyzed across two audit cycles (50 per cycle). The sex distribution was identical between cycles, with 36 females (72%) and 14 males (28%) in each, as shown in **(Figure 2)**. The median age increased from 36.5 years (mean 38.5) in Cycle 1 to 46 years (mean 46.3) in Cycle 2.

In Cycle 1, vital sign documentation was profoundly deficient. Only one patient (2%) had a complete set of the six core vital signs recorded. Systolic blood pressure was the most frequently documented parameter (82%), while critical signs such as respiratory rate and oxygen saturation were recorded in only 4% of cases. Consequently, the NEWS2 score was calculated by a specialized physician in only a single case (2%) and was not formally documented in any of the others. The root cause analysis for the failures identified in Cycle 1 revealed two primary issues. Firstly, the cause of incorrect clinical escalation was 100% due to a lack of awareness of the NEWS2 standards and escalation protocol among the clinicians. Secondly, the failure to perform NEWS2 was caused by the inability to complete vital signs, which was attributed predominantly to a lack of instruments (96% of cases), with lack of knowledge and time being minor factors (2% each).

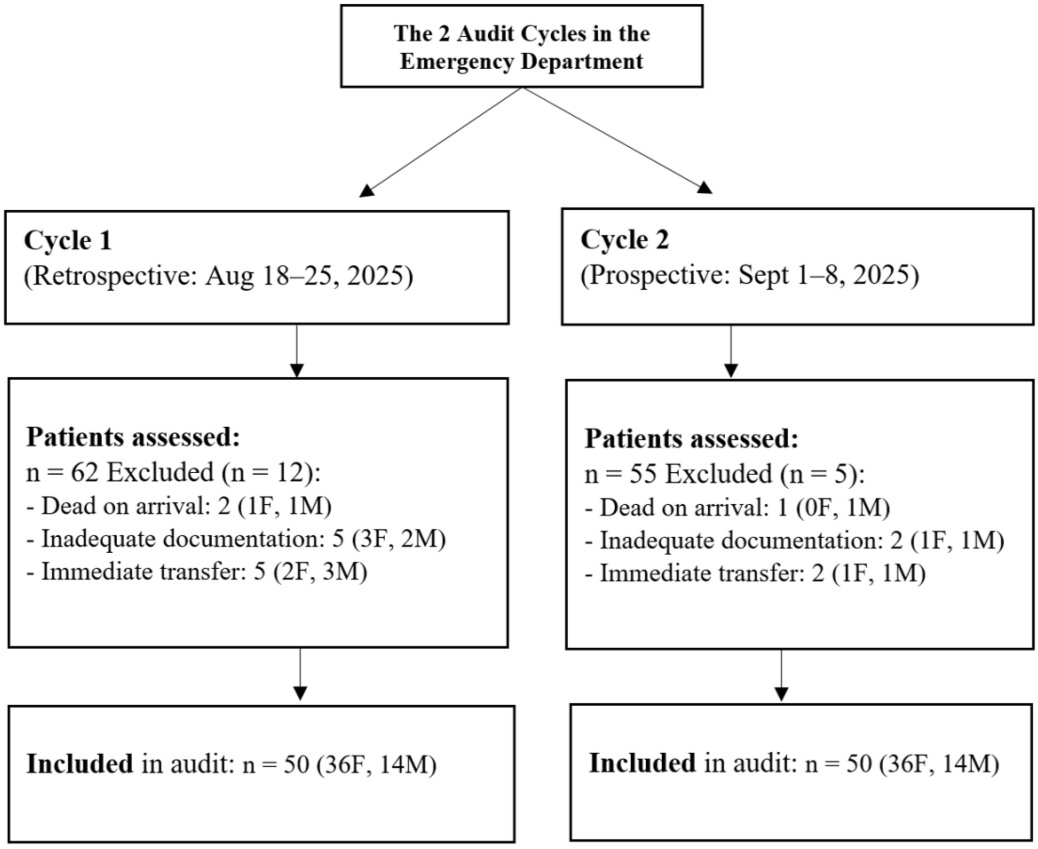

Figure 2: NEWS2 Implementation Audit: Pre- and Post-Intervention.
A CONSORT-style flow diagram comparing two audit cycles for NEWS2 implementation in an Emergency Department. ED, Emergency Department; NEWS2, National Early Warning Score 2; F, Female/s; M, Male/s.

The authors, with the assistance of the hospital's Quality Office, implemented a targeted intervention to address the audit findings. This included educational seminars and posters to strengthen the NEWS2 protocols, procure the required equipment, and promote a supportive environment for clinicians. Intervention fidelity was monitored through attendance logs and a 5-item pre- and post-knowledge check. All 28 emergency department staff (100% of clinicians involved in triage) attended at least one session across all shifts; mean knowledge scores improved from 1.2/5 to 4.6/5. Posters were displayed in all clinical areas, and the Quality Office confirmed equipment availability before Cycle 2.

Subsequently, the reaudit demonstrated a transformation in practice. All six core vital signs were recorded for all 50 patients (100%) in Cycle 2. The NEWS2 score was successfully calculated in 48 cases (96%) and formally documented in the medical record in 47 cases (94%), primarily due to inexperience and documentation oversight among junior staff.

The assessment of vital signs and first triage was performed solely by physicians in both cycles. Timeliness of care was already high in the auditing cycle, with nearly all vital signs (98%) recorded within 15 minutes and all patients receiving a senior review within 30 minutes of triage. The reaudit showed a further improvement in the efficiency of vital sign recording, achieving this within the 15-minute window for 100% of cases, while maintaining a rapid time to senior review (<30 minutes).

3.2. Comparative and Statistical Analyses

The improvement between cycles was statistically significant for all key process measures. The compliance rate for calculating NEWS2 increased by 94 percentage points ($p < 0.0001$). In Cycle 1, no patient had a documented NEWS2 score; thus, escalation decisions were based solely on clinical impression, with only 2 of 50 cases (4%) receiving timely senior review for apparent deterioration. In Cycle 2, among the 9 patients with a NEWS2 score of 5 or higher, appropriate escalation (senior review within 30 minutes and documented action) occurred in 8 cases (88.9%). A shift in patient disposition was observed, though not all changes reached statistical significance, as shown in **(Table 2)**. In Cycle 2, the distribution of initial NEWS2 scores among the 48 calculated cases was varied, with 9 patients (18.8%) scoring 5 or higher, triggering the escalation protocol. This protocol was followed appropriately in 8 of these 9 cases (88.9%).

(Table 2) reveals that the intervention was associated with statistical significance and near-perfect compliance in vital sign documentation, confirming that the root cause was effectively addressed. The observed shifts in patient disposition are not statistically significant. Absolute Risk Difference (ARD) and 95% CI were calculated to quantify effect magnitude and precision.

4. Discussion

ShubraKhit Central Hospital is a public, 200-bed secondary care facility serving a predominantly rural population, with an estimated annual ED volume of 25,000–30,000 adult visits. Resources are

Table 2: Comparative Documentation of Vital Signs and Key Metrics

Metric	Cycle 1 (n=50)	Cycle 2 (n=50)	ARD% (95% CI)	p-value*
Individual Vital Signs				
Systolic BP	82% (41)	100% (50)	+18% (9–27)	0.002
Heart Rate	8% (4)	100% (50)	+92% (84–100)	<0.0001
Respiratory Rate	4% (2)	100% (50)	+96% (89–100)	<0.0001
O_2 Saturation	4% (2)	100% (50)	+96% (89–100)	<0.0001
Temperature	2% (1)	100% (50)	+98% (92–100)	<0.0001
AVPU	4% (2)	100% (50)	+96% (89–100)	<0.0001
Supplemental O_2	4% (2)	100% (50)	+96% (89–100)	<0.0001
Composite Measures				
All 6 Vital Signs	2% (1)	100% (50)	+98% (92–100)	<0.0001
No Vital Signs Recorded	18% (9)	0% (0)	-18% (–28 to –8)	0.001
Patient Disposition				
Discharged	54% (27)	58% (29)	+4% (–12 to 20)	0.68
Ward Admission	44% (22)	26% (13)	-18% (–34 to –2)	0.06
ICU Admission	2% (1)	10% (5)	+8% (–1 to 17)	0.09
Transferred	0%	6% (3)	+6% (0 to 13)	0.08

ARD, Absolute Risk Difference; SpO_2, Oxygen Saturation; AVPU, Level of Consciousness Scale (Alert, Voice, Pain, Unresponsive); ICU, Intensive Care Unit; n, number of patients; p-values calculated using the Chi-Squared test. *Fisher's exact test for metrics with small counts; otherwise χ^2. Statistical significance: $p < 0.05$.

constrained, with limited monitoring equipment and no electronic early warning system in place. Therefore, while our low-cost, education-plus-equipment intervention proved effective here, findings may not generalize to: (1) tertiary urban hospitals with nurse-led triage and electronic health records; (2) settings where basic monitoring equipment is consistently available; or (3) facilities lacking institutional support from a dedicated Quality Office to drive and sustain change.

This audit demonstrates the observed impact of a targeted, multimodal intervention on adherence to early warning score protocols. Cycle 1 findings revealed critical systemic failures, with near-complete non-compliance in NEWS2 documentation, which is highly consistent with studies that identify inadequate resources and training as primary barriers to the implementation of track-and-trigger systems [4]. The specific root causes, a lack of equipment (96%) and a lack of awareness of the protocol (100%), provided a clear roadmap for intervention.

The re-auditing results show a statistically significant improvement in 96% NEWS2 calculation and 100% vital sign compliance, associated with the implementation of the guidelines. The small proportion of non-compliant cases in Cycle 2 was largely attributable to documentation lapses and inexperience among junior physicians, rather than systemic barriers. This suggests that while structural gaps (e.g., equipment, training) were effectively resolved, sustained compliance requires ongoing supervision and embedding of protocol discipline into routine practice—particularly for less experienced staff. However, this aligns with the established quality improvement principles that emphasize addressing the root causes through a combination of education, resource provision, systemic support, and ongoing supervision [13].

Additionally, the observed increase in ICU admissions (from 2% to 10%) and decrease in ward admissions (from 44% to 26%) occurred concurrently with the implementation of the intervention. Given the non-randomized, short two-cycle design, these disposition changes may reflect case-mix differences, temporal effects, or documentation bias rather than a confirmed causal effect. However, they suggest that a more precise assessment of patient acuity may be associated with a more appropriate disposition [14].

The rapid rise from 2–4% to nearly 100% compliance within one week raises concerns about Hawthorne effects, temporary resource influx, or documentation artifacts. To verify the results, pre-specified data quality checks—including double-entry verification and spot-checks—were conducted. Sensitivity analyses excluding the first 24–48 hours post-intervention confirmed that the improvements were sustained and not solely due to immediate observation or reporting bias.

Consistent with guidance from the Royal College of Physicians (RCP) and NHS England on the National Early Warning Score 2 (NEWS2), these findings must be interpreted within the local context [15]. Observed improvements should therefore be understood as context-specific and may not generalize to other settings.

The effectiveness of our intervention hinged on a rigorously conducted root cause analysis (RCA) using the 5 Whys technique—a lean, iterative method recommended for identifying system-level failures in clinical quality improvement (Institute for Healthcare Improvement, 2023 We found that incomplete vital sign documentation and absent NEWS2 escalation are mainly due to shortage of equipment and lack of training at the institution and not because of individual error. Thus, we ensured that interventions targeted the underlying system issues rather than the symptoms. On the other hand, this study adheres to SQUIRE 2.0 reporting standards for quality improvement, explicitly describing available resources, staff allocation, and environmental constraints to enhance transparency and support the interpretation of results in light of local operational realities [16].

Despite nurses' training and availability, triage remained exclusively physician-led—a practice that aligns with evidence that physicians often view themselves as sole decision-makers in emergency care, thereby reinforcing a hierarchical structure that marginalizes nursing input, according to Gregoriou et al. [17]. This

may bias timeliness and throughput metrics, limiting generalizability [18]. Therefore, future audit cycles should evaluate nurse-led vital signs collection to optimize workflow and external validity. Best practice often involves nursing-led vital signs collection to free physician time for specialized, complex decision-making [19].

Limitations

This audit has limitations that should certainly be acknowledged. It did not intuitively assess the long-term resilience of the observed improvements, considering the cycle durations or their direct impact on patients' clinical outcomes. Furthermore, the single-hospital setting can limit the generalizability of our findings. Short cycles and a single pre- and post-snapshot reduce sustainability assessment, and potential Hawthorne or documentation bias may have affected results. Moreover, we cannot exclude the influence of secular trends, such as seasonal shifts in patient acuity or the publicity effect of the audit itself. However, hospital records confirm no concurrent changes in ED staffing, policy, or other quality initiatives during the study period. Misclassification is possible regarding who recorded vital signs or back-charting, and no adjustment was made for case mix. Some χ^2 assumptions may have been violated, and the identical sex split across cycles warrants verification. Plans for a third cycle, spanning 3–6 months, with SPC monitoring, will potentially strengthen the clinical evidence base and assess the extensive clinical implications of implementing structured and updated vital signs monitoring and escalation guidelines.

5. Conclusions

This audit revealed concerning gaps in vital signs measurement and escalation during triage and emergency care in a typical Egyptian central hospital, often due to limited resources and a lack of awareness and knowledge of the latest guidelines. Targeted interventions significantly improved adherence, and the National Early Warning Score 2 (NEWS2) demonstrated a fast, practical, and efficient method for early risk detection within this particular setting. To sustain these improvements, we have integrated NEWS2 documentation into the ED onboarding orientation for all new physicians, established monthly spot audits by the Quality Office, and scheduled biannual refresher training. A third audit cycle is planned for March 2026 to assess the sustainability over the six months. While long-term resilience was not evaluated, embedding NEWS2 into routine emergency practice at this site might have contributed to safer and higher-quality patient emergency care. However, going beyond broad generalizations requires continuous measurement and multicenter evaluation.

Conflicts of Interest

The authors declare no conflicts of interest related to this work.

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This audit was conducted as part of routine quality improvement at ShubraKhit Central Hospital and received no external funding. The hospital's quality improvement budget covered the costs of equipment.

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Informed consent

Before the start of the study's second cycle, written consent was obtained formally from all patients involved. They were completely free to decide whether to participate, and the privacy of patient information was strictly maintained throughout the audit process.

Large Language Model

We have employed an advanced Large Language Model (LLM) to enhance and refine a few sentences. This process focused solely on improving the text's clarity and style, without generating or adding any new information to the content.

Authors Contribution

AA conceived and designed the audit. MD collected and entered the data AT performed the statistical analysis. AmT supervised the audit process. All authors reviewed and approved the final manuscript.

Data Availability

The data used to support this clinical audit can be obtained from the corresponding author upon request. However, access to them is limited to safeguard patient confidentiality in accordance with the institution's data protection policy.

References

1. Elliott M, Endacott R. The clinical neglect of vital signs' assessment: an emerging patient safety issue? Contemp Nurse. 2022;58(4):249-52. [PMID: 35924342, https://doi.org/10.1080/10376178.2022.2109494].
2. Wangdi S, Guragai K, Namgay P, Dorji J, Wangchuk K. Improving initial vital signs assessment and documentation in the emergency department of regional hospital, Bhutan: quality improvement project. BMJ Open Qual. 2025;13(Suppl 1). [PMID: 40447295, PMCID: PMC12131496, https://doi.org/10.1136/bmjoq-2024-003151].
3. Hope J, Dall'Ora C, Redfern O, Darbyshire JL, Griffiths P. Why vital signs observations are delayed and interrupted on acute hospital wards: A multisite observational study. Int J Nurs Stud. 2025;164:105018. [PMID: 39946865, https://doi.org/10.1016/j.ijnurstu.2025.105018].
4. Petersen JA, Rasmussen LS, Rydahl-Hansen S. Barriers and facilitating factors related to use of early warning score among acute care nurses: a qualitative study. BMC Emerg Med. 2017;17(1):36. [PMID: 29191159, PMCID: PMC5710111, https://doi.org/10.1186/s12873-017-0147-0].
5. Williams B. The National Early Warning Score: from concept to NHS implementation. Clin Med (Lond). 2022;22(6):499-505. [PMID: 36427887, PMCID: PMC9761416, https://doi.org/10.7861/clinmed.2022-news-concept].
6. Welch J, Dean J, Hartin J. Using NEWS2: an essential component of reliable clinical assessment. Clin Med (Lond). 2022;22(6):509-13. [PMID: 36427875, PMCID: PMC9761428, https://doi.org/10.7861/clinmed.2022-0435].
7. El sayed AN, El said Kamel Am, Elhadari G, moussa be. Comparing the Prognostic Value of the Latest Version of the National Early Warning Score (NEWS-2) and the Quick Sequential Organ Failure Assessment Score (qSOFA) in the Prediction of the Mortality Rate of Septic Patients. ARCADEs of MEDICINE. 2025;0(0):0-0. [https://doi.org/10.21608/arcmed.2025.375056.1112].

8. Badr MN, Khalil NS, Mukhtar AM. Effect of National Early Warning Scoring System Implementation on Cardiopulmonary Arrest, Unplanned ICU Admission, Emergency Surgery, and Acute Kidney Injury in an Emergency Hospital, Egypt. J Multidiscip Healthc. 2021;14:1431-42. [PMID: 34163171, PMCID: PMC8214550, https://doi.org/10.2147/JMDH.S312395].
9. Tavare A, Pullyblank A, Redfern E, Collen A, Barker RO, Gibson A. NEWS2 in out-of-hospital settings, the ambulance and the emergency department. Clin Med (Lond). 2022;22(6):525-9. [PMID: 36427884, PMCID: PMC9761413, https://doi.org/10.7861/clinmed.2022-news-ooh].
10. Aziz Mamdouh E, Shehata Mohamed H, Abdallah Abdelatief D. Assessment of nurses' performance regarding the implementation of patient safety measures in intensive care units. Egyptian Journal of Health Care. 2020;11(1):82-100.
11. Royal College of Physicians (RCP). NHS England approves use of National Early Warning Score (NEWS) 2 to improve detection of acutely ill patients; 2025. Cited 2025 Sep 18. Available from: https://bit.ly/3NB8x9Q.
12. University Hospitals Bristol NHS Foundation Trust. How To Guides; 2025. Cited 2025 Sep 1. Available from: https://www.uhbristol.nhs.uk/for-clinicians/clinicalaudit/how-to-guides/.
13. Hanania HL, Hanania AN. In: Eltorai AEM, Bakal JA, Kim DW, Wazer DE, editors. Quality improvement. Academic Press; 2023. p. 639-45. [PMCID: PMCID, https://doi.org/10.1016/b978-0-323-88423-5.00062-5].
14. Farenden S, Gamble D, Welch J. Impact of implementation of the National Early Warning Score on patients and staff. Br J Hosp Med (Lond). 2017;78(3):132-6. [PMID: 28277766, https://doi.org/10.12968/hmed.2017.78.3.132].
15. NHS England. Resources to support the safe adoption of the revised National Early Warning Score (NEWS2); 2025. Cited 2025 Oct 20. Available from: https://www.england.nhs.uk/2018/04/safe-adoption-of-news2/?utm_source=chatgpt.com.
16. SQUIRE. SQUIRE 2.0 Guidelines; 2025. Cited 2025 Oct 20. Available from: https://www.squire-statement.org/index.cfm?fuseaction=page.viewPage&nodeID=1&pageID=471&utm_source=chatgpt.com.
17. Gregoriou PL, Charalambous A, Rousou E, Papastavrou E, Merkouris A. Attitudes of Physicians and Nurses Toward Interprofessional Collaboration: a Systematic Literature Review. Mater Sociomed. 2025;37(1):64-73. [PMID: 40098756, PMCID: PMC11910901, https://doi.org/10.5455/msm.2025.37.64-73].
18. Onal EG, Knier K, Hunt AW, Knudsen JM, Nestler DM, Campbell RL, et al. Comparison of emergency department throughput and process times between male and female patients: A retrospective cohort investigation by the Reducing Disparities Increasing Equity in Emergency Medicine Study Group. J Am Coll Emerg Physicians Open. 2022;3(5):e12792. [PMID: 36187504, PMCID: PMC9512773, https://doi.org/10.1002/emp2.12792].
19. Ouellet S, Gallani MC, Fontaine G, Mercier E, Lapierre A, Severino F, et al. Strategies to improve the quality of nurse triage in emergency departments: A systematic review. Int Emerg Nurs. 2025;81:101639. [PMID: 40532318, https://doi.org/10.1016/j.ienj.2025.101639].

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Original Article

Quality of sepsis management in the Emergency Department at Goulburn Valley Health, Victoria, Australia: A Retrospective Audit

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Clinical audit

ABSTRACT

Background: This audit aims to assess the care of sepsis at Goulburn Valley Health against national benchmarks and sepsis protocol to provide insight into improving sepsis care. Secondary objectives also investigate the relationships among various factors and sepsis care, enabling a deeper understanding that can inform future studies.

Method: The audit was conducted at Goulburn Valley Hospital, Shepparton, in the Emergency Department (ED). Retrospective review of electronic and paper medical records of patients diagnosed with sepsis. Participants included patients admitted with sepsis or septic shock to the ED between 01/01/2023 and 31/03/2023. Key measurements include adherence to the local sepsis guideline pathway, time from triage to IV fluids, time from triage to IV antibiotics, and compliance with eTG (electronic therapeutic guidelines) when administering initial treatment to patients. Further measurements include analysing triage-to-blood culture times, lactate trends, and adequacy of fluid resuscitation.

Results: Median time of fluid resuscitation from triage to ED admission was 51 minutes [IQR: 32-91.5 minutes]. Median time of antimicrobial infusion from triage to ED admission was 68 minutes [IQR: 48-117]. 59% of patients received appropriate antimicrobial coverage, whilst 41% did not.

Conclusion: The median times for infusion compared favorably with the national pilot under our definitions; however, differences in time-zero, selection, and small sample size limit direct comparability. Substandard antimicrobial coverage during sepsis treatment was noted. Improvements in sepsis management are recommended based on the findings, including adding a sepsis bundle dashboard and further integrating antimicrobial stewardship.

1. Introduction

Sepsis is defined as a time-critical medical condition that arises when the body's immune response to an infection causes damage to tissue and organs [1, 2]. In 2017, there were approximately 55,251 cases of sepsis with 8,700 related deaths due to sepsis. The direct economic burden of sepsis amounts to 700 million dollars annually within the Australian healthcare system [1]. The significance of sepsis as a medical condition with high morbidity and mortality means that evidence-based standards of sepsis management are pivotal in providing better patient health outcomes [3]. The rationale for completing this audit at Goulburn Valley Health is to review current standards of sepsis management in the Emergency Department and to provide insight into the clinical improvement of local sepsis protocols.

The benchmark criteria used to determine sepsis cases are the Goulburn Valley Health sepsis protocol form, which is similar to the SIRS criteria and includes clinical indicators such as respiratory rate, heart rate, temperature, and white cell count. The SIRS criteria resulted in earlier identification in greater than 50% of patients within a median time of 26 minutes [IQR 0,119 minutes] compared to qSOFA with a median time of 113 minutes [IQR 60, 251 minutes] or equivalent (54.7% vs 42.3%, p<0.001) [4]. The prompt sepsis identification provided by SIRS in the emergency department would affect patient management [5]. Other criteria, such as qSOFA, may be used in the emergency setting to determine organ dysfunction, but it is recommended to use it in conjunction with SIRS for identification and prognosis.

Within the Australian regional context, a further study investigated the appropriateness of antimicrobial prescribing for patients. It was found that inappropriate prescribing in sepsis was higher in regional health centres compared to metropolitan centres (24.0% vs. 22.1%; P <0.001) [6]. The audit will investigate whether a regional hospital such as Goulburn Valley Health has a high rate of inappropriate antimicrobial prescribing.

2. Method

The study will be a single-hospital, retrospective observational study involving patients admitted to Goulburn Valley Health (GVH) in Victoria, Australia. Patients who presented to the Emergency Department (ED) from 01/01/2023 to 31/03/2023 will be included. The patient group will consist of all adults aged 18 and above, formally diagnosed on the patient's ED discharge summary

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with "sepsis" or "septic shock" as per the treating clinician, and triaged as Category 2 as per the Australasian Triage System. Patient sepsis status will be determined using the SIRS criteria, which coincides with the hospital's sepsis protocol. Patients not included are paediatric patients (under 18 years of age) and patients triaged to other categories other than Category 2. Completion of local sepsis protocol forms involves initiating the form at triage and completing it within 60 minutes, clearly marking sepsis criteria as fulfilled, completing the primary survey sheet, and obtaining the signature of either the bedside nurse or the treating clinician. Patients were also grouped by demographic factors, including age, which was further categorised into three age groups: under 65 inclusive, 65-75 exclusive, and 75 and over inclusive. Patients were separated by immunocompromised state, which included the following causes: chronic kidney disease (CKD), malignancy from all causes, type 1 and type 2 diabetes, all infectious sources, systemic diseases including rheumatoid arthritis (RA), and inflammatory bowel disease (IBD). The time from triage to admission for fluid infusion, antibiotic infusion, and blood culture (BC) collection will involve recording the time from first contact at triage until the recorded time of fluid infusion as per hospital documentation, the recorded time for antibiotic infusion as per the medication chart, and the recorded time of BC collection as per pathology records, respectively. The patient's length of stay (LOS) was measured from formal admission to the ED until the recorded time of discharge from the ED, wards (including surgical and medical), or the intensive care unit (ICU). Lactate levels were recorded from the initial pathology blood draw to form the "initial" lactate values, and the subsequent lactate value was recorded as the "serial" lactate value. Fluid resuscitation volume was calculated as the crystalloid fluid (only 0.9% normal saline was considered) infused over a period of three hours at a rate of 30ml/kg, as either maintenance or bolus doses.

Patient information from Goulburn Valley Health will be collected from the electronic Health Information System (HIS) and accessed and stored electronically on the local GVH intranet. Information to be collected will include a combination of quantitative and qualitative data, such as sepsis protocol charts, fluid balance charts, medication charts, blood culture reports, PROMPT (Policies and Procedures) guidelines as per Goulburn Valley Health, and patient demographic details, including sex and age. Outcome measurements, including length of stay and immunocompromised state, were extracted from the patient database. National guideline information will be derived from the Sepsis Medical Record Review conducted by the Australian Commission on Safety and Quality in Health Care (ACSQH) [7]. Antimicrobial adherence information was gathered from the regional audit review completed by Bishop et al [6].

Patient information will be collected and organised into several variables in a spreadsheet using Microsoft Excel (2019), and statistical calculations will be performed in GraphPad Prism 8. The tools to be used will depend on the objective. Given the small sample size and presence of outliers in the results, non-parametric analysis will be utilised. The primary objective results will be presented as median values with interquartile ranges, along with confidence intervals based on the Hodges-Lehman estimator at approximately 95% confidence. To compare categorical values, a chi-squared test will be used. The Mann-Whitney U test and the Kruskal-Wallis test with subsequent Dunn's multiple comparison test will be utilised for multiple-group analysis. A p-value of <0.05 is used to signify statistical significance. Once the statistical analysis is complete, the data will be used for presentation and reporting of the findings. Once the collected information is no longer used for the clinical audit, it will be disposed of in accordance with local guidelines.

2.1. Ethics Statement

Due to the nature of the clinical audit (Quality improvement audit), it will be a low-risk/negligible project. Information will be collected through a data request monitored by the hospital's ethics department, which has received approval from the research and ethics department. Data will be utilised and stored on the local hospital intranet for the duration of the project. Patient results post statistical calculations will be deidentified in line with the hospital's research policy. A waiver has been obtained from the local hospital Human Research Ethics Committee (HREC) in accordance with NHMRC Ethics guidelines.

3. Results

During the study period from 1 January 2023 to 31 March 2023, 117 patients were diagnosed with sepsis in the Emergency Department, of whom 78 met the study criteria. The average age of the participants was 69 years (95% CI 65-74), with an age range from 23 to 100 years. Age distribution revealed 20 participants under 65 (26%), 15 between 65 and 75 (19%), and 43 above 75 (55%). Regarding sex distribution, 32 females (41%) and 46 males (59%) participated. 40 participants (51%) were classed as immunocompromised. Of the 40 participants, 16 (40%) were immunocompromised due to malignancy from all causes, 23 (58%) due to CKD, 11 (28%) due to either type 1 or type 2 diabetes, and 3 (8%) due to systemic diseases. The median length of stay was 5298 minutes [IQR 4224-7290], with 49/78 (63%) of patients admitted from the ED to specialty inpatient wards, 18/78 (23%) admitted to the intensive care unit (ICU), and 11/78 (14%) discharged from the ED directly after 24 hours.

Of the 78 patients, 81% (n = 63) met local sepsis protocol criteria for sepsis. Of the 63 patients that were diagnosed as sepsis according to local sepsis criteria, 57% (n=36) of local sepsis protocol forms were completed appropriately and promptly, and 43% (n=27) were either partially completed or not completed at all [Figure 1].

The national median time for fluid resuscitation from triage to ED admission was 72 minutes, according to the National Pilot Study. Data collated from the hospital show that the median time of fluid resuscitation from triage to ED admission was 51 minutes [IQR: 32-91.5 minutes]. Data from the National Pilot Study shows that the median time of antimicrobial infusion from triage to ED admission was 91 minutes. In comparison, the hospital median time of antimicrobial infusion from triage to ED admission was 69 minutes [IQR: 48-117]. The median time for blood culture collection was recorded at 28 minutes [IQR: 27-39]. The median fluid resuscitation volume over the three hours from triage was 1000ml [IQR 1000-1500]. Initial lactate reading was recorded for 77/78 of the participants with a value of 1.6 [IQR 1.4-2.0], with serial lactate levels at 1.6 [IQR 1.3-1.9]

The choice of antimicrobials used was determined from national eTG guidelines. As per the National Pilot Study for sepsis, 85% of patients audited had received adequate antimicrobial coverage based upon a provisional diagnosis of sepsis and an initial source (except where cases were diagnosed as sepsis of unknown origin). 7.5% of patients from the audit group did not receive adequate coverage, and another 7.5% of patients were unable to be assessed within the study. When compared to hospital data collated, 59% of patients were given appropriate antimicrobial coverage, with 41% of patients not receiving adequate coverage.

Through Kruskal-Wallis analysis with Dunn's multiple comparison test, analysis of age and multiple sepsis bundle factors, including

Table 1: Depicts the categorisation of patient demographic information into groups based on sex, age, and immunocompromised status. A descriptive analysis of the study's primary and secondary objectives is presented below.

Characteristic	N (%)	Mean (95% CI)	Median (IQR)
Age (total)	78/78	69 (65-74)	-
Age (<65)	20/78 (26%)	-	-
Age (65-75)	15/78 (19%)	-	-
Age (75+)	43/78 (55%)	-	-
Sex - Female	32/78 (41%)	-	-
Sex - Male	46/78 (59%)	-	-
Immunocompromised (total)	40/78 (51%)	-	-
malignancy from all causes	16/40 (40%)	-	-
CKD	23/40 (58%)	-	-
type 1 and type 2 diabetes	11/40 (28%)	-	-
systemic diseases including RA and IBD	3/40 (8%)	-	-
Time from triage to antibiotic infusion in 60 minutes	27/78 (35%)	-	68.50 (62-80) minutes
Time from triage to fluid infusion in 60 minutes	26/78 (33%)	-	50.50 (39-69) minutes
Sepsis form completed	36/63 (57%)	-	-
Antibiotic criteria met	43/78 (55%)	-	-
Length of inpatient stay	76/78 (97%)	-	5298 (4224-7290) minutes
Wards (all specialties included)	49/78 (63%)	-	-
ICU (intensive care unit)	18/78 (23%)	-	-
Emergency department	11/78 (14%)	-	-
Lactate – initial level	77/78 (99%)	-	1.6 (1.4-2.0)
Lactate – serial	50/78 (64%)	-	1.6 (1.3-1.9)
Time from triage to blood culture In 60 minutes	76/78 (98%)	-	28 (27-39) minutes
Fluid resuscitation volume	66/78 (85%)	-	1000 (1000-1500) ml

CKD, Chronic Kidney Disease; RA, Rheumatoid Arthritis; IBD, Inflammatory Bowel Disease; ICU, Intensive Care Unit.

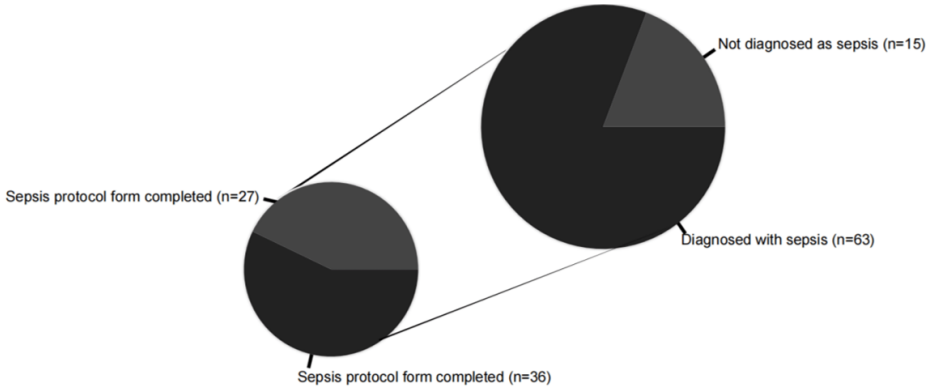

Figure 1: The figure to the right depicts the proportion of patients (n=78) diagnosed with sepsis in the audit as per the sepsis protocol. Amongst patients diagnosed with sepsis, the nested pie chart to the left depicts the proportion of diagnosed cases with either completed or partially/uncompleted sepsis protocol forms.

fluid infusion times, antibiotic infusion times, blood culture collection times, and fluid resuscitation volume. There were insignificant age differences across the antibiotic, fluid infusion, blood culture collection, and fluid resuscitation volume categories. There was a significant difference in length of stay between the three groups ($H(2) = 14.94$, $p = 0.0006$), specifically between the under 65 and 65-75 age groups ($p = 0.0106$) and between the under 65 and over 75 age groups ($p = 0.0007$). There was also a statistically significant difference in lactate levels ($H(2) = 6.179$, $p = 0.0455$), specifically between the under-65 and 65-75 age groups ($p = 0.048$). Further values are summarised in the table below.

Table 2: Sources of sepsis and adherence to guideline antibiotic therapy (n=78)

Sepsis Source	Diagnosis of source from study data (n)	Guideline Treatment for Source (Tazobactam + Piperacillin as default for febrile neutropenia)	Number of patients treated with antibiotics as per Guideline (n, %)
All sources (From Sepsis study)	147/159	N/A	135/147, 92%
Respiratory	27/78	Ceftriaxone + Azithromycin	22/27, 81%
Genitourinary	19/78	Ceftriaxone + Stat Gentamicin	12/19, 63%
Integumentary	13/78	Flucloxacillin/Cephazolin	4/13, 31%
PUO	10/78	Flucloxacillin + Gentamicin	5/10, 50%
Gastrointestinal	6/78	Amoxicillin + Stat Gentamicin + Metronidazole	3/6, 50%
Others including meningitis, dental infection, quinsy	3/78	Ceftriaxone (meningitis) Benzylpenicillin + metronidazole (quinsy, dental infection)	0/3, 0%

LRTI, Lower respiratory tract infection; URTI, Upper respiratory tract infection; UTI, Urinary tract infection; PUO, Pyrexia of unknown origin; Respiratory, including bacterial, viral pneumonia, and other LRTI/URTI infections; Genitourinary, including cystitis, urethritis, pyelonephritis, ascending UTI, renal calculi, epididymo-orchitis; Skin, including cellulitis, chronic wounds, erysipelas, trauma; Gastrointestinal, including gastroenteritis, cholangitis, and surgical abdominal causes, including cholecystitis and appendicitis.

Table 3: Values from the Kruskal-Wallis analysis of age groups and various sepsis bundle factors

Comparison Groups	<65 vs >75 (mean rank difference, p value)	<65 vs 65-75 (mean rank difference, p value)	65-75 vs >75 (mean rank difference, p value)	All age groups (H(df), p value)
Length of stay	-21.60, p < 0.0007*	-21.57, p = 0.0106*	0.0231, p > 0.9999	H(2) = 14.94, p = 0.0006*
Antibiotic infusion	-5.259, p > 0.9999	-0.7407, p > 0.9999	4.518, p > 0.9999	H(2) = 0.61, p = 0.737
Fluid infusion	0.9167, p > 0.9999	2.414, p > 0.9999	1.497, p > 0.9999	H(2) = 0.2327, p = 0.890
Blood culture collection	1.753, p > 0.9999	8.080, p = 0.5152	6.327, p > 0.9999	H(2) = 2.161, p = 0.3394
Lactate levels	-13.59, p = 0.2063	-14.96, p = 0.0480*	-1.366, p > 0.9999	H(2) = 6.179, p = 0.0455*
Fluid resuscitation volume	0.09276, p > 0.9999	1.515, p > 0.9999	1.422, p > 0.9999	H(2) = 0.1094, p = 0.9468

H, Kruskal Wallis statistic; df, degrees of freedom; p values <0.005 denote statistical significance.

Through Chi-squared analysis, there was non-significant association between sex and antibiotic infusion time ($\chi^2 = 1.1197$, df = 2, p = 0.29), fluid infusion time ($\chi^2 = 0.4641$, df = 2, p = 0.4957), and blood culture collection time ($\chi^2 = 0.037$, df = 2, p = 0.847).

Using the Mann-Whitney U test revealed that there was no statistically significant relationship between length of stay and whether a participant was immune-compromised or non-immune compromised (p=0.0968). A statistically significant association was noted between the time of fluid infusion and the time of antibiotic infusion (p=0.0296). Furthermore, there was a noted associated between age and length of stay (p<0.0001).

4. Discussion

This study demonstrated that 81% (n=63) of cases were diagnosed with sepsis based on local sepsis criteria, whilst 19% (n=15) were diagnosed with sepsis but did not meet local sepsis criteria. The results show that there is discordance between clinical diagnosis and local protocol criteria. This can affect patient treatment, including inappropriate diagnoses and treatments. By providing patients with treatment that they do not require, this places them at a higher risk of adverse events relating to treatment. Furthermore, resources used for the patient's treatment would be unnecessarily utilised and would not have provided any additional benefit Of the 63 patients, 57% (n=36) of the patients had an appropriately completed sepsis protocol form whilst 43% (n=27) of patients had either partially completed form or the form was not completed at all, meaning that there is low compliance with completing sepsis protocol forms. The hospital expects that every sepsis protocol form be completed once the patient meets the criteria; therefore, the hospital has underperformed on this metric. Reasons for low compliance with form completion include time constraints with other patient jobs, human error, and treating teams' unawareness of the sepsis form due to insufficient training. The sepsis protocol aims to create a standardized guideline to help identify cases of sepsis, guide appropriate initial investigations to strengthen the diagnosis, and ensure that patients receive proper treatment and that it is not missed due to human error. The use of a sepsis protocol has been linked to improving the mortality outcomes of patients diagnosed with severe sepsis. A study by Nguyen et al. (2007) examined the outcomes of using a sepsis protocol (referred to as a "bundle" in the report) to determine whether modifying physician behaviour for the treatment of sepsis in the emergency department would improve inpatient mortality rates. The study found that more appropriate treatment was provided to the patient (100.0 vs. 89.7%, p = 0.04) and that there was a clinically significant decrease in mortality (OR 0.36, [0.17-0.79] p = 0.01) [8]. The adherence to sepsis protocol forms can be further improved by ongoing training and awareness of the form, to hold discussion with nursing and medical staff to make the protocol a priority during the care of a patient, delegation of the sepsis protocol to the triage nurse for the ward nurse to follow

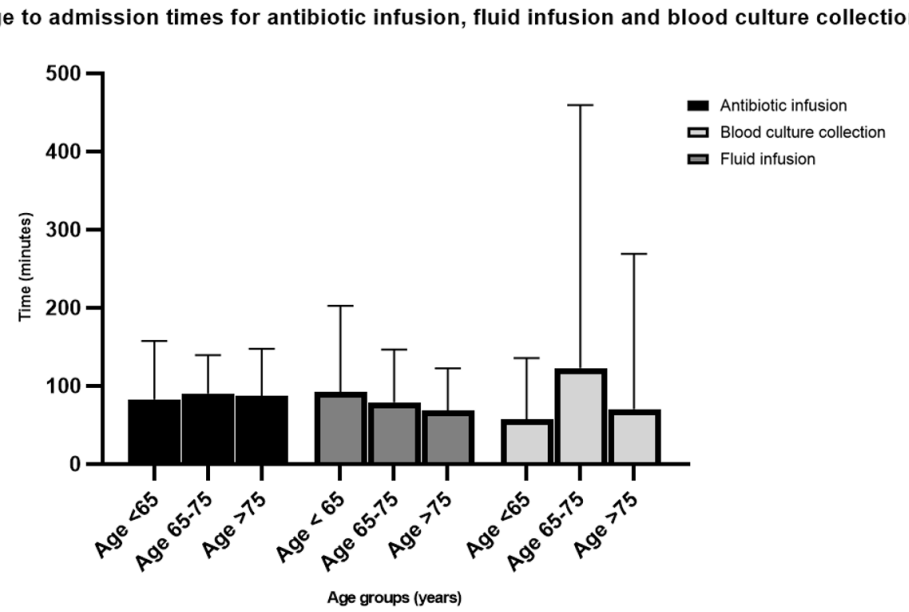

Figure 2: Boxplot of antibiotic use and median times of fluid infusion and antibiotic infusion with IQR.

through on and finally, to place signage or posters across the ED to bring further awareness.

When analysing the data from the study regional hospital, the median time for fluid resuscitation from triage to ED admission was 51 minutes [IQR: 32-91.5 minutes], which was 21 minutes quicker than the national standard of 72 minutes, indicating that the hospital's performance exceeded the national standard. The median time of antimicrobial infusion from triage to ED admission was 68 minutes [IQR: 48-117 minutes], which was 23 minutes quicker than the national standard of 91 minutes, meaning that the hospital's performance exceeded the national standard.

The discrepancy in the average times is most likely due to multiple outlier data points in the national standard, which would skew the collated data and be inappropriate for measuring fluid and antimicrobial infusion performance. The hospital had performed well in the median time for both treatments due to reasons such as appropriate recognition of reduced blood pressure by the treating team, accessibility of fluid bags in an easily accessible area for the treating team to use, accessible guidelines on antimicrobial use on the PROMPT website and strong communication between varying team members that are a part of the patient's care.

Nevertheless, upon further analysis, multiple areas of improvement were identified. One such area is improving electronic blood pressure monitoring devices with reduced calibration error and making sphygmomanometers more accessible. Often, nurses reported blood pressure readings from the electronic blood pressure machines, which did not meet sepsis criteria; however, when measured manually, they did meet the criteria, leading to a delay in fluid infusion from the time of electronic measurement to the time of manual measurement. A potential delay in antimicrobial treatment is due to inefficient stock management. Given the volume of patients requiring antimicrobials in the hospital, inefficient stock management would lead to medications not being readily available at the dispensing machine, requiring extra time to order and transport them from one area of the hospital to another, delaying treatment. Another factor in delayed treatment infusion is documentation delays. The documentation process for treatments involves two nurses signing off on the order prior to administration. At times, there may not be two nurses available to sign off on the order due to higher-priority jobs or because nurses are on break, which would further delay treatment. The delay can be reduced by upgrading electronic devices to improve blood pressure monitoring accuracy and by purchasing more sphygmomanometers; however, this may not be feasible given cost constraints in the ED and logistical issues. Furthermore, documentation policies may need to be updated to allow either two nurses or a nurse and a doctor to sign off, providing greater avenues for completing documentation.

Appropriate antimicrobial treatment coverage was measured based on adherence to eTG guidelines, suspected source, any drug allergies, renal function, and local antimicrobial resistance. Hospital data show that 59% of patients treated for sepsis had appropriate antimicrobial coverage, compared to 85% in the national benchmark. The results show a substandard antimicrobial coverage in the treatment of sepsis. A possible cause of such a discrepancy is the varied choice of antimicrobials by physicians and the use of outdated local antimicrobial guidelines. Locum consultants usually lead the ED at the study regional hospital, having come from various hospitals and training backgrounds. Given this variation, some physicians would prefer to use a certain antimicrobial over another, even if it deviates from eTG guidelines. Furthermore, consultants accustomed to following local hospital policy would find themselves using the hospital's antimicrobial guidelines, last reviewed in 2022. Given that three years have passed since the guidelines were last reviewed, there is a possibility of changes to the eTG guidelines that are not reflected in the guidelines. The study completed by Kumar et al analysed groups of patients that were treated with either appropriate antimicrobial coverage or inappropriate antimicrobial coverage and found that there was an almost five fold decrease in mortality (52% vs 10.3%, OR = 9.45, 95%CI [7.74-11.54] $p > 0.0001$) of the patients in the appropriate antimicrobial group compared to the inappropriate antimicrobial group [9]. Appropriate antimicrobial coverage can be further improved through ongoing training on where to access

eTG guidelines and CPD activities. Implementing an antimicrobial stewardship program in the ED would enable infectious disease experts to provide appropriate treatment regimens tailored to each patient's clinical situation. The stewardship team should take a multidisciplinary approach, with doctors and pharmacists involved in the regular monitoring and updating of all antimicrobial policies [10].

Finally, increased convenience in accessing medical records internally and externally to the hospital should be provided to ensure that we are aware of pertinent medical information prior to giving antibiotics that would be ineffective in treating the patient, such as resistance to organisms on previous cultures, recent hospital admissions, medication history causing immunosuppression, and malignancy history.

Sepsis recognition through sepsis bundles can be implemented within the hospital to help health staff promptly diagnose sepsis. This would involve completing the interval sepsis bundle within 1 hour at the initial stage, and then post-treatment [11]. A study conducted by Ventakesh et al utilised a sepsis bundle in intervals of 1 hour and 3 hours, which involved the collection of two sets of blood cultures, serum lactate measurement, antibiotics within 3 hours for septic patients without shock, and 1 hour with shock and a fluid bolus at a rate of 20ml/kg. The study found that there was increased compliance in administering antibiotics within 1 hour (OR 1.90 [95% CI 1.1-3.6]) and 3 hours (OR 1.7 [95% CI 1.4-2.1]), reduction in in-hospital mortality (OR 0.60 [95% CI 0.4-0.8]) and improved adherence to antimicrobial guidelines (OR 1.4 [95% CI 0.9-2.1]) [12]. Through such sepsis bundle implementation, this would create a streamlined process for sepsis investigation, diagnosis, and management, aiming to reduce mortality and in-hospital admissions, proving beneficial from both the patient's and health economics perspectives [13].

Limitation

There are some potential limitations in this study, such as confounding factors within the sepsis local protocol definition. The protocol is based on sepsis diagnosis in 4 categories, of which at least 2 must be met. The four categories for diagnosing a suspected sepsis include temperature either < 36°C or > 38°C, heart rate over >90 bpm, respiratory rate >20/min, or white cell count <4 or >12x109 L. Multiple co-morbidities may present in patients that may skew values needed for diagnosis. One such example may be an elevated heart rate in a patient with atrial fibrillation, which would have been present if the patient were not septic, or an increased respiratory rate due to end-stage COPD. Hence, diagnosis must involve an in-depth evaluation and a clinical diagnosis consistent with the criteria. Another noted limitation is the use of only Category 2 triage patients defined with sepsis or septic shock. This introduces a selection bias, selecting only the most urgent sepsis cases; hence, higher-urgency care is provided to those patients, leading to an underestimation of the time from triage to infusion of fluids and antibiotics.

In addition, 63 patients were utilised out of the 78 potential patients diagnosed with sepsis over 3 months. Due to the smaller sample size and time period investigated, this would affect both the reliability and validity of the results compared to a larger study cohort. Further audits, which collect data over a more extended time period or across a larger patient population and involve more hospitals, would provide a larger sample size and, consequently, greater reliability and validity of the results. Moreover, the findings are expected to assist other regional hospitals in planning to improve the quality of care for sepsis patients. Human measurement errors and incomplete recording of values, such as the start of antibiotic infusions and the scanning of records, including sepsis protocols, were also limitations that reduced the data obtained from patient records.

5. Conclusions

The study investigated sepsis management in the regional setting, measuring triage-to-admission infusion times for antibiotics and fluids, antibiotic adherence, and the rate of completion of local sepsis protocols. The study's implications are to highlight the factors that affect sepsis treatment and to identify strategies to enhance patient care. Applications of the study would include implementing sepsis bundles or expanding antimicrobial stewardship. Future studies would utilise the data for any further audits conducted at the hospital or for the evaluation of new policies and procedures implemented at the hospital, to serve as a benchmark. Data collated from the study hospital are expected to provide more information and insight into sepsis management within a regional setting.

Conflicts of Interest

The authors declare no competing interests that could have influenced the objectivity or outcome of this research.

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Large Language Model

None

Authors Contribution

JIA contributed to conceptualization, methodology, investigation, formal analysis, project administration, resources, visualization, and manuscript writing.

Data Availability

The datasets generated and/or analyzed during the current study are not publicly available due to institutional and patient privacy restrictions at Goulburn Valley Health but are available in de-identified form from the corresponding author on reasonable request and subject to approval by the Goulburn Valley Health Research and Ethics Department.

References

1. Australian Commission on Safety and Quality in Health Care. Sepsis Clinical Care Standard. Sydney: ACSQHC; 2022. Available from: https://www.safetyandquality.gov.au/publications-and-resources/resource-library/sepsis-clinical-care-standard-2022.

2. Australian Commission on Safety and Quality in Health Care. Sepsis Medical Record Review: Pilot Study. Sydney: ACSQHC; 2022. Available from: https://www.safetyandquality.gov.au/publications-and-resources/resource-library/sepsis-medical-record-review-pilot-study.
3. Gyawali B, Ramakrishna K, Dhamoon AS. Sepsis: The evolution in definition, pathophysiology, and management. SAGE Open Med. 2019;7:2050312119835043. [PMID: 30915218, PMCID: PMC6429642, https://doi.org/10.1177/2050312119835043].
4. Ore T. Trends and disparities in sepsis hospitalisations in Victoria, Australia. Aust Health Rev. 2016;40(5):511-8. [PMID: 26654709, https://doi.org/10.1071/AH15106].
5. Prasad PA, Fang MC, Abe-Jones Y, Calfee CS, Matthay MA, Kangelaris KN. Time to Recognition of Sepsis in the Emergency Department Using Electronic Health Record Data: A Comparative Analysis of Systemic Inflammatory Response Syndrome, Sequential Organ Failure Assessment, and Quick Sequential Organ Failure Assessment. Crit Care Med. 2020;48(2):200-9. [PMID: 31939788, PMCID: PMC7494056, https://doi.org/10.1097/CCM.0000000000004132].
6. Bishop JL, Schulz TR, Kong DCM, James R, Buising KL. Similarities and differences in antimicrobial prescribing between major city hospitals and regional and remote hospitals in Australia. Int J Antimicrob Agents. 2019;53(2):171-6. [PMID: 30722961, https://doi.org/10.1016/j.ijantimicag.2018.10.009].
7. Australian Commission on Safety and Quality in Health Care. National Sepsis Program; 2023. Based on the 2022–23 ACSQHC National Sepsis Program. Available from: https://www.safetyandquality.gov.au/our-work/national-sepsis-program.
8. Nguyen HB, Corbett SW, Steele R, Banta J, Clark RT, Hayes SR, et al. Implementation of a bundle of quality indicators for the early management of severe sepsis and septic shock is associated with decreased mortality. Crit Care Med. 2007;35(4):1105-12. [PMID: 17334251, https://doi.org/10.1097/01.CCM.0000259463.33848.3D].
9. Kumar A. Early antimicrobial therapy in severe sepsis and septic shock. Curr Infect Dis Rep. 2010;12(5):336-44. [PMID: 21308515, https://doi.org/10.1007/s11908-010-0128-x].
10. D'Onofrio V, Meersman A, Magerman K, Waumans L, van Halem K, Cox JA, et al. Audit of empirical antibiotic therapy for sepsis and the impact of early multidisciplinary consultation on patient outcomes. Int J Antimicrob Agents. 2021;58(3):106379. [PMID: 34161787, https://doi.org/10.1016/j.ijantimicag.2021.106379].
11. Khanina A, Cairns KA, McGloughlin S, Orosz J, Bingham G, Dooley M, et al. Improving sepsis care for hospital inpatients using existing medical emergency response systems. Infect Dis Health. 2020;25(2):63-70. [PMID: 31740379, https://doi.org/10.1016/j.idh.2019.10.003].
12. Venkatesh B, Schlapbach L, Mason D, Wilks K, Seaton R, Lister P, et al. Impact of 1-hour and 3-hour sepsis time bundles on patient outcomes and antimicrobial use: A before and after cohort study. Lancet Reg Health West Pac. 2022;18:100305. [PMID: 35024649, PMCID: PMC8654968, https://doi.org/10.1016/j.lanwpc.2021.100305].
13. Arulappen AL, Danial M, Ng LW, Teoh JC. The Impact of Antibiotics Administration on Mortality for Time in Sepsis and Septic Shock Patients including Possible Reasons for Delayed Administration in Malaysia. Antibiotics (Basel). 2022;11(9). [PMID: 36139981, PMCID: PMC9495043, https://doi.org/10.3390/antibiotics11091202].

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Study Protocol

Socio-Cultural Determinants of Access to HIV Treatment and Care Among Pregnant and Postpartum People: A Systematic Review Protocol

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ABSTRACT

Introduction: HIV-related maternal mortality remains high in many low-resource settings despite global declines. Lifelong antiretroviral therapy (ART) improves maternal and child outcomes, yet ART initiation, retention, and adherence remain suboptimal during pregnancy and postpartum. Socioeconomic, behavioral, and structural determinants influence linkage to care and viral suppression, but evidence describing their impact across the perinatal continuum remains fragmented. This review will synthesize these determinants through an equity lens using the PROGRESS-Plus framework, and reporting will follow PRISMA-E 2012 guidelines.

Methods and Analysis: This protocol follows PRISMA-E 2012 guidelines and is registered with PROSPERO (CRD420250650979). A comprehensive search will be conducted across multiple databases for studies published from January 2012 to May 2025. Eligible designs will include quantitative, qualitative, and mixed-methods studies evaluating HIV testing, ART initiation, retention in care, and viral suppression in relation to socio-cultural, economic, behavioral, or health system factors. The PECO framework will be used (Population: pregnant/postpartum individuals with HIV ; Exposure: social/structural determinants; Comparator: not exposed; Outcomes: HIV care cascade indicators). Postpartum will be defined as up to 12 months after delivery, and adolescents aged 15–17 years will be included. Two independent reviewers will screen studies using Rayyan. Quality will be assessed using Joanna Briggs Institute tools. Random-effects meta-analysis will be conducted when feasible. Qualitative findings will undergo thematic synthesis; mixed-methods results will be integrated narratively.

Ethics and dissemination: Approval is not required as this review uses publicly available data. Findings will be submitted for publication, presented at guideline meetings, and shared at scientific conferences.

1. Introduction

The global battle against Human Immunodeficiency Virus (HIV) and Advanced HIV Disease (AHD) has achieved extraordinary progress, largely due to the development and scale-up of antiretroviral therapy (ART). ART has transformed HIV from a fatal illness into a manageable chronic condition, with HIV-related mortality declining by nearly 40% between 2010 and 2021 [1, 2]. Despite these accomplishments, significant inequalities persist in access to and adherence to HIV treatment and care, particularly among vulnerable and key populations. As of 2023, an estimated 9.3 million people living with HIV still lacked access to ART [3].

While biological and clinical determinants of treatment outcomes are well-documented, there is growing recognition of the critical role of socio-cultural and structural factors in shaping the continuum of HIV care. These influences—such as beliefs, norms, values, practices, and interactions with the health system—affect health-seeking behaviors, engagement with care, and treatment adherence [4].

Pregnant and postpartum people represent a priority population in the global HIV response. In 2023, the World Health Organization (WHO) estimated that 1.3 million pregnant individuals worldwide were living with HIV [5]. Although vertical transmission can be prevented through timely diagnosis, access to prevention of mother-to-child transmission (PMTCT) services, and sustained adherence to ART during pregnancy and the postpartum period, it continues to pose a significant concern [6]. Socio-cultural barriers—including gender inequities in healthcare, stigma and discrimination, lack

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of partner or family support, poverty, geographic isolation, and limited health literacy—frequently hinder engagement with HIV care and retention in treatment among this group [7].

Previous systematic reviews have examined determinants of HIV care, often focusing on either supply-side (health system) or demand-side (individual and community) factors influencing initiation and retention in ART [8, 9, 10]. However, as understanding of both biomedical and socio-structural determinants evolves, there remains a pressing need for an updated and consolidated synthesis of socio-cultural influences on HIV care, specifically in the context of pregnant and postpartum populations. Moreover, while earlier reviews have largely focused on outcomes such as ART initiation, adherence, and retention in care, our review will also include viral suppression as a key outcome [11].

Recognizing and understanding the influence of socio-cultural determinants on access to HIV treatment and care is crucial for developing targeted and effective interventions. This protocol describes the methodology for a systematic review and meta-analysis designed to: [2] identify socio-cultural determinants influencing HIV treatment and care access among pregnant and postpartum people; [1] compare barriers across regions and healthcare systems; and [3] generate evidence to inform contextually and culturally appropriate policy and intervention strategies. By doing so, the review aims to contribute to improved maternal and child health outcomes in the context of HIV.

1.1. Objectives

1.1.1. Primary objective

- To determine and examine socio-cultural determinants influencing HIV/AIDS treatment and care access in pregnant and postpartum people.

1.1.2. Secondary objectives

- To compare barriers across different regions and healthcare systems.
- To offer recommendations for policy and intervention strategies to enhance HIV treatment and care adherence during the pregnancy and postpartum period.

2. Methods

A systematic review of studies exploring factors that influence access to HIV care and treatment, including HIV testing, uptake of ART, adherence to antiretroviral (ART) regimens, and HIV counseling of pregnant and postpartum people with HIV, will be performed.

This literature review will be conducted in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The review protocol has been submitted for registration with PROSPERO (Registration ID: CRD420250650979).

2.1. Information sources

We will perform an extensive literature search across the following major databases: PubMed, CINAHL, Web of Science, EMBASE, PsycINFO, Scopus, LILACS, and African Index Medicus, for studies published between January 2012 and May 2025. The decision to apply this publication year filter is based on the WHO Consolidated Guidelines on the Use of Antiretroviral Drugs for Treating and Preventing HIV Infection (2013). The revision process for these guidelines was initiated in early 2012 under the oversight of the WHO Guidelines Review Committee. This 2013 update consolidated ART-related recommendations into a single set of guidelines, encompassing HIV treatment and prevention across all age groups and populations within the broader HIV care continuum. As the guideline revision process began in 2012, we restricted our search to studies published from that year onward.

A robust search strategy will be developed in collaboration with a university librarian to ensure the systematic and comprehensive identification of relevant literature. The strategy will incorporate Medical Subject Headings (MeSH) terms and keywords related to HIV, pregnancy, postpartum, treatment access, and determinants. Searches will be conducted across PubMed, CINAHL, Web of Science, EMBASE, PsycINFO, Scopus, LILACS, and African Index Medicus, with no language restrictions. To supplement these databases, we will also review Google Scholar, the reference lists of included studies, and those of similar systematic reviews to identify additional eligible studies.

The search strategy will be developed and reported in full accordance with PRISMA-S guidelines. For each database, we will document the complete line-by-line search strategy, database interface, search dates, applied filters, and the number of hits, all of which will be included in the Appendix for transparency and reproducibility.

Existing evidence indicates that MEDLINE (PubMed), Embase, Web of Science, and Google Scholar together cover the vast majority of biomedical literature, with recall rates estimated at approximately 95–98%. While the incremental yield from additional databases is expected to be modest, their inclusion will enhance methodological rigor and comprehensiveness. We will also acknowledge in the discussion that, despite broad database coverage, some non-indexed or unpublished data may remain inaccessible.

2.2. Inclusion and exclusion criteria

We will include quantitative observational studies (case-control, cohort, and cross-sectional studies) as well as qualitative and mixed-method studies. The eligible studies must report at least one of these four outcomes: HIV testing, initiation of ART, retention in HIV care, or viral suppression. Studies must analyze associations between these outcomes and various determinants, including but not limited to socio-cultural, socio-demographic, economic, psychosocial, behavioral, or health system-related factors.

Studies focused on pregnant or postpartum people with HIV aged 18 years or older will be considered. Included studies must estimate risk effects or associations and account for potential confounding in their analysis. Non-English studies will be included without language restrictions to minimize language bias. They will be translated using a combination of machine translation tools (e.g., Google Translate, Microsoft Translator) and AI-assisted platforms such as DeepL. Two reviewers will independently verify all translations, and any discrepancies will be resolved by consensus. This workflow follows Cochrane guidance for the inclusion of non-English studies and emphasizes transparency, reproducibility, and accuracy in data extraction. Only studies with full-text articles available will be included. Editorials, commentaries, reviews, and studies without primary data or relevant outcomes will be excluded.

Study PECO Population(s), Exposure(s), Comparator(s), Outcome(s) The PECO framework will guide this systematic review. The Population (P) of interest is pregnant and postpartum individuals diagnosed with HIV/AIDS. Exposure (E) comprises social and structural determinants, including socio-cultural, economic, and health system factors that may influence engagement with HIV care. The Comparator (C) will be individuals not exposed

Table 1: Search grid with identifiable PECO concepts

PECO Concept	Description
Participants	Pregnant or postpartum individuals diagnosed with HIV/AIDS
Exposure	Examining socio-cultural determinants and barriers that influence key stages of HIV care, including screening, initiation of ART, retention in treatment, and achievement of viral suppression.
Comparators	None
Outcomes	Access to HIV/AIDS treatment and care across the continuum.

PECO, Population, Exposure, Comparator, and Outcome; ART, Antiretroviral Therapy.

to the determinant under study, although studies without explicit comparators will also be considered. The Outcome (O) is defined as HIV care cascade measures, specifically HIV screening, initiation of ART, retention in treatment, and achievement of viral suppression **(Table 1)**.

2.3. Study Selection

The study selection will employ a two-step approach: title screening and abstract screening, followed by a full-text review. We will use Rayyan, an online tool to facilitate review management for the screening process [12].

First, two reviewers will independently screen all records at each stage using predefined inclusion criteria. Any duplicates and titles that fail to meet the inclusion criteria will be excluded. After this initial screening, the full-text articles of the remaining potentially eligible studies will be uploaded manually to Rayyan for further review.

During the full-text screening phase, two reviewers will independently assess each article to determine its final eligibility. Any discrepancies will be resolved through discussion or, if necessary, consultation with a third reviewer. Additionally, the reviewers will manually search the reference lists of included articles to identify any further key studies for potential inclusion. The selection process will be documented using a PRISMA flow diagram.

3. Case Presentation

3.1. Search Strategy

The full Boolean search string for MEDLINE (via PubMed) is provided below as the primary example, combining MeSH terms and free-text terms related to HIV, antiretroviral therapy, pregnancy/postpartum, and socio-cultural determinants of access to care. This strategy will be adapted for use in other databases (e.g., mapping MeSH to CINAHL subject headings, using topic search [TS] fields in Web of Science, and keyword-based searches in Google Scholar). Filters will be applied for publication year (2012 onwards) to align with the initiation of the 2013 WHO guideline revision. Detailed search strings for all databases will be included in an appendix, in line with PRISMA-S reporting standards.

3.2. PubMed (3,511 results)

("HIV"[MeSH Terms] OR "HIV Infection*"[MeSH Terms] OR "human immunodeficiency virus*") AND ("Anti-Retroviral Agent*"[MeSH Terms] OR "Antiretroviral Therapy, Highly Active"[MeSH Terms] OR "Prevention of Mother-to-Child Transmission"[MeSH Terms] OR ARV OR ART OR HAART OR PMTCT OR "antiretroviral therap*" OR "highly active antiretroviral therap*" OR "prevention of mother-to-child HIV transmission" OR "treatment*" OR "care*" OR "antiretrovir*") AND ("Pregnancy"[MeSH Terms] OR "Pregnant Wom*n"[MeSH Terms] OR "Maternal Health"[MeSH Terms] OR "Breast Feeding"[MeSH Terms] OR "Mothers"[MeSH Terms] OR pregnant* OR antepartum OR postpartum OR perinatal OR natal OR breastfeed* OR mother* OR maternal*) AND (“access” OR cultur* OR “health barrier*" OR "cultural barrier*" OR "determinant*" OR "social barrier*")

3.3. CINAHL (1,701 results)

(MH "HIV" OR MH "HIV Infections" OR "human immunodeficiency virus*") AND (MH "Anti-Retroviral Agents" OR MH "Antiretroviral Therapy, Highly Active" OR MH "Prevention of Mother-to-Child Transmission" OR ARV OR "Anti-retroviral Therapy" OR ART OR "Highly Active Anti-Retroviral Therapy" OR HAART OR "prevention of mother-to-child HIV transmission" OR PMTCT OR antiretrovir* OR treatment* OR care*) AND (MH "Pregnancy" OR MH "Pregnant Wom*n" OR MH "Maternal Health" OR MH "Breast Feeding" OR MH "Mothers" OR pregnant* OR antepartum OR postpartum OR perinatal OR natal OR breastfeed* OR mother* OR maternal*) AND (“access” OR “soci*” OR “cultur*” OR "socio-cultural determinant*")

3.4. Web of Science (5,377 results)

TS=("HIV" OR "HIV Infection*" OR "human immunodeficiency virus*") AND TS=("Anti-Retroviral Agent*" OR "Antiretroviral Therapy, Highly Active" OR "Prevention of Mother-to-Child Transmission" OR ARV OR ART OR HAART OR PMTCT OR "antiretroviral therap*" OR "highly active antiretroviral therap*" OR "prevention of mother-to-child HIV transmission" OR treatment* OR care* OR "antiretrovir*") AND TS=("Pregnancy" OR "Pregnant Wom*n" OR "Maternal Health" OR "Breast Feeding" OR "Mothers" OR pregnant* OR antepartum OR postpartum OR perinatal OR natal OR breastfeed* OR mother* OR maternal*) AND TS=("access" OR cultur* OR "health barrier*" OR "cultural barrier*" OR determinant* OR "social barrier*")

3.5. Google Scholar (710,000)

"HIV" OR "HIV infection" OR "human immunodeficiency virus" AND ("antiretroviral therapy" OR "ART" OR "ARV" OR "HAART" OR "PMTCT" OR "highly active antiretroviral therapy" OR "prevention of mother-to-child HIV transmission") AND ("pregnancy" OR "pregnant women" OR "maternal health" OR "breastfeeding" OR "mothers" OR "maternal" OR "postpartum" OR "perinatal") AND ("access" OR "cultural barriers" OR "health barriers" OR "social determinants" OR "healthcare access" OR "cultural factors")

3.6. Data extraction and classification

Two reviewers will independently screen titles/abstracts and full texts against the eligibility criteria. Prior to formal screening, we will conduct a pilot calibration exercise on a sample of 20–50 records to refine decision rules and ensure consistency. Inter-rater agreement will be assessed using Cohen’s κ statistic at both the title/abstract and full-text stages, with discrepancies resolved through discussion or by a third reviewer if necessary **(Table 2)**.

For data extraction, we will use a standardized form pretested on a small sample of studies to ensure clarity and consistency. From each included study, we will extract study characteristics (e.g., year of publication, country), HIV testing, ART initiation, adherence, and factors influencing access to HIV care. These

Table 2: Data to be extracted from the included studies

Domain	Data Items	Notes/Definitions
Bibliometric Data	Authors, year of publication, country of origin	The country will also be coded by the WHO region and the World Bank income group.
Study Characteristics	Study design, study setting (facility, community, urban/rural), sample size, participant eligibility criteria, sampling method	Setting classification harmonized across studies.
Population Characteristics	Age, pregnancy/postpartum stage, HIV status confirmation, comorbidities	Extracted as reported; disaggregate by pregnancy vs. postpartum where possible.
Exposure Operationalization	Definition and measurement of social/structural determinants (e.g., SES, stigma, health system barriers)	Record both categorical/continuous coding and data source (survey, registry, etc.).
Comparator	Unexposed group (where applicable)	Document if the study is descriptive and has no comparator.
Outcome Variables	HIV testing uptake, ART initiation, retention in care (6, 12, 24 months), adherence (measure specified), discontinuation, viral suppression (<200 copies/mL or study definition)	Map to the harmonized HIV care cascade framework.
Effect Measures	Risk ratio, odds ratio, hazard ratio, prevalence ratio, etc.	Note whether crude or adjusted.
Adjustment Sets	Covariates included in multivariable analyses	Specify variables adjusted for (e.g., age, SES, parity).
Equity Variables (PROGRESS-Plus)	Place of residence, race/ethnicity, occupation, gender/sex, religion, education, socioeconomic status, social capital, plus age, disability, sexual orientation, etc.	Capture where reported.
Timepoints	Follow-up points for outcomes (e.g., 6, 12, 24 months, postpartum intervals)	Standardize across studies for synthesis.
Funding Source	Funder name/type, presence of industry sponsorship	Note any reported conflicts of interest.

ART, Antiretroviral Therapy; HIV, Human Immunodeficiency Virus; SES, Socioeconomic Status; PROGRESS-Plus, Place of residence, Race/ethnicity, Occupation, Gender/sex, Religion, Education, Socioeconomic status, and Social capital, plus additional personal characteristics.

factors may include socio-demographic, socioeconomic, medical, health system-related, knowledge and belief-related, risky health behaviors, psychosocial aspects, stigma and discrimination, family and interpersonal violence, and community HIV/AIDS prevalence. Extracted data will be organized in structured summary tables.

3.7. Quality Appraisal

The methodological quality of included studies will be appraised using the Joanna Briggs Institute (JBI) critical appraisal checklists [13], with the specific checklist selected according to study design (e.g., cohort, case-control, cross-sectional, qualitative). For studies employing mixed-methods designs, the Mixed Methods Appraisal Tool (MMAT, 2018) will be applied to ensure comprehensive evaluation across both qualitative and quantitative components.

Each item within the checklists will be classified as "Yes," "No," "Unclear," or "Not Applicable." Two reviewers will independently perform all assessments, with disagreements resolved by consensus or adjudication by a third reviewer. The results of the critical appraisal will be tabulated and used to inform the interpretation of findings. While no studies will be excluded solely on quality grounds, risk of bias assessments will be explicitly considered in the narrative synthesis and any sensitivity analyses, ensuring that study quality informs the overall strength and credibility of the evidence.

3.8. Statistical Analysis

3.8.1. Synthesis & Statistical Analysis

The primary effect measures of interest will be adjusted odds ratios (aORs), adjusted risk ratios (aRRs), or adjusted hazard ratios (aHRs), as reported by individual studies. When studies report only unadjusted estimates, these will be extracted but analyzed separately or included in sensitivity analyses. Where necessary, effect measures will be converted to a common metric (e.g., log odds ratio) for meta-analysis. For prevalence or proportion data (e.g., HIV testing uptake, ART initiation), pooled estimates will be calculated using a random-effects model with appropriate transformations (e.g., Freeman–Tukey double arcsine or generalized linear mixed models [GLMM]) to stabilize variances.

Random-effects models will be used to account for between-study heterogeneity. Effect sizes will be reported with 95% confidence intervals (CIs), and prediction intervals will also be provided to convey expected between-study variation. Results will be interpreted primarily in terms of effect sizes and intervals rather than statistical significance thresholds.

Statistical heterogeneity will be quantified using the I^2 statistic, with $I^2 > 50\%$ considered substantial. Where ≥ 10 studies are available, we will conduct subgroup analyses and meta-regression to explore sources of heterogeneity. Potential moderators will include geographic region, World Bank income level, antenatal vs. postpartum period, study design, and risk of bias classification. Influence analyses will be conducted to assess the impact of outliers.

For meta-analyses including ≥ 10 studies, we will assess small-study effects using contour-enhanced funnel plots and statistical tests for asymmetry (e.g., Egger's test for continuous outcomes, Harbord's test for binary outcomes), with interpretation informed by the limitations of these methods.

For qualitative studies, we will use a thematic synthesis approach to identify recurring patterns and themes related to barriers and facilitators of HIV care. Where applicable, findings will be integrated through a mixed-methods synthesis, with qualitative evidence contextualizing and explaining quantitative results.

The overall certainty of evidence for each outcome will be assessed using the GRADE approach, adapted for observational designs. Domains will include risk of bias, consistency, directness, precision, and publication bias. The summary of the Findings tables will present pooled effect estimates alongside certainty ratings.

Results will be summarized in structured tables, including variables such as study design, setting, exposure operationalization, outcome definitions and timepoints, effect measures, adjustment sets, equity variables (aligned with PROGRESS-Plus), and funding/conflicts of interest. This ensures systematic alignment between extracted variables and the analytic framework.

4. Discussion

We anticipate several potential limitations in this review. Variations in study design, population characteristics (e.g., antenatal versus postpartum), and health system contexts may complicate comparability and reduce the strength of pooled estimates. In addition, despite an extensive search strategy, the possibility of database coverage bias persists, particularly for studies conducted in underrepresented regions. These limitations will be explicitly acknowledged and considered in the interpretation of findings.

5. Conclusions

This protocol outlines the planned methods for a systematic review examining the influence of social and structural determinants on HIV care among pregnant and postpartum individuals. By mapping barriers and facilitators across multiple levels, this review aims to pinpoint key intervention targets. The findings will guide culturally relevant, context-specific mental health and stigma-reduction strategies, inform tailored interventions such as group therapy, and support their integration into antenatal, postnatal, family, and community care. Ultimately, the goal is to strengthen HIV care delivery, reduce mental health burdens, enhance support networks, and improve ART adherence and maternal–child outcomes. As a protocol, this document specifies the planned methodology; the conclusions of the review itself will depend on the evidence identified and synthesized.

Conflicts of Interest

The authors declare no competing interests that could have influenced the objectivity or outcome of this research

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Institutional Review Board (IRB)

This review is based on the analysis of publicly available published studies and does not involve any new data collection from human participants. As such, a formal ethical approval is not required. The review will strictly adhere to established ethical standards for secondary research.

Large Language Model

None

Authors Contribution

OI, AM, NN, SFM, and AR conceptualized the study design and objectives. EN, HF, SR, MAQ, ZHJ, and OI conducted the literature search and drafted the manuscript. EN, HF, SR, MAQ, and ZHJ critically reviewed and revised the final manuscript. AR is the guarantor and critically reviewed the manuscript. All authors approve the final manuscript as submitted for publication.

Data Availability

This systematic review is based on an analysis of previously published studies. All data analyzed during this study are derived from articles publicly available on electronic databases, including PubMed, Web of Science, and CINAHL. Full details of the search strategy, inclusion criteria, and data extraction process are described in the Methods section of the manuscript.

References

1. Collaborators GH. Global, regional, and national burden of HIV/AIDS, 1990-2021, and forecasts to 2050, for 204 countries and territories: the Global Burden of Disease Study 2021. Lancet HIV. 2024;11(12):e807-22. [PMID: 39608393, PMCID: PMC11612058, https://doi.org/10.1016/S2352-3018(24)00212-1].
2. Oguntibeju OO. Quality of life of people living with HIV and AIDS and antiretroviral therapy. HIV AIDS (Auckl). 2012;4:117-24. [PMID: 22893751, PMCID: PMC3418767, https://doi.org/10.2147/HIV.S32321].
3. Daoud O, Gladstein JE, Brixner D, O'Brochta S, Naik S. Health disparities in HIV care and strategies for improving equitable access to care. Am J Manag Care. 2025;31(1 Suppl):S3-S12. [PMID: 39899753, https://doi.org/10.37765/ajmc.2025.89687].
4. Kerr J, Smith A, Nzama N, Bullock NAA, Chandler C, Osezua V, et al. Systematic Review of Neighborhood Factors Impacting HIV Care Continuum Participation in the United States. J Urban Health. 2024;101(1):31-63. [PMID: 38093034, PMCID: PMC10897076, https://doi.org/10.1007/s11524-023-00801-3].
5. Eke AC, Mirochnick M, Lockman S. Antiretroviral Therapy and Adverse Pregnancy Outcomes in People Living with HIV. N Engl J Med. 2023;388(4):344-56. [PMID: 36720135, PMCID: PMC10400304, https://doi.org/10.1056/NEJMra2212877].
6. McNairy ML, Teasdale CA, El-Sadr WM, Mave V, Abrams EJ. Mother and child both matter: reconceptualizing the prevention of mother-to-child transmission care continuum. Curr Opin HIV AIDS. 2015;10(6):403-10. [PMID: 26352391, PMCID: PMC4707659, https://doi.org/10.1097/COH.0000000000000199].
7. Darmayasa IM, Setiawan WA, Evilia W, Ubro F. Psycho-Social Impact of Stigmatization against Pregnant Women with HIV. European Journal of Medical and Health Sciences. 2023;5(4):43-5. [https://doi.org/10.24018/ejmed.2023.5.4.1560].
8. Colvin CJ, Konopka S, Chalker JC, Jonas E, Albertini J, Amzel A, et al. A systematic review of health system barriers and enablers for antiretroviral therapy (ART) for HIV-infected pregnant and postpartum women. PLoS One. 2014;9(10):e108150. [PMID: 25303241, PMCID: PMC4193745, https://doi.org/10.1371/journal.pone.0108150].
9. Gari S, Doig-Acuna C, Smail T, Malungo JR, Martin-Hilber A, Merten S. Access to HIV/AIDS care: a systematic review of sociocultural determinants in low and high income countries. BMC Health Serv Res. 2013;13:198. [PMID: 23714167, PMCID: PMC3679910, https://doi.org/10.1186/1472-6963-13-198].
10. Hodgson I, Plummer ML, Konopka SN, Colvin CJ, Jonas E, Albertini J, et al. A systematic review of individual and contextual factors affecting ART initiation, adherence, and retention

for HIV-infected pregnant and postpartum women. PLoS One. 2014;9(11):e111421. [PMID: 25372479, PMCID: PMC4221025, https://doi.org/10.1371/journal.pone.0111421].
11. In: WHO Guidelines Approved by the Guidelines Review Committee. WHO Guidelines Approved by the Guidelines Review Committee. Geneva: World Health Organization Copyright © World Health Organization 2013.; 2013. [PMID: 24716260, PMCID: PMCID].
12. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan-a web and mobile app for systematic reviews. Syst Rev. 2016;5(1):210. [PMID: 27919275, PMCID: PMC5139140, https://doi.org/10.1186/s13643-016-0384-4].
13. Joanna Briggs I. Critical appraisal tools; 2017. [PMCID: PMCID].