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Review Article

Infection Prevention and Control Challenges and Adverse Event Prevention in Pakistani Healthcare Settings: A Narrative Review

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ABSTRACT

Background: Preventable adverse events remain a major patient-safety concern in Pakistani healthcare settings, where medication errors, surgical complications, surgical site infections, healthcare-associated infections, antimicrobial misuse, and underreporting of adverse events are shaped by both clinical and system-level weaknesses. Existing evidence is dispersed across clinical, public-health, and health-system literature, limiting integrated understanding of how infection prevention and control challenges interact with broader organizational and governance barriers. Objective: This narrative mini-review aimed to synthesize available evidence on infection prevention and control challenges and adverse event prevention in Pakistani healthcare settings, with emphasis on clinical safety problems, systemic determinants, and feasible prevention strategies. Methods: A structured narrative search was conducted using PubMed, Scopus, Web of Science, CINAHL, and Google Scholar for English-language literature published from 2005 to 2024. Search concepts included adverse events, patient safety, medication errors, surgical complications, surgical site infections, healthcare-associated infections, infection prevention and control, antimicrobial stewardship, healthcare quality, root-cause analysis, and Pakistan. Eligible sources included original research, review articles, case studies, policy-relevant reports, and grey literature addressing adverse-event occurrence, determinants, or prevention in Pakistani healthcare settings. Evidence was synthesized thematically because of heterogeneity in study designs, populations, outcomes, and reporting methods. Results: The synthesis identified medication errors, surgical complications and surgical site infections, healthcare-associated infections, antimicrobial misuse, and underreporting of adverse events as major patient-safety domains. Key contributing factors included illegible or incomplete prescriptions, limited pharmacist involvement, inconsistent surgical checklist use, weak IPC infrastructure, antibiotic misuse, inadequate surveillance, workplace violence, punitive reporting culture, ethical and governance gaps, professional hierarchy, and socio-cultural delays in care-seeking. Priority prevention strategies included standardized prescribing, phased electronic health records, pharmacist-led medication review, WHO Surgical Safety Checklist implementation, IPC care bundles, antimicrobial stewardship, non-punitive incident reporting, workforce protection, and multidisciplinary safety teams. Conclusion: Adverse event prevention in Pakistan requires integrated action across clinical practice, hospital administration, and health policy. Sustainable improvement depends on combining practical bedside interventions with stronger IPC capacity, reporting culture, workforce safety, multidisciplinary collaboration, surveillance, and transparent governance. Keywords: Patient Safety; Infection Prevention and Control; Healthcare-Associated Infections; Medication Errors; Surgical Site Infection; Antimicrobial Stewardship; Adverse Events; Pakistan.

INTRODUCTION

Patient safety remains a critical public health priority in Pakistan, where preventable adverse events continue to affect healthcare quality, patient outcomes, institutional trust, and health-system performance. The country's healthcare system operates through a complex mix of public and private providers, with substantial variation in infrastructure, workforce capacity, regulatory oversight, and access to standardized clinical protocols. These structural differences contribute to fragmented care pathways and uneven implementation of safety practices, particularly in resource-constrained hospitals and primary care settings (1, 2). Within this context, adverse events such as medication errors, surgical complications, surgical site infections, healthcare-associated infections, and preventable delays in care are not isolated clinical incidents; rather, they reflect broader weaknesses in governance, workforce training, documentation systems, infection prevention and control, and institutional safety culture (3).

The burden of adverse events in Pakistani healthcare settings is shaped by both proximal clinical factors and wider systemic determinants. Medication errors may arise from incomplete prescriptions, illegible handwriting, polypharmacy, limited use of generic prescribing, and insufficient integration of pharmacists into clinical decision-making (6, 7). Surgical complications and surgical site infections are influenced by inconsistent adherence to infection prevention protocols, variable implementation of surgical safety checklists, overcrowding, antibiotic misuse, and shortages of trained infection prevention personnel (9–13). Healthcare-associated infections are further intensified by weak surveillance systems, inadequate antimicrobial stewardship, suboptimal waste management, and limited infrastructure for sustained infection control (13–15). These clinical problems are compounded by social and institutional barriers, including violence against healthcare workers, fear-based reporting cultures, ethical-practice gaps, corruption, professional hierarchy, and delayed care-seeking due to socio-cultural practices (16–24).

Although individual studies and reports have examined medication safety, infection prevention, surgical safety, workplace violence, and health-system governance in Pakistan, the evidence remains dispersed across clinical, administrative, and public-health literature. Existing discussions often focus on one domain of patient safety, such as hospital-acquired infections or medication errors, without adequately integrating the clinical causes of adverse events with the institutional and socio-cultural conditions that sustain them. This fragmentation limits the ability of clinicians, hospital administrators, policymakers, and researchers to understand adverse-event prevention as a systems-level challenge requiring coordinated clinical, organizational, and governance responses. A context-specific synthesis is therefore needed to consolidate current evidence, identify recurring patterns, and highlight feasible prevention strategies for Pakistani healthcare settings.

This narrative mini-review was conducted to synthesize available evidence on infection prevention and control challenges and adverse event prevention in Pakistani healthcare settings. The review focuses on three interrelated domains: common categories of adverse events, including medication errors, surgical complications, surgical site infections, and healthcare-associated infections; clinical and systemic determinants contributing to these events; and practical mitigation strategies, including electronic documentation, standardized checklists, pharmacist-led interventions, antimicrobial stewardship, IPC care bundles, workforce protection, and strengthening of patient-safety culture. By integrating clinical and system-level evidence, this review aims to provide a coherent framework for understanding adverse-event prevention in Pakistan and to identify priority areas for future implementation-focused research and policy reform.

MATERIALS AND METHODS

This narrative mini-review used a structured literature-search approach to identify and synthesize evidence related to infection prevention and control challenges, adverse events, and patient-safety improvement in Pakistani healthcare settings. A narrative review design was selected because the

objective was to integrate evidence from heterogeneous sources, including original studies, review articles, case-based reports, and policy-relevant grey literature, rather than to generate pooled quantitative estimates. The synthesis was organized thematically to examine both direct clinical contributors to adverse events and broader systemic, cultural, and institutional barriers that influence patient safety.

Electronic literature searches were conducted in PubMed, Scopus, Web of Science, CINAHL, and Google Scholar. The search focused on English-language publications from 2005 to 2024. The main search concepts were adverse events, patient safety, medication errors, surgical complications, surgical site infections, healthcare-associated infections, infection prevention and control, antimicrobial stewardship, healthcare quality, root-cause analysis, and Pakistan.

Boolean operators were used to combine these concepts, with search terms including "adverse events," "patient safety," "medication errors," "hospital-acquired infections," "healthcare-associated infections," "surgical site infections," "surgical complications," "infection prevention and control," "antimicrobial stewardship," "healthcare quality," "root cause analysis," and "Pakistan." The Google Scholar search was used to identify additional contextual and grey-literature sources relevant to Pakistani healthcare practice and patient-safety systems.

Studies and reports were considered eligible if they addressed the occurrence, causes, contributing factors, or prevention of adverse events in Pakistani healthcare settings. Eligible sources included original research articles, review articles, case studies, institutional or policy reports, and relevant grey literature from credible health organizations. Studies were included when they provided empirical data, substantive qualitative findings, or policy-relevant discussion on medication safety, infection prevention and control, surgical safety, healthcare-associated infections, patient-safety culture, professional roles, workplace violence, ethical challenges, governance, or health-system barriers in Pakistan. Articles were excluded if they were not relevant to the Pakistani healthcare context, were not available in English, did not address adverse events or patient safety, or consisted only of opinion without substantive clinical, empirical, or policy content. Where selected non-Pakistani studies were cited, they were used only to provide regional or international context for interventions such as computerized prescribing, surgical safety checklists, antimicrobial stewardship, or infection-control bundles.

The literature-selection process involved screening titles and abstracts for relevance to the review objective, followed by full-text assessment of potentially eligible sources. Information was extracted on the type of adverse event or patient-safety issue, healthcare setting, reported determinants, clinical or systemic causes, prevention strategies, and implementation barriers. Findings were grouped into thematic domains, including medication errors, surgical complications and surgical site infections, healthcare-associated infections, infection prevention and control barriers, antimicrobial stewardship, workplace violence, safety culture, ethical and governance challenges, socio-cultural determinants, and underutilization of healthcare professionals such as pharmacists. The synthesis emphasized recurring patterns across studies rather than numerical pooling because of variation in study designs, populations, outcomes, and reporting methods.

No meta-analysis was performed because the included literature was methodologically heterogeneous and did not provide sufficiently comparable quantitative outcomes for statistical pooling. Formal risk-of-bias assessment was not undertaken, which is consistent with the narrative mini-review design but limits the ability to grade the certainty of evidence. To improve transparency, the review distinguished Pakistan-specific evidence from broader international literature wherever relevant and interpreted external evidence only as contextual support. The main methodological limitations of this approach include possible selection bias, incomplete retrieval of unpublished local safety initiatives, variation in the

quality of included sources, and limited comparability across healthcare settings. Despite these limitations, thematic synthesis was considered appropriate for consolidating dispersed evidence and identifying practical clinical and policy priorities for adverse-event prevention in Pakistan.

RESULTS / SYNTHESIS

The evidence identified in this narrative mini-review was synthesized thematically across major domains of adverse events and patient-safety challenges in Pakistani healthcare settings. The recurring themes included medication errors, surgical complications and surgical site infections, healthcare-associated infections, antimicrobial misuse, weak infection prevention and control systems, underdeveloped safety culture, workplace violence, ethical and governance barriers, socio-cultural delays in care-seeking, and limited multidisciplinary integration of healthcare professionals. Across these domains, adverse events appeared to arise from the interaction of direct clinical deficiencies and broader structural limitations, rather than from isolated individual errors alone. The synthesis therefore grouped findings into two overlapping categories: clinical adverse-event domains and system-level determinants affecting prevention and reporting.

Table 1. Thematic Summary of Evidence on Adverse Events and Patient-Safety Challenges in Pakistani Healthcare Settings

Thematic Domain	Main Patient-Safety Problem	Key Contributing Factors	Evidence Pattern Identified	Suggested Prevention Direction
Medication errors	Prescription, dispensing, and administration-related errors	Illegible handwriting, incomplete prescriptions, polypharmacy, limited generic prescribing, inadequate pharmacist involvement	Medication errors were repeatedly linked with weak prescribing systems and limited clinical pharmacy integration	Electronic prescribing, standardized prescription formats, pharmacist-led medication review, provider training, rational drug-use policies
Surgical complications and SSIs	Preventable intraoperative and postoperative complications	Inconsistent checklist use, suboptimal IPC practices, overcrowding, limited surgical surveillance, resource constraints	Surgical safety problems were associated with both procedural inconsistency and institutional limitations	WHO Surgical Safety Checklist, SSI surveillance, perioperative IPC training, antimicrobial stewardship
Healthcare-associated infections	Device-associated and hospital-acquired infections	Weak IPC infrastructure, antibiotic misuse, shortage of trained IPC staff, poor waste management, overcrowding	HAIs were described as a persistent consequence of inadequate IPC capacity and antimicrobial misuse	IPC care bundles, hand hygiene programs, ASPs, trained IPC nurses, improved hospital infrastructure
Antimicrobial misuse	Irrational prescribing and resistance risk	Inadequate stewardship, empirical prescribing, limited microbiology support, weak prescribing oversight	Antibiotic misuse was closely linked with SSIs, HAIs, and broader patient-safety risks	Antimicrobial stewardship programs, prescribing audits, microbiology-guided therapy, clinical pharmacist involvement
Safety culture and error reporting	Underreporting of adverse events	Fear of blame, punitive culture, workplace violence, limited incident-reporting mechanisms	Reporting barriers were linked with organizational culture and lack of psychological safety	Non-punitive reporting systems, leadership support, anonymous reporting, feedback-based learning
Workforce violence and psychological safety	Suppressed communication and defensive practice	Violence against healthcare workers, mistrust, stress, poor institutional protection	Violence was identified as a major barrier to open disclosure and adverse-event reporting	Legal protection, security protocols, institutional reporting pathways, staff-support mechanisms
Ethical and governance barriers	Reduced quality, trust, and accountability	Ethical-practice gaps, corruption, resource diversion, weak accountability structures	Governance weaknesses were described as upstream contributors to unsafe care	Transparent procurement, merit-based administration, ethics training, institutional accountability mechanisms
Professional role underutilization	Missed opportunities for prevention	Limited pharmacist role, physician-centric hierarchy, weak interprofessional collaboration	Underuse of pharmacists and allied professionals limited medication safety and IPC improvement	Multidisciplinary teams, pharmacist-led interventions, interprofessional education, defined safety roles
Socio-cultural determinants	Delayed access to appropriate care	Preference for traditional healers, delayed referral, cultural barriers, limited awareness	Social practices were linked with delayed care-seeking and poorer outcomes in vulnerable groups	Community awareness, culturally sensitive education, referral strengthening, patient engagement

Medication errors emerged as one of the most prominent adverse-event categories. The available evidence linked these errors primarily to suboptimal prescribing practices, including illegible handwriting, incomplete prescriptions, excessive polypharmacy, limited use of generic drug names, and inadequate participation of pharmacists in clinical decision-making. One cited Pakistani hospital-based study reported that illegible handwriting and incomplete prescriptions collectively accounted for a large proportion of prescribing errors, while another highlighted the potential of clinical pharmacist interventions through documented corrective actions related to dosing, therapeutic alternatives, and prescription optimization (6, 7). These findings suggest that medication safety in Pakistan is not only a matter of individual prescriber performance but also reflects the absence of reliable documentation systems, standardized prescribing formats, routine medication review, and embedded clinical pharmacy services.

The synthesis also indicated that medication-error prevention requires phased and context-sensitive implementation. Full electronic health-record or computerized prescribing systems may reduce legibility-related errors, but their adoption is limited by financial, infrastructural, and training

constraints. In the short term, standardized prescription charts, mandatory completion fields, medication reconciliation at admission and discharge, and pharmacist-led prescription review may provide more feasible safety improvements. Training programs on medication-error reporting and rational prescribing are also needed, particularly because medication safety depends on both technical prescribing competence and institutional willingness to identify, report, and correct errors (6–8).

Surgical complications and surgical site infections represented another major safety domain. The evidence suggested that these events were commonly associated with inconsistent infection prevention and control practices, variable adherence to perioperative protocols, overcrowded clinical environments, and limited surveillance. The WHO Surgical Safety Checklist was identified as a practical intervention with evidence of benefit in Pakistani tertiary-care settings, particularly for reducing postoperative complications when implemented consistently (12). However, the broader synthesis suggested that checklist availability alone is insufficient unless supported by staff training, leadership commitment, local ownership, documentation compliance, and monitoring systems.

Surgical site infections were closely related to the broader IPC environment. Contributing factors included poor hand hygiene, inconsistent sterilization practices, inadequate waste management, suboptimal antibiotic prophylaxis, and limited antimicrobial stewardship. The evidence also showed that surgical safety and infection prevention cannot be separated from institutional capacity. Hospitals with high patient loads, limited trained IPC personnel, and constrained operating-room resources are less able to implement standardized safety protocols reliably. Therefore, the prevention of surgical complications and SSIs requires combined action through surgical checklists, IPC education, antimicrobial stewardship, surveillance, and administrative support (9–14).

Healthcare-associated infections were identified as a persistent and system-sensitive adverse-event category. The review found that HAIs, including device-associated infections, were linked with weak IPC systems, antibiotic misuse, insufficient infection-control staffing, and infrastructural limitations. Internationally recognized interventions such as care bundles for central lines, urinary catheters, and ventilator-associated infection prevention are relevant to Pakistani hospitals, but their success depends on local implementation capacity. The evidence suggests that care bundles should be supported by audit, feedback, training, availability of supplies, and accountability mechanisms rather than introduced as isolated checklists (13, 15).

Antimicrobial misuse was a cross-cutting theme across surgical infections, HAIs, and medication safety. Overuse or inappropriate use of antibiotics contributes to antimicrobial resistance and weakens the effectiveness of infection prevention programs. The synthesis indicated that antimicrobial stewardship programs are essential but remain difficult to implement consistently in resource-constrained settings because of limited microbiology services, empirical prescribing norms, lack of prescribing audits, and underuse of pharmacists. Practical stewardship strategies may include antibiotic restriction policies, culture-guided prescribing, periodic prescription audits, feedback to prescribers, and formal pharmacist participation in antimicrobial review (9, 13).

Table 2. Clinical Adverse-Event Domains, Root Causes, and Mitigation Strategies

Adverse-Event Domain	Proximal Clinical Causes	System-Level Causes	Mitigation Strategies	Implementation Considerations
Medication errors	Illegible prescriptions, wrong dose, incomplete prescription, polypharmacy	Absence of electronic prescribing, limited pharmacist role, weak reporting culture	EHRs/CPOE, standardized prescription charts, pharmacist-led review, medication reconciliation	Begin with low-cost prescription standardization where full EHR implementation is not feasible
Surgical complications	Missed procedural steps, poor perioperative documentation, inconsistent safety checks	Overcrowding, insufficient training, weak monitoring, limited checklist ownership	WHO Surgical Safety Checklist, perioperative audit, team briefing and debriefing	Checklist compliance should be actively monitored rather than assumed
Surgical site infections	Poor asepsis, inappropriate antibiotic prophylaxis, inadequate sterilization	Weak IPC infrastructure, staff shortages, limited surveillance	SSI surveillance, IPC training, ASPs, sterilization protocols	Requires infection-control teams and administrative support
Healthcare-associated infections	Device contamination, poor hand hygiene, delayed removal of invasive devices	Shortage of IPC staff, poor waste management, limited supplies	IPC care bundles, hand hygiene programs, device-care protocols, audit and feedback	Bundle effectiveness depends on supply availability and staff compliance
Antimicrobial resistance risk	Empirical broad-spectrum prescribing, prolonged antibiotic use	Limited microbiology support, weak stewardship, lack of prescribing accountability	ASPs, culture-guided therapy, antibiotic audits, pharmacist involvement	Stewardship should be adapted to local microbiology and prescribing capacity

Adverse-Event Domain	Proximal Clinical Causes	System-Level Causes	Mitigation Strategies	Implementation Considerations
Underreporting of adverse events	Failure to disclose errors, incomplete incident documentation	Fear of blame, violence, punitive culture, weak protection systems	Non-punitive incident reporting, anonymous reporting, leadership feedback	Reporting systems must protect staff and demonstrate learning from reports

The review also identified several system-level and cultural barriers that shape patient safety outcomes in Pakistan. Workplace violence against healthcare workers emerged as a major threat to safety culture. In environments where clinicians fear verbal, physical, or legal retaliation, adverse events are less likely to be reported, discussed, or used for institutional learning. This creates a cycle in which errors remain hidden, root causes remain unaddressed, and staff may adopt defensive clinical behaviors. A positive patient-safety culture requires psychological safety, leadership support, non-punitive reporting, and visible corrective action after incidents (16–18).

Ethical and governance barriers were also repeatedly relevant. Ethical-practice gaps, institutional corruption, and weak accountability systems can reduce trust, divert resources, and undermine the implementation of patient-safety interventions. These barriers operate upstream of clinical practice; even well-designed interventions such as checklists, stewardship programs, or electronic systems may fail if procurement is unreliable, staff appointments are not merit-based, supervision is weak, or institutional leadership does not prioritize safety. Therefore, adverse-event prevention in Pakistan requires attention not only to clinical protocols but also to governance, transparency, resource allocation, and institutional accountability (19–21).

Socio-cultural determinants further influenced patient safety, especially where delayed care-seeking, reliance on traditional healers, limited health literacy, or gender-related barriers affected timely access to appropriate services. These factors are particularly relevant in maternal and community health contexts, where delays in reaching formal healthcare can increase the risk of complications and adverse outcomes. Patient-safety strategies should therefore include community education, culturally sensitive communication, referral strengthening, and patient engagement alongside hospital-based interventions (22).

The underutilization of pharmacists and other non-physician healthcare professionals was another recurring theme. Evidence from Pakistani settings indicates that pharmacists can contribute substantially to prescription review, dosing correction, medication reconciliation, patient counseling, and antimicrobial stewardship, yet their clinical role remains limited in many institutions. Physician-centric hierarchies and weak interprofessional structures reduce opportunities for early error detection and shared decision-making. Expanding multidisciplinary collaboration is therefore a practical and necessary component of adverse-event prevention, particularly in medication safety and antimicrobial stewardship (7, 23, 24).

Table 3. System-Level Barriers and Their Effects on Patient-Safety Improvement

System-Level Barrier	Effect on Patient Safety	Affected Domains	Practical Corrective Action
Resource constraints	Limits availability of supplies, trained staff, electronic systems, and surveillance	IPC, HAIs, medication safety, surgical safety	Prioritize low-cost standardized tools, phased digital systems, and targeted IPC staffing
Weak safety culture	Reduces reporting, learning, and accountability	All adverse-event domains	Establish non-punitive reporting and leadership-led feedback systems
Workplace violence	Suppresses disclosure and increases defensive practice	Error reporting, emergency care, staff wellbeing	Legal protection, security systems, violence-reporting pathways
Corruption and poor governance	Weakens procurement, staffing, quality monitoring, and public trust	Institutional safety, IPC infrastructure, workforce morale	Transparent procurement, administrative accountability, ethics oversight
Professional hierarchy	Limits pharmacist and multidisciplinary contribution	Medication safety, ASPs, IPC	Formalize multidisciplinary safety teams and pharmacist-led review
Limited surveillance	Prevents accurate measurement of infections and adverse events	HAIs, SSIs, surgical complications	Build hospital-level adverse-event and infection surveillance systems
Socio-cultural barriers	Delays appropriate care and referral	Maternal health, community health, preventable complications	Community education, culturally sensitive referral systems, patient engagement

Overall, the synthesis indicates that adverse events in Pakistani healthcare settings are produced by a combination of clinical-process failures and systemic weaknesses. Medication errors, SSIs, HAIs, and antimicrobial misuse require direct technical interventions, but these interventions are unlikely to succeed unless institutional safety culture, workforce protection, governance, surveillance, and multidisciplinary collaboration are strengthened simultaneously. The evidence supports an integrated patient-safety model in which clinical tools such as prescription standardization, surgical checklists, IPC

care bundles, antimicrobial stewardship, and pharmacist-led medication review are implemented alongside reforms targeting reporting culture, staff safety, accountability, and resource allocation.

Taken together, the findings suggest that Pakistan's patient-safety agenda should move from isolated protocol adoption toward context-sensitive implementation. Hospitals may begin with feasible low-cost interventions, including standardized prescription formats, checklist monitoring, hand-hygiene audits, IPC training, medication reconciliation, and anonymous incident reporting. At the policy level, stronger legal protection for healthcare workers, investment in IPC workforce development, transparent governance, and formal integration of pharmacists into clinical care are needed to create conditions in which adverse events can be prevented, reported, and systematically reduced.

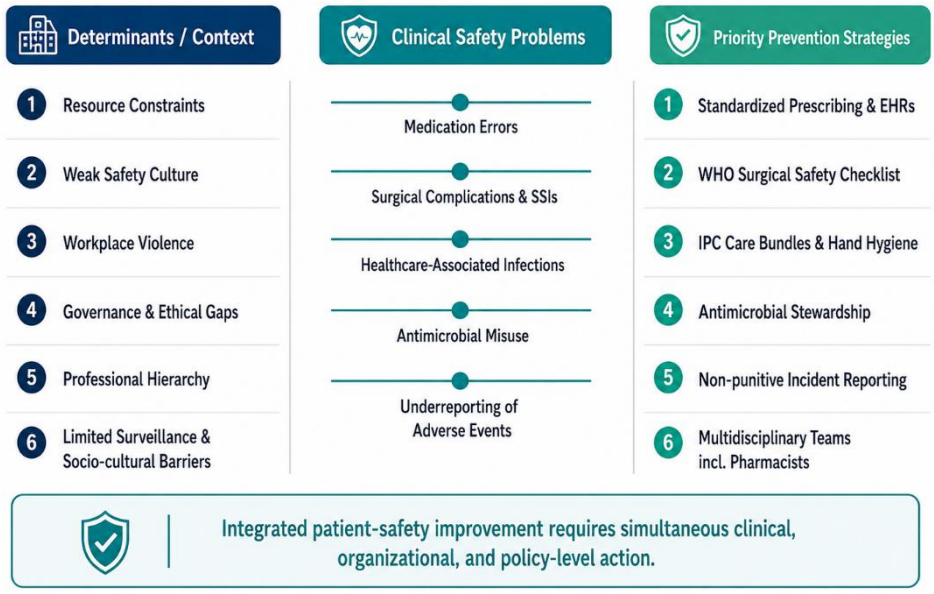

Figure 1 Conceptual synthesis of narrative review findings on adverse events in Pakistani healthcare settings. The figure summarizes the review's integrated patient-safety framework, showing how upstream determinants such as resource constraints, weak safety culture, workplace violence, governance and ethical gaps, professional hierarchy, limited surveillance, and socio-cultural barriers contribute to major clinical safety problems, including medication errors, surgical complications and surgical site infections, healthcare-associated infections, antimicrobial misuse, and underreporting of adverse events. The right column highlights priority prevention strategies identified through the narrative synthesis, including standardized prescribing and electronic health records, surgical safety checklist implementation, IPC care bundles, antimicrobial stewardship, non-punitive incident reporting, and multidisciplinary team-based care involving pharmacists. The forest-plot-inspired central panel is used conceptually to illustrate thematic synthesis and does not represent pooled effect estimates or quantitative meta-analysis.

DISCUSSION

This narrative mini-review synthesized evidence on infection prevention and control challenges and adverse event prevention in Pakistani healthcare settings, with emphasis on the interaction between clinical safety problems and broader system-level determinants. The principal finding is that preventable adverse events in Pakistan are not confined to isolated failures in individual clinical practice; instead, they arise from a layered interaction of weak prescribing systems, inconsistent perioperative safety practices, inadequate infection prevention infrastructure, antimicrobial misuse, poor surveillance, underdeveloped reporting culture, workforce violence, governance gaps, and limited multidisciplinary integration. Medication errors, surgical complications, surgical site infections, healthcare-associated infections, and underreporting of adverse events therefore require an integrated patient-safety response that combines clinical standardization with organizational and policy-level reform.

Medication errors remain a major patient-safety concern in Pakistani healthcare settings. The evidence reviewed suggests that many errors are linked with preventable prescribing deficiencies, including illegible handwriting, incomplete prescriptions, excessive polypharmacy, limited generic prescribing,

and insufficient clinical involvement of pharmacists (6,7). These findings are consistent with international patient-safety literature showing that medication errors can be reduced through structured prescribing systems, computerized physician order entry, pharmacist-led medication review, and team-based medication reconciliation (26,27). However, the implementation context in Pakistan differs from high-resource settings because many hospitals continue to face financial, infrastructural, workforce, and training constraints. Consequently, a phased implementation model may be more feasible than immediate full-scale digital transformation. Standardized prescription charts, mandatory prescription fields, high-risk medication protocols, medication reconciliation at admission and discharge, and pharmacist-led prescription review may serve as practical early interventions while electronic prescribing and integrated electronic health records are developed progressively.

Surgical complications and surgical site infections represent another important domain where evidence-based interventions exist but implementation remains inconsistent. The WHO Surgical Safety Checklist has been associated with reductions in postoperative complications when applied effectively, including in tertiary-care settings in Pakistan (12). Nevertheless, checklist use should not be treated as a documentation exercise alone. The broader literature indicates that checklist effectiveness depends on team communication, leadership support, training, monitoring, and local ownership rather than simple availability of the form (29). In Pakistani hospitals, high patient volumes, limited operating-room resources, variable infection-control practices, and weak surveillance mechanisms may reduce the consistency with which safety procedures are applied. This suggests that surgical safety improvement should combine checklist compliance with structured team briefings, perioperative infection-control training, antibiotic prophylaxis protocols, surveillance of surgical site infections, and feedback loops for surgical teams.

Healthcare-associated infections remain closely linked to institutional infection prevention and control capacity. The reviewed literature indicates that hospital-acquired and device-associated infections are influenced by weak hand hygiene compliance, inadequate sterilization, insufficient waste management, overcrowding, antibiotic misuse, shortages of trained IPC personnel, and limited surveillance infrastructure (9,13,15). International evidence supports IPC care bundles, hand hygiene programs, antimicrobial stewardship, and continuous audit-feedback systems as key interventions for reducing device-associated and hospital-acquired infections (30,31). However, implementation in Pakistan must account for gaps in supplies, staffing, microbiology support, training, and administrative oversight. Care bundles are unlikely to succeed if introduced as isolated checklists without ensuring availability of consumables, staff accountability, leadership engagement, and infection-control monitoring.

Antimicrobial misuse emerged as a cross-cutting safety problem linking medication errors, surgical infections, HAIs, and antimicrobial resistance. In many resource-constrained settings, empirical broad-spectrum prescribing is reinforced by limited diagnostic capacity, delayed culture reports, patient expectations, weak prescribing audits, and absence of functional stewardship teams. Antimicrobial stewardship programs can reduce inappropriate antibiotic use, but their success depends on multidisciplinary participation, including physicians, pharmacists, microbiologists, nurses, infection-control practitioners, and hospital administrators (13,34). In Pakistan, stewardship should initially prioritize feasible institutional actions such as antibiotic prescribing audits, restriction policies for selected high-risk antimicrobials, culture-guided therapy where available, perioperative antibiotic protocols, and pharmacist-supported feedback to prescribers. Such measures may provide a realistic bridge between ideal stewardship models and current resource constraints.

The synthesis also highlights that patient safety in Pakistan cannot be improved through technical interventions alone. A weak safety culture, fear of blame, and underdeveloped incident-reporting systems limit institutional learning from adverse events. These barriers are intensified by workplace violence against healthcare workers, which suppresses open disclosure, increases psychological distress, and promotes defensive practice (15,16). International patient-safety literature emphasizes that learning

from failure requires psychological safety, non-punitive reporting, leadership accountability, and visible corrective action (32,33). For Pakistan, this means that adverse-event reporting systems must be paired with staff protection, confidentiality, feedback mechanisms, and organizational commitment to learning rather than punishment. Without such safeguards, clinicians may continue to underreport errors even when reporting tools are available.

Governance and ethical barriers further complicate adverse-event prevention. Ethical-practice gaps, corruption, weak accountability, and inefficient administration can undermine the quality and consistency of care by diverting resources, weakening procurement systems, reducing staff morale, and eroding public trust (18–20). These structural problems operate upstream of clinical practice. For example, hand hygiene protocols cannot be sustained if supplies are unavailable, stewardship programs cannot function without microbiology support and prescribing oversight, and safety checklists cannot be implemented reliably without managerial accountability. Therefore, patient-safety reform in Pakistan requires governance-sensitive strategies, including transparent procurement, merit-based appointments, functional hospital quality committees, ethics training, audit systems, and accountability mechanisms that support rather than punish frontline staff.

The underutilization of pharmacists and other non-physician healthcare professionals represents a missed opportunity for improving safety. Evidence from Pakistani settings indicates that pharmacists can contribute to prescription review, dose correction, therapeutic substitution, patient counseling, medication reconciliation, and antimicrobial stewardship (7,22,23). However, physician-centric hierarchies and limited institutional role definitions restrict their participation in routine clinical decision-making. Interprofessional education and multidisciplinary safety teams should therefore be prioritized, particularly in hospitals with high medication-error risk, high antimicrobial consumption, and high rates of healthcare-associated infections. Expanding pharmacist-led and nurse-led safety roles may be especially valuable where physician workload is high and formal digital systems remain limited.

Socio-cultural determinants also influence adverse events by shaping care-seeking behavior, communication, and access to timely treatment. Delayed presentation due to traditional healing practices, limited health literacy, gender-related barriers, mistrust of formal healthcare, or poor referral pathways may increase the risk of preventable complications, particularly in maternal, neonatal, and community-health contexts (21). This indicates that adverse-event prevention should not be restricted to hospitals alone. Community education, culturally sensitive counseling, referral strengthening, patient engagement, and public trust-building are necessary components of a broader patient-safety strategy.

This review has several limitations that should be considered when interpreting its findings. First, the narrative mini-review design allowed integration of heterogeneous evidence but did not include a formal systematic-review protocol, PRISMA flow diagram, or quantitative risk-of-bias assessment. Second, the available evidence was diverse in design, setting, and quality, limiting direct comparison across studies and preventing statistical pooling. Third, unpublished local quality-improvement initiatives, institutional audits, and adverse-event data may not have been captured, meaning the review may underrepresent practical interventions occurring within individual hospitals. Fourth, some relevant domains, such as primary-care safety, diagnostic error, nursing workload, and digital health readiness, require deeper empirical exploration. Despite these limitations, the synthesis provides a clinically meaningful overview of recurring patient-safety problems in Pakistan and identifies practical directions for integrated reform.

Future research should move beyond descriptive reporting and focus on implementation science. Priority areas include evaluating phased electronic prescribing systems, pharmacist-led medication reconciliation, surgical checklist compliance programs, IPC care-bundle implementation, antimicrobial stewardship models, and non-punitive incident-reporting systems in Pakistani hospitals. Future studies should include measurable outcomes such as medication-error rates, surgical site infection rates, HAI incidence, antibiotic consumption patterns, reporting frequency, staff safety perceptions, and patient outcomes. Multicenter designs, mixed-methods implementation studies, cost-effectiveness analyses, and

context-sensitive quality-improvement trials would help identify which interventions are feasible, acceptable, scalable, and sustainable in Pakistan's resource-constrained healthcare environment.

CONCLUSION

This narrative mini-review indicates that adverse event prevention in Pakistani healthcare settings requires more than isolated clinical protocols. Medication errors, surgical complications, surgical site infections, healthcare-associated infections, antimicrobial misuse, and underreporting of adverse events are shaped by interacting clinical, organizational, cultural, and governance-related determinants. The evidence supports a phased and context-sensitive patient-safety strategy that combines standardized prescribing, pharmacist-led medication review, surgical safety checklists, IPC care bundles, antimicrobial stewardship, surveillance systems, non-punitive reporting, workforce protection, and transparent institutional governance. Strengthening patient safety in Pakistan therefore requires simultaneous action at bedside, hospital-administration, and policy levels, with future research focused on implementation, scalability, and measurable reductions in preventable harm.

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