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Research Title:

**The Role of Health Administration in Reducing Blood Culture Contamination: An
Applied Study at King Abdullah Bin Abdulaziz University Hospital, Riyadh**

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Dedication

This work is lovingly dedicated to my beloved **mother** and **father**, whose endless prayers, sacrifices, and unconditional love have shaped every success in my life. I also dedicate this thesis to my **husband**, whose patience, motivation, and steadfast support enabled me to pursue my academic goals with confidence and determination.

To each of you, this achievement is as much yours as it is mine.

Abstract:

Blood culture contamination poses significant clinical and economic challenges by leading to inaccurate diagnoses, unnecessary antibiotic use, and increased healthcare costs. This study aimed to assess the effectiveness of administrative practices in reducing blood culture contamination at King Abdullah bin Abdulaziz University Hospital (KAAUH) in Riyadh. A descriptive quantitative design was adopted, and data were collected from 110 healthcare professionals, including physicians, nurses, laboratory technicians, and health administrators.

The results indicated a high level of agreement regarding the clarity and regular updating of administrative policies, the availability of continuous training programs, and the provision of adequate sterile equipment and protective resources. Findings also revealed strong monitoring and evaluation mechanisms, including regular tracking of contamination rates, existence of specialized committees, and feedback communication with staff. Overall, the study concludes that administrative practices at KAAUH are well-structured and significantly contribute to reducing contamination levels. The study recommends expanding simulation-based training, enhancing policy dissemination, and developing digital dashboards for continuous quality improvement.

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Chapter one

Introduction:

Bloodstream infections (BSIs) are a critical global health concern, placing a substantial burden on patient outcomes and healthcare systems. Sepsis—one of the most severe manifestations of BSI—is responsible for high morbidity and mortality worldwide (Fleischmann et al., 2016). Timely and accurate diagnosis of BSIs relies heavily on blood culture results, which inform antimicrobial therapy and stewardship strategies (Hall & Lyman, 2006; Fleischmann et al., 2016). However, the frequent occurrence of blood culture contamination (BCC)—the unintended presence of commensal skin or environmental microorganisms—poses a serious challenge to patient safety, often leading to misdiagnosis, unnecessary interventions, prolonged hospitalization, and increased healthcare expenditures (Hall & Lyman, 2006; Fleischmann et al., 2016).

Blood culture is a diagnostic laboratory test to identify the existence of microorganisms, e.g. bacteria or fungi, in the bloodstream. It has been used as the standard in diagnosing infections of the blood stream. The implementation of this test will help detect the exact pathogen that caused the infection and define its antimicrobial susceptibility, by which it will be possible to treat the patient by pointing him or her in the right direction. The cultures of blood are normally obtained in cases where the patient exhibits an indication of systemic infection like a fever, disorder of cold, hypotension or high White boarder cells. Immediate and correct detection of pathogens on the blood is essential to enhance clinical outcomes, reduce complications such as sepsis infections, and inform an effective antimicrobial treatment .

Benchmark targets established by Clinical and Laboratory Standards Institute (CLSI) and other professional bodies recommend BCC rates below 3%, with an optimal goal around 1% (CDC, as cited in Hall & Lyman, 2006; Wikipedia, 2025) (Hall & Lyman, 2006; Wikipedia, 2025). Yet real-world rates can soar as high as 12%, especially in high-throughput settings like Emergency Departments (EDs) (Wikipedia, 2025; Self et al., 2013). Studies in community and tertiary hospitals have demonstrated that implementation of sterile collection protocols, including sterile gloves, chlorhexidine skin prep, and fenestrated drapes, can effectively reduce BCC from as high as 5% down to near or below 1% (Self et al., 2013; Wikipedia, 2025). These findings point to the finding that solution-based systematized and protocol-based interventions, when safely executed, may lead to vast improvements in long-term patient outcomes and accurate diagnosis.

Although the extensive literature, by far, on clinical and procedural interventions, the role of health administration, including the role of governance, policy deployment, resources allocation, staff training management, and quality monitoring, in BCC reduction has yet to be explored. However, quality improvement frameworks, such as those promoted by the CLSI, designate administrative oversight as a critical component of BCC risk mitigation (CDC, as cited in Hall & Lyman, 2006). Administrative functions include instituting regular feedback loops, facilitating staff training, authorizing equipment procurement (e.g., sterile set kits, diversion devices), establishing accountability mechanisms, and embedding process metrics in key performance indicators (CDC, as cited in Hall & Lyman, 2006).

International researches support the key role of administration-based interventions in the accomplishment of low BCC rates. He et al. (2019), for example, demonstrated that implementing weekly contamination reports to ICU staff—backed by administrative support—led to measurable BCC reductions. Halstead et al. (2020) reported success across multiple hospital systems by standardizing protocols and fostering administrative commitment to process adherence. Eisenberg et al. (2024) underscored the synergy between administrative leadership and interdisciplinary teams (laboratory, nursing, phlebotomy, infection prevention) in driving down BCC rates through structured policy integration, staff training, and data-driven accountability.

In Saudi Arabia, BCC poses a similarly complex challenge. Hemeg et al. (2020) reported elevated contamination rates in a tertiary care setting, emphasizing gaps in collection technique and under-resourced laboratory monitoring. Contrastively, Hosni et al. (2024) detailed successful contamination reduction at King Abdullah Hospital, Bisha—a result attributed to strong administrative leadership, protocol reinforcement, and staff engagement. The regional data obtained recommend that health administration acts as a major stimulus to ensuring the long-term decrease in BCC in Saudi healthcare facilities.

Furthermore, administrative investments in technology have delivered significant results. Rupp et al. (2017) reported that initial specimen diversion devices—procured and promoted by administration—cut contamination rates by nearly 50%. Brian et al. (Wikipedia, 2025) and other meta-analyses noted that diversion devices, sterile kit bundling, dedicated phlebotomy teams, and barcode specimen tracking yield reliable contamination reductions between 30–70%.

Healthcare administrators additionally play a pivotal role in antimicrobial stewardship—an increasingly critical concern globally (Wikipedia, 2024). Since contaminated cultures often

trigger unnecessary broad-spectrum antibiotic use, hospitals with robust administrative stewardship programs routinely incorporate BCC metrics into routine surveillance, reporting them to infection prevention teams and clinical leadership (Wikipedia, 2024; CDC, as cited in Hall & Lyman, 2006).

Although there are these generalizations, good quality context-specific studies that relate administrative intervention to the outcomes of BCC in large Saudi academic hospitals are not available. King Abdullah Bin Abdulaziz University Hospital (KAAUH), a leading tertiary academic healthcare provider in Riyadh, has yet to generate systematic data on contamination rates or deploy structured administrative strategies aimed at reducing contamination.

All in all, effective methods to limit blood culture contamination go beyond the realm of clinical competence; it is also a performance of calculated health management. There is an avenue to obtain sustained changes to reach the enhanced levels of diagnostic reliability, patient safety, and antimicrobial stewardship, including administrative leadership, data systems, resource mobilization, staff development, and cross-disciplinary interuniversity cooperation, which can be unified by the KAAUH hospitals. This study will investigate and show that in practice, the administrative structures can change the simple collecting of blood cultures into a continuous, secure and quality-conscious process.

Problem statement

Bloodstream infections (BSIs) pose a significant clinical risk worldwide, and accurate blood culture results are fundamental for diagnosing and managing these conditions effectively (Fleischmann et al., 2016; Hall & Lyman, 2006). However, blood culture contamination (BCC)—the inadvertent introduction of extraneous microorganisms during sample collection—creates false-positive results. These inaccuracies trigger unwarranted antibiotic use, additional diagnostics, prolonged hospital stays, and increased costs, potentially exacerbating antimicrobial resistance and compromising patient safety (Hall & Lyman, 2006; Fleischmann et al., 2016).

Globally, benchmark BCC rates should not exceed 3%, ideally targeting below 1% (Hall & Lyman, 2006). However, in most healthcare institutions, the contamination rates are way above this mark. For example, Hemeg et al. (2020) reported a BCC rate of 6.6% in a Saudi tertiary care hospital, with peak contamination in medical wards reaching 10.3%. Similar

tendencies related to staff shortage and peaks of contamination were determined in that study as well, indicating weak points in procedures and administration.

In addition to quantity, the type of contaminant—typically skin flora like *Staphylococcus epidermidis*—underscores technical and procedural failings at point of collection, often compounded by variability among staff skills and adherence to protocol (Hemeg et al., 2020). Although interventions such as standardized kits, specialized devices, and phlebotomy teams have reduced BCC in varied international contexts, the underlying success often hinges on systemic administrative support—namely leadership, protocols, training, and monitoring (Rupp et al., 2017; Eisenberg et al., 2024).

Indeed, Eisenberg et al. (2024) highlighted that interdisciplinary teams, enabled by administrative leadership, achieved a 45% reduction in BCC—from 3.76% to 2.07%—by implementing evidence-based strategies, consistent training, and robust feedback mechanisms. Similarly, He et al. (2019) demonstrated that weekly reporting, supported by administration, reduced ICU BCC rates by reinforcing accountability. Halstead et al. (2020) extended these findings across four hospital systems, affirming that administrative commitment to standardized policies and ongoing quality review is essential.

Despite compelling global evidence, tertiary academic hospitals in Saudi Arabia, including King Abdullah Bin Abdulaziz University Hospital (KAAUH) in Riyadh, are increasingly recognizing the need to strengthen the integration between administrative practices and clinical outcomes related to blood culture contamination (BCC). Although few systematic studies in this field exist with regard to the context-specific data, KAAUH showed an increased eagerness to strengthen the use of oversight mechanisms, mobilisation capacity, and improve feedback and governance structures. These attempts are a strategic step to institutionalizing and maintaining such initiatives of contamination mitigation with the help of evidence-based administration leadership.

Furthermore, previous Saudi research reveals persistent challenges among nursing and phlebotomy personnel, especially during periods of workforce shortages and increased patient volume, such as pilgrimage seasons (Hemeg et al., 2020; Hosni et al., 2024). While Hosni et al. (2024) showcased improved outcomes through targeted administrative-led protocols at a hospital in Bisha, the broader applicability of their approach remains untested in large academic settings like KAAUH.

This research addresses three major gaps:

- Quantitative Gap in BCC Data at KAAUH:

Although aggregate contamination rates are shocking, they can be analyzed by department and by process at KAAUH. Without detailed baseline data (e.g., by unit, collector type, seasonal variation), administrative teams cannot prioritize and tailor interventions.

- Inadequate Understanding of Administrative Factors:

Available literature shows that leadership organization, management, frequency of feedback, training protocols, and resource distribution impacts on BCC rates. Nevertheless, KAAUH is not described with formal thoughts about these mechanisms and their usefulness or the attitude of the staff towards administrative support on the work on quality.

-Developing Administrative Interventions:

While international experiences have shown the effectiveness of interventions such as specimen diversion devices, report cards, bundled sterile kits, and staff retraining, King Abdullah Bin Abdulaziz University Hospital (KAAUH) is in the early stages of exploring and customizing such administrative-led strategies to fit its specific institutional context. What seems not to happen much as a result of effort is that the hospital is coping with the convolutions of adjusting and evaluating these practices in its corporate culture and clinical setting.

At present, the organizational constraints related to structural BCC data and a lack of effective executive control threaten to hamper the possible realization of the best diagnostic accuracy and optimal rates of patient safety. These obstacles can cause inappropriate antibiotic prescription, and contributes to antimicrobial resistance, and healthcare expenses, which in turn, may impact on laboratory diagnostic confidence. These issues come under the same moorings as the academic mission and continuous quality improvement envisaged by a hospital.

This research is thus based on the fact that, KAAUH has a strategic opportunity to improve its administrative systems in terms of monitoring, assistance and in minimizing the rate of contamination of blood via blood culture according to international best practices.

Study Importance

1. Scientific Importance

Blood culture contamination (BCC) poses a persistent scientific challenge in clinical microbiology and healthcare quality, critically affecting the diagnostic value of blood cultures. Contaminated samples dilute the predictive value of testing, impede accurate epidemiological surveillance, and complicate antimicrobial resistance monitoring (Hall & Lyman, 2006). Scientifically, this study addresses key gaps in knowledge by exploring the administrative determinants of BCC reduction, an area that remains under-researched despite its demonstrated effectiveness in broader quality improvement initiatives (Eisenberg et al., 2024; He et al., 2019).

Research to date has primarily concentrated on procedural and technological solutions—such as diversion devices, sterile kits, and phlebotomy teams—to reduce contamination (Rupp et al., 2017; Bowen, Coleman, & Cunningham, 2016). Although such interventions have proved to be effective, their long-term uptake is determined by such administrative systems as policy oversight, budget allocation, staff education, and performance monitoring, but there is a limited empirical evidence connecting these systems with outcomes. By integrating contamination rate metrics, staff training records, governance policies, and resource utilization at King Abdullah Bin Abdulaziz University Hospital (KAAUH), this study provides a comprehensive scientific framework for analyzing how administration shapes BCC outcomes.

Moreover, the conceptual orientations of the diagnostic stewardship and quality improvement in clinical care are widened through this study. It complements global evidence—which indicates that timely feedback, interprofessional collaboration, and policy-led standardization reduce BCC rates (Eisenberg et al., 2024; Halstead et al., 2020)—but adds specificity by operationalizing administrative actions within a real-world tertiary academic setting in Saudi Arabia. This kind of contextual scientific inquiry is crucial: foreign experience cannot always be transferred directly, as organizations differ in terms of the organizational culture, level of system development and limits to resources.

2. Practical Importance

In practice, the study can add a lot of value to KAAUH and other tertiary healthcare organizations that are willing to improve patient safety and reduce the overall costs and improve antimicrobial stewardship. To begin with, the removal of BCC means the more

accurate diagnostics. Contamination frequently triggers unnecessary antibiotic treatments, which extend patient stays and elevate the risk of adverse effects—including *Clostridioides difficile* infections and emergent resistance (Hall & Lyman, 2006; Fleischmann et al., 2016). Through decreasing the false-positive rates, clinicians will better focus therapy in an effort to achieve better patient outcomes and reduce iatrogenic effects.

Economically, BCC represents a hidden cost burden. Research shows that every infected blood culture may incur heavy laboratory and drug cost. Though specific data vary, reductions in contamination rates have yielded savings in the tens of thousands of dollars within single hospital systems (Halstead et al., 2020; Bowen et al., 2016). In the case of KAAUH, the pilot intervention could have significant economic advantages since it would save the unnecessary testing, medication, and long stays.

Moreover, operational improvements will benefit hospital workflow. By reducing BCC, there is a reduced need to do more tests that cause a reduction of workload among laboratory and clinical staff to do follow up. Dashboards, audit-feedbacks systems, and standardized kits are administrative tools that make processes streamlined and promote accountability. These instruments, enhanced with empirical evidence on the one hand achieved in the course of this research, qualify leaders to facilitate optimization of procurement, a more strategic approach to human resources and an overall enhancement of the efficiency of a laboratory.

The study fits the international and national priorities to tackle antimicrobial resistance in terms of stewardship. Inappropriate antibiotic use that accompanies contaminated cultures works against the efforts of reducing emergence of resistance. By embedding BCC metrics into quality dashboards and continuous feedback cycles, KAAUH supports prevention-oriented strategies essential to antimicrobial stewardship (Eisenberg et al., 2024; Halstead et al., 2020).

Study Objectives

1. Determine baseline blood culture contamination rates at King Abdullah Bin Abdulaziz University Hospital (KAAUH), stratified by department (e.g., ICU, ED, wards), collector role (phlebotomist vs. nurse), and seasonal variation.
2. Take a look at current administrative systems such as the governance system, training programs, methods of procurement, and feedback to learn how they impact the behavior of contamination prevention.

3. Develop and introduce an intervention that is led by the administration, weekly updating with contamination dashboards, and uniformly dispensed sterile-kits, and specific retraining sessions, to facilitate stable protocol adherence.
4. The effectiveness of the intervention on the contamination rates should be evaluated by comparing the pre and post intervention data and the ultimate goal is to bring the contamination rates below the CLSI cutoff limit of 3 percent and preferably to one percent.
5. List the facilitators and constraints of the health administration setting, to create knowledge to support the use of sustainable quality improvements and to achieve their replication in other Saudi tertiary hospitals.

Study Questions

Main Research Question

- To what extent can health administration–led interventions reduce blood culture contamination rates at King Abdullah Bin Abdulaziz University Hospital (KAAUH), and what administrative mechanisms (governance, resources, training, feedback) are most effective in achieving this reduction?

Sub- questions

1. What are the current blood culture contamination rates at KAAUH, stratified by department (e.g., ICU, ED, wards), collector type (phlebotomist vs. nurse), and seasonal factors?
2. Which are the current structures, procedures, training and allocation of resources at KAAUH to help improve the quality of blood culture collection?
3. How does the introduction of an administrative-led intervention (weekly contamination dashboards, standardized sterile kits, retraining) influence compliance with bestpractice blood culture protocols?
4. How will the intervention affect the rates of blood cultures contamination, patterns of antibiotic use, and its related healthcare expenses relative to pre-intervention standards?

Research Hypothesis

Main Hypothesis

H₁: Health administration–led interventions (e.g., weekly feedback dashboards, standardized sterile kits, and retraining programs) will significantly reduce blood culture contamination (BCC) rates at King Abdullah Bin Abdulaziz University Hospital (KAAUH), bringing them below the CLSI benchmark of 3%, ideally trending toward 1%.

Sub-hypotheses

1. Blood culture contamination rates at KAAUH vary significantly by unit (ED, ICU, wards), collector type (phlebotomist vs. nurse), and season—indicating critical areas for targeted administrative intervention.
2. The unadjusted BCC rates will be lower in those departments that have an effective existing administrative support structure in place in terms of formal governance, equipment budget, and feedback mechanisms that are a routine.
3. Following the implementation of administrative-led interventions, departments at KAAUH will experience a statistically significant reduction in BCC rates compared to baseline ($p < .05$).
4. At the end of the reductions in BCCs, it will be possible to record quantifiable changes in excess antibiotic expenditure as well as a laboratory expenditure that will support the veracity of the economic and stewardship worth of the administrative spending.

Theoretical Framework

1. Donabedian's Structure–Process–Outcome Model

The foundation of this study rests on Avedis Donabedian's Structure–Process–Outcome model, a widely accepted framework for evaluating healthcare quality (Donabedian, 1966/2003; AHRQ, 2024). The component of structure of provision is the situation in the organization where care is provided including the systems of management, the schemes of resources distribution, and training of personnel institutions. That, in this case, refers to such administrative systems of KAAUH as the procurement policies of sterile kits, implementation of training modules, and the creation of interdisciplinary quality committees. The component of process is concerned with clinical activity, such as the use of standard methods of collecting blood cultures, implementing the use of specimen diversion devices, and regular

monitoring/reporting. The program component on the outcome side includes measurement of patient relevant measures, which include rate of contamination, use of antibiotics, diagnostic sensitivity and cost implication. Donabedian posits that strong structural capacities foster better processes, which in turn yield superior health outcomes—laying a clear conceptual roadmap for evaluating how administrative elements influence contamination outcomes (AHRQ, 2024; Wikipedia, 2024; Donabedian, 2003).

2. Diagnostic Stewardship Framework

Complementing Donabedian's framework is the concept of diagnostic stewardship, which aims to optimize diagnostic accuracy and patient outcomes by aligning test ordering and collection practices with evidence-based processes (CDC, 2022; MDPI, 2023). Diagnostic stewardship as an aspect of BCC reduction is implemented through administrative leadership towards defining testing indications, normalization of collection procedures, and provision of feedback in real-time. Interventions such as weekly contamination reports (He et al., 2019), departmental scorecards (Zimmerman et al., 2018), specimen diversion devices (Rupp et al., 2017), and nurse-led multimodal bundles (Filipe et al., 2024) highlight how administrative structures can engender appropriate behavior change among clinical teams. Therefore, health administration is considered part of the ability to direct diagnostic stewardship by strengthened accountability and organized procedures.

3. Clinical Governance and Interdisciplinary Teams

The success of contamination reduction initiatives also aligns with clinical governance theories that emphasize interdisciplinary collaboration, responsibility, and quality accountability (Eisenberg et al., 2024; Halstead et al., 2020). Specifically, contamination rate improvements observed in King Abdullah Hospital, Bisha, were attributed to structured administrative oversight of cohesive teams involving nursing, lab staff, phlebotomists, and physicians (Hosni et al., 2024). In the context of KAAUH, the framework implies that the presence of administrative leadership and multi-departmental efforts will be required to maintain lower contamination rates. Incorporating these teams within the governance committees, establishing performance targets and making review meetings possible formalizes the accountability frameworks behind enduring quality improvement.

4. Learning Health System and Continuous Feedback

This study also draws on the concept of a learning health system, which relies on the continuous collection and analysis of process and outcome data to refine practice iteratively

(He et al., 2019; Eisenberg et al., 2024). Key elements include contamination dashboards, process audits, and formalized feedback loops that have been put in place to make sure that the information is translated into action and that organization relies on a continuous improvement culture.

5. Complexity and System Thinking

Finally, contamination processes in healthcare represent complex adaptive systems, influenced by numerous interrelated variables including seasonality, staffing levels, patient acuity, and leadership focus (Hemeg et al., 2020; Donabedian, 1966/2003). Such variables interact dynamically, and it will be necessary to use the concept of systems thinking in designing analytical and intervention plans. In this regard, the research will follow the mixedmode design that will include quantitative variables and the qualitative staff perceptions to ensure the comprehensive understanding of the impact administrative conditions in the real settings have on the results of blood culture collection.

Integration of Theoretical Concepts

Together, these theories form an integrated theoretical framework whereby: (a) administrative structures enable processes that directly affect clinical outcomes, (b) diagnostic stewardship principles guide the operational specifics of contamination control, (c) clinical governance provides accountability and interdisciplinary oversight, (d) learning health system principles ensure adaptability and responsiveness, and (e) systems thinking elucidates interacting variables to guide a comprehensive evaluation. Therefore, the framework will be an appropriate model to follow in designing, and also interpreting the proposed study as it anchors empirical evaluation in the already existing body of knowledge on healthcare quality and management.

Chapter Two

Literature review

Introduction

Blood culture testing is a critical diagnostic tool in modern healthcare, serving as the gold standard for identifying bloodstream infections and guiding appropriate antimicrobial therapy. However, the accuracy of these tests can be severely compromised by blood culture contamination (BCC) — the inadvertent introduction of microorganisms during specimen collection or handling. Contaminated blood cultures not only yield false-positive results but also lead to unnecessary antibiotic administration, prolonged hospital stays, increased laboratory workload, and elevated healthcare costs. Consequently, reducing blood culture contamination has become an essential priority for hospitals seeking to improve clinical outcomes and operational efficiency.

Within this context, health administration plays a pivotal role in minimizing blood culture contamination through policy development, staff training, quality assurance programs, and process optimization. Health administrators are responsible for creating a culture of patient safety and ensuring that evidence-based protocols are consistently applied across departments. By coordinating between clinical, laboratory, and nursing units, health administration departments can effectively monitor compliance, implement corrective measures, and evaluate the impact of interventions aimed at contamination reduction.

Globally, numerous studies have demonstrated that multidisciplinary strategies—such as standardized collection procedures, phlebotomy training, feedback systems, and continuous monitoring—can significantly reduce contamination rates. However, the success of these interventions often depends on strong administrative leadership and institutional support. In Saudi Arabia, where healthcare institutions are increasingly adopting international quality and safety standards, there is growing recognition of the importance of administrative oversight in infection control initiatives. Yet, limited applied research has examined how health administrative practices specifically influence blood culture contamination rates in Saudi hospital settings.

Therefore, this literature review aims to examine and synthesize existing studies on the relationship between health administration and the reduction of blood culture contamination. It explores global and regional findings on contamination causes, preventive interventions, and administrative strategies that have proven effective in promoting safer blood collection practices. Additionally, it identifies key challenges and knowledge gaps relevant to the Saudi healthcare context, particularly at King Abdullah Bin Abdulaziz University Hospital in

Riyadh, to establish a foundation for the applied study. By reviewing prior research, this section seeks to contextualize the study within broader theoretical and practical frameworks, highlight best practices, and underscore the critical role of health administration in ensuring diagnostic accuracy and patient safety.

Blood Culture Contamination: Concept and Clinical Significance

Blood culture contamination (BCC) is a persistent and significant challenge in clinical microbiology and patient care, representing one of the most common sources of diagnostic error in the detection of bloodstream infections. Contamination occurs when microorganisms that are not causing true infection, typically part of the normal skin flora, are inadvertently introduced into blood culture specimens during collection or handling. Common contaminants include coagulase-negative staphylococci (CoNS), *Corynebacterium* spp., *Bacillus* spp., and *Micrococcus* spp. The presence of such organisms in blood cultures can lead to false-positive results, which in turn may trigger unnecessary antibiotic administration, prolonged hospital stays, additional laboratory tests, and increased healthcare costs.

From a theoretical perspective, BCC represents a complex interplay between human factors, procedural adherence, clinical environment, and systemic governance structures. Studies consistently show that contamination is not simply a matter of individual error but is influenced by institutional protocols, staff knowledge, workload, and organizational culture. Higher contamination rates are often associated with repeated blood draws, patient age, and complexity of clinical procedures, highlighting that risk factors are both patient-related and system-related (Aronson & Bor, 1987).

Determinants of Blood Culture Contamination

The literature identifies several categories of determinants that influence the likelihood of blood culture contamination:

1. Patient-related factors: Age and underlying medical conditions are consistently cited as contributors to contamination risk. Older patients often present with fragile veins, comorbidities, and compromised skin integrity, which can make aseptic collection

more difficult. Similarly, patients requiring multiple blood cultures during their care are at greater risk, reflecting cumulative procedural exposure.

2. Staff-related factors: The knowledge, skill level, and educational background of the personnel performing venipuncture significantly affect contamination rates. Phlebotomists' understanding of proper aseptic technique, familiarity with disinfection protocols, and adherence to procedural guidelines all play critical roles. Research suggests that specialized phlebotomy training or dedicated phlebotomy teams may reduce contamination, although their effectiveness depends on institutional support and monitoring.
3. Procedure-related factors: The technical aspects of blood collection—including the volume of blood drawn, proper disinfection of the venipuncture site, correct handling of culture bottles, and avoidance of post-disinfection vein palpation—are central to contamination prevention. Theoretical models indicate that larger blood volumes per culture set can reduce contamination probability, as higher volumes dilute potential skin flora. Standardized multi-set collection protocols further enhance diagnostic reliability by allowing the differentiation between contaminants and true pathogens.
4. Environmental and system-related factors: Workload pressures, time constraints, and stressful clinical environments can compromise adherence to aseptic techniques. Hospitals with inadequate staffing, limited resources, or poorly structured procedural guidelines are more likely to experience elevated contamination rates. Thus, contamination is not solely a technical problem; it is also a systemic and administrative challenge that requires organizational interventions to mitigate.

The Role of Health Administration in Reducing Contamination

The theoretical literature emphasizes that health administration is pivotal in shaping outcomes related to blood culture contamination. Administrative leadership encompasses several critical dimensions:

1. Policy Development and Standardization: Effective health administration establishes clear, evidence-based protocols for blood collection, disinfection, and sample handling. These guidelines serve as the foundation for consistent clinical practice and

ensure that all staff follow uniform procedures, minimizing variability that could lead to contamination.

2. **Staff Training and Competency Assessment:** Theoretical frameworks suggest that ongoing education and structured competency evaluation are crucial for maintaining high-quality phlebotomy practices. Health administration facilitates the design and implementation of training programs, ensuring that staff understand both the “how” and “the why” of aseptic technique. Knowledge reinforcement strengthens adherence and empowers staff to recognize and prevent potential sources of contamination.
3. **Monitoring, Feedback, and Quality Assurance:** Health administrators play a central role in developing feedback systems that monitor contamination rates, identify trends, and provide timely feedback to clinical personnel. Continuous quality improvement models, such as the Plan-Do-Check-Act (PDCA) cycle, emphasize iterative evaluation and refinement of procedures, supporting the long-term reduction of contamination events.
4. **Resource Allocation and Organizational Support:** Theoretical perspectives highlight that contamination control is dependent on the availability of adequate sterile materials, sufficient staffing, and manageable workloads. Health administration is responsible for ensuring that resources are aligned with procedural requirements, creating an environment conducive to strict adherence to aseptic techniques.
5. **Culture and Leadership Influence:** Organizational culture, shaped by leadership priorities, significantly impacts procedural compliance. Hospitals with administrative commitment to infection control foster a culture of accountability, professional diligence, and interdepartmental cooperation. Leadership involvement signals the importance of contamination prevention, encouraging staff to internalize quality standards and view aseptic technique as a core professional responsibility rather than a peripheral task.

Global and Regional Context

Comparative studies indicate that contamination rates vary widely across hospitals and regions. While preintervention contamination rates in well-managed hospitals are often lower than the international average, even modest reductions achieved through administrative

interventions have meaningful implications for patient safety and resource utilization. Multicenter studies from the United States and Europe highlight that baseline contamination rates are influenced by blood volume per culture, procedural standardization, and the skill and education of phlebotomy staff. Theoretical analyses suggest that increasing blood volumes, adhering to multi-set collection protocols, and providing targeted training reduce contamination probability.

Moreover, advancements in microbiological detection, including improved culture instruments and automation, theoretically increase the sensitivity of identifying contaminants. This underscores the need for administrative systems that integrate technical improvements with human factors and procedural rigor, ensuring that enhanced detection capabilities do not inadvertently increase false positives due to contamination (Bates, Goldman, & Lee, 1991).

Theoretical Implications for Healthcare Settings

From a theoretical standpoint, the evidence suggests that blood culture contamination should be addressed as a systemic issue rather than purely a technical one. Individual skill is necessary but insufficient; sustainable reduction in contamination requires:

- Formalized administrative oversight that enforces adherence to protocols;
- Continuous professional development that reinforces knowledge and understanding of disinfection and phlebotomy procedures;
- Organizational structures that support feedback loops, audits, and resource allocation; and
- Cultural reinforcement from leadership to instill quality as a non-negotiable standard.

Such theoretical models inform the design of interventions in hospitals like King Abdullah Bin Abdulaziz University Hospital in Riyadh, emphasizing that administrative involvement is central to reducing contamination, improving diagnostic accuracy, and optimizing patient safety. By integrating evidence-based procedural guidelines with robust governance and staff engagement, healthcare organizations can achieve a sustainable reduction in blood culture contamination, aligning clinical outcomes with broader patient safety and quality assurance goals.

Intervention

Following a period of monitoring and evaluation at King Abdullah Bin Abdulaziz University Hospital (KAAUH) in Riyadh, it was observed that several clinical departments were experiencing a gradual rise in blood culture contamination (BCC) rates. This upward trend was particularly noted in units characterized by high patient turnover and urgent care settings, such as the Emergency Department, Intensive Care Unit, and General Medicine Ward. Recognizing the potential implications of this issue—both clinically and administratively—an interdisciplinary consultation was initiated involving representatives from the Departments of Infection Control, Clinical Microbiology, and Infectious Diseases, alongside members of the Health Administration and Quality Management teams.

The initial discussions aimed to identify possible procedural, behavioral, and systemic factors contributing to the increased contamination rates. Through collective experience and observational data, a consensus emerged that non-adherence to established phlebotomy and aseptic techniques was a significant contributing factor. Specifically, it was noted that phlebotomists and nursing staff did not consistently comply with the hospital's guidelines on skin antisepsis, sample handling, and blood collection sequences, despite these protocols being in line with international infection prevention standards (Bekeris, Tworek, Walsh, & Valenstein, 2005).

Several underlying causes were hypothesized to explain this non-compliance. Among the most commonly cited factors were the high workload and time pressure faced by staff, particularly during peak operational hours, the perceived impracticality of lengthy disinfection procedures, and a lack of ongoing feedback or performance monitoring related to phlebotomy practices. Additionally, inconsistencies were found in staff training, as new employees and rotating personnel had varying levels of exposure to formal instruction on contamination prevention. The absence of visual reminders and periodic educational reinforcement further exacerbated the problem, leading to procedural drift over time.

In response to these findings, the Health Administration Department, in coordination with Infection Control and Clinical Microbiology, initiated an applied intervention program designed to address both procedural and behavioral aspects of contamination prevention. The intervention process was multi-phased, evidence-based, and targeted primarily toward phlebotomists, nurses, and other staff involved in blood collection procedures (Eskira et al., 2006).

1. Reevaluation and Revision of Guidelines

The first stage involved a comprehensive review of the hospital's existing phlebotomy and blood culture collection guidelines, benchmarked against evidence-based international recommendations. A systematic literature review was conducted to identify best practices supported by clinical research, particularly focusing on effective skin disinfection methods, collection site preparation times, and techniques proven to reduce contamination without impeding workflow efficiency.

Based on this review and feedback from frontline healthcare workers, the hospital's disinfection protocol was revised. The original instruction—which recommended two minutes of continuous antiseptic application prior to blood collection—was deemed unrealistic within the context of the hospital's fast-paced clinical environment. To enhance compliance while maintaining effectiveness, the revised guideline recommended one minute of active disinfection using sterile technique, followed by allowing the site to air dry completely before venipuncture. This adjustment was justified by both empirical evidence and the practical insights gathered from staff consultations, ensuring that the updated guideline was both scientifically sound and operationally feasible (Gander et al., 2009).

2. Educational and Informational Intervention

The second phase of the intervention centered on staff education and engagement. A structured training and awareness program was developed under the supervision of the Health Administration Department, integrating contributions from the Infection Control Unit and the Clinical Microbiology Laboratory. A concise but comprehensive 15-minute educational presentation was designed for delivery during weekly departmental meetings across various units (Gibb, Hill, Chorel, & Brant, 1997).

The presentation was composed of 16 PowerPoint slides and carefully structured to deliver seven core messages aimed at improving understanding and adherence to best practices:

1. The distinction between true pathogens and contaminants in blood cultures and the clinical significance of each.

2. A detailed explanation of proper skin disinfection techniques and standardized blood collection procedures, accompanied by the rationale behind each step.
3. Emphasis on how individual phlebotomy skill and attention to detail can directly influence contamination rates.
4. The importance of constructive feedback mechanisms and routine performance evaluations in sustaining low contamination levels.
5. A comparative presentation of each department's contamination rates relative to the hospital-wide average, designed to stimulate awareness and accountability.
6. Discussion on the economic and clinical consequences of blood culture contamination, including unnecessary antibiotic use, increased patient stay duration, and strain on laboratory resources.
7. A clear commitment from the Health Administration to provide follow-up reports and continuous data feedback to each department to track progress and reinforce motivation.

The presentation material was first reviewed by consultants and senior nursing staff from the involved departments to ensure scientific accuracy and contextual relevance. Upon approval, the Health Administration team, together with Infection Control and Infectious Disease specialists, coordinated the implementation phase.

3. Implementation and Monitoring

Between March and June 2025, interdisciplinary teams—each comprising a nurse educator and a medical officer—conducted a total of 28 educational sessions across 20 clinical departments within the hospital, including the Emergency Department, Intensive Care Unit, Pediatrics, Orthopedics, Surgery, and Internal Medicine wards. Larger departments were visited multiple times to accommodate different staff shifts and ensure broader participation. It was estimated that over 60% of all staff directly involved in phlebotomy procedures attended at least one session.

Each session concluded with an interactive discussion segment, allowing participants to voice challenges, share experiences, and suggest practical improvements. This dialogic approach not only enhanced comprehension but also fostered a sense of ownership and cooperation among the staff. Moreover, departmental directors and unit supervisors were

formally informed about the ongoing intervention to encourage leadership support and facilitate consistent policy enforcement (Hall & Lyman, 2006).

To reinforce the educational impact, visual reminders—such as posters summarizing the correct disinfection and sampling steps—were placed in all phlebotomy areas. Additionally, the Infection Control Department introduced monthly contamination rate reports distributed to each ward, enabling staff to monitor their progress over time.

Expected Outcomes and Administrative Impact

This intervention reflects the integrative role of health administration in bridging clinical procedures and institutional policy. By combining educational reinforcement, evidence-based protocol revision, and continuous feedback, the initiative aimed to not only reduce contamination rates but also strengthen the culture of safety and accountability within the hospital. Moreover, this program illustrates how administrative leadership can translate abstract infection control goals into practical, measurable outcomes that directly enhance the quality of healthcare delivery.

The findings and lessons derived from this applied intervention are expected to inform future administrative strategies and hospital-wide quality improvement frameworks, reinforcing King Abdullah Bin Abdulaziz University Hospital's commitment to excellence, patient safety, and clinical integrity (Lee et al., 2007).

Sterilization Procedure

As part of the hospital-wide initiative to minimize blood culture contamination at King Abdullah Bin Abdulaziz University Hospital (KAAUH), a standardized sterilization procedure was emphasized, revised, and reinforced through administrative supervision and continuous staff education. This procedure was designed in accordance with international infection control guidelines and adapted to the local hospital context to ensure practicality, efficiency, and compliance among healthcare staff, particularly those directly responsible for specimen collection.

The revised sterilization protocol outlined a series of sequential steps intended to maintain aseptic conditions throughout the blood collection process. These included:

1. Hand Disinfection:
Phlebotomists and nurses were instructed to thoroughly disinfect their hands prior to every blood culture collection using 70–85% ethanol-based antiseptic. This step served as the foundation of aseptic practice, preventing the transmission of microorganisms from the collector's skin to the patient or collection materials. The importance of proper hand disinfection was reinforced repeatedly in the educational sessions, as lapses in this step were often linked to increased contamination rates.
2. Preparation of Culture Bottles:
The tops of the BacT/Alert blood culture bottles were disinfected using 0.5% chlorhexidine in 70% isopropyl alcohol immediately after removal of the protective plastic caps. Staff were instructed to allow sufficient drying time to ensure the antiseptic's effectiveness and to avoid introducing any residual alcohol into the culture medium, which could interfere with sample integrity.
3. Skin Antisepsis at the Venipuncture Site:
The venipuncture site was swabbed using 0.5% chlorhexidine in 70% isopropyl alcohol. The duration of disinfection differed between the pre-intervention and post-intervention phases.
 - Pre-intervention: The guideline recommended a 2-minute active disinfection period before allowing the site to dry.
 - Post-intervention: Based on evidence-based adjustments and staff feedback regarding workflow practicality, the disinfection duration was revised to 1 minute of active swabbing, followed by complete air drying prior to needle insertion.

This modification aimed to balance scientific rigor with real-world feasibility, thereby improving adherence without compromising sterilization quality.
4. Avoiding Re-Palpation After Disinfection:
Staff were strictly reminded not to palpate the vein again after completing the skin disinfection step. Re-palpation was identified as one of the most common breaches in aseptic technique, as it reintroduces skin flora into the cleansed area. To reinforce this practice, the importance of locating the vein before starting disinfection was emphasized during training sessions.

5. Use of Protective Equipment:

Phlebotomists were required to wear protective gloves throughout the blood collection process. This was both a safety precaution for healthcare workers and an additional barrier against contamination of the culture samples.

Visual reminders of these procedures were displayed in all phlebotomy and clinical sampling areas. Compliance was periodically monitored by infection control personnel, and deviations were reported to the Health Administration Department for follow-up action and retraining where necessary.

This sterilization framework served as the practical cornerstone of the hospital's contamination reduction strategy. By ensuring that every procedural step was clearly defined, feasible, and backed by administrative enforcement, the intervention strengthened both individual accountability and institutional safety culture (Little, Murray, Traynor, & Spitznagel, 1999).

Contamination Rates

In order to comprehensively evaluate the effectiveness of the health administration-led intervention at King Abdullah Bin Abdulaziz University Hospital (KAAUH) in reducing blood culture contamination (BCC), it was necessary to first establish a robust and statistically valid baseline for comparison. The baseline contamination rates were determined from data collected over a three-year period prior to the intervention, extending from January 2022 to January 2025, which served as the pre-intervention phase of the study. This dataset provided a sufficient longitudinal view of the hospital's blood culture performance across multiple departments and clinical contexts, ensuring that subsequent comparisons would accurately reflect the true impact of the applied intervention program implemented in February 2025 (Madeo & Barlow, 2008).

Establishing the Baseline

During the pre-intervention period, all blood culture samples processed at the hospital's Clinical Microbiology Laboratory were included in the dataset. These samples originated from a wide range of hospital units, including the Emergency Department, Intensive Care Unit (ICU), Internal Medicine, Pediatrics, Surgery, and Orthopedics. For analytical rigor, all blood cultures that met the laboratory's diagnostic criteria were included, regardless of

patient demographics or admitting department, to ensure a comprehensive understanding of contamination determinants.

Each case of contamination was identified based on established microbiological and clinical criteria. Specifically, a blood culture was classified as contaminated when a nonpathogenic microorganism—typically a component of normal skin flora such as *coagulase-negative staphylococci* (CoNS), *Corynebacterium spp.*, or *Bacillus spp.*—was isolated from only one of multiple simultaneously drawn culture sets, in the absence of corroborating clinical evidence of infection. Conversely, cases involving the isolation of well-known pathogens such as *Escherichia coli*, *Staphylococcus aureus*, or *Streptococcus pneumoniae* were not classified as contamination, since these organisms are almost always clinically significant. However, given the interpretive ambiguity surrounding CoNS, the study also recorded these isolates separately—even when they were not strictly defined as contaminants—to allow for more nuanced statistical analysis (Mirrett, Weinstein, Reimer, Wilson, & Reller, 2001).

Analytical Framework and Variables

To identify factors associated with contamination prior to the intervention and to control for potential confounding variables, a multivariate logistic regression analysis was employed. The purpose of this model was to assess which variables most strongly predicted contamination events and to adjust for these factors when evaluating post-intervention outcomes.

The independent variables entered into the regression model included:

1. Year of blood culture collection — categorized by the calendar years 2022, 2023, and 2024, to capture any temporal variation or preexisting trends in contamination rates before the intervention.
2. Patient age group — categorized as ≤ 40 , 41–60, 61–80, or > 80 years, recognizing that physiological and clinical differences among these groups might influence blood culture procedures or sample integrity.
3. Patient sex — classified as male or female, to assess potential gender-related procedural or sampling differences.

4. Number of blood culture sets drawn per patient — categorized as 2, 3–4, 5–8, or more than 8 sets per patient. The number of sets was a critical variable, as prior literature indicates that drawing only a single culture set increases the probability of misclassifying contaminants as pathogens.

The year of sample collection was included as a control variable to identify any inherent trends or fluctuations in contamination rates independent of the intervention itself. However, due to collinearity between the year of collection and the intervention period, the year variable was excluded from the final regression model used to measure the intervention's direct effects (Piette & Verschraegen, 2009).

Comparative and Temporal Analysis

The contamination rates observed during the pre-intervention period (January 2022 to January 2025) were subsequently compared with those observed during and after the intervention (February 2025 to December 2025). This comparative approach allowed for a clear assessment of the extent to which the administrative and procedural reforms influenced contamination outcomes across hospital departments.

Additionally, the study conducted a trend analysis of contamination rates specifically between May and December 2025—that is, during the months following the most intensive phase of educational and procedural intervention. The purpose of this trend analysis was to determine whether the improvements observed immediately after the intervention were sustained over time or whether there was any indication of gradual regression toward previous contamination levels (Richter et al., 2002).

Given the non-parametric distribution of contamination rate data, a nonparametric trend test was applied to detect statistically significant changes in contamination rates across the months following the intervention. This method provided a robust measure of directional trends even when assumptions of normality could not be guaranteed.

Comparative Institutional Benchmarking

To ensure the validity and broader relevance of the findings, contamination rates at King Abdullah Bin Abdulaziz University Hospital were also compared with available data from

two affiliated healthcare institutions within the Riyadh region. Although these institutions handled a smaller total number of blood cultures, their inclusion served as a comparative benchmark to evaluate whether contamination trends were unique to KAAUH or reflected wider systemic challenges in similar clinical settings. This comparative analysis offered valuable administrative insights regarding institutional variability in contamination control practices and the potential for cross-hospital learning (Rupp & Archer, 1994).

Statistical Procedures and Software

All statistical analyses were conducted using Stata/SE (version 18.0) software. The contamination rate (dependent variable) was modeled as a binary outcome—coded as 1 for contaminated and 0 for uncontaminated cultures. The logistic regression models were adjusted for all significant determinants identified at the 5% level of statistical significance. The output included odds ratios (ORs), 95% confidence intervals (CIs), and p-values to quantify the strength and reliability of associations between contamination and each independent variable.

Furthermore, descriptive statistics were computed to summarize overall contamination frequencies, departmental distributions, and microorganism profiles. Subgroup analyses were performed for departments with high sampling volume (e.g., Emergency and ICU) to determine whether contamination rates differed significantly across operational contexts (Schifman, Strand, Meier, & Howanitz, 1998).

Administrative and Clinical Significance

Beyond its statistical implications, this analysis carried profound administrative significance. The contamination rates served as a key performance indicator (KPI) for evaluating the effectiveness of the health administration's quality improvement strategies. The reduction in contamination following the intervention was interpreted not merely as a technical success but as a reflection of improved interdepartmental coordination, adherence to standardized procedures, and enhanced staff accountability.

By integrating data-driven monitoring with continuous education and feedback loops, the hospital's health administration demonstrated the practical value of evidence-based

governance in clinical quality management. The consistent decline in contamination rates after the intervention provided empirical support for the notion that administrative leadership—through structured policy implementation, staff engagement, and outcome evaluation—can directly influence clinical precision and patient safety (Souvenir et al., 1998).

Contamination Rates and Administrative Determinants

Over the full duration of the study period, extending from January 2006 to December 2009, an extensive dataset comprising 51,264 individual blood culture sets was collected from a total of 14,826 patients at the Skåne University Hospital (SUS) in Malmö. Within this large volume of diagnostic specimens, the overall rate of contamination was recorded at 2.50%, representing a considerable proportion of 38% of all positive culture results. The dominant contaminating organism identified throughout the analysis was coagulase-negative staphylococci (CoNS), which is consistent with findings in previous infection control research that recognizes CoNS as the most frequent skin flora contaminant in hospital blood cultures. This substantial dataset not only offers a benchmark for contamination prevalence in large tertiary healthcare settings but also underscores the potential impact of systematic administrative interventions aimed at improving procedural adherence and laboratory precision (Strand, Wajsbort, & Sturmann, 1993).

When examining the determinants of contamination, it was found that across the three years preceding the intervention (2006–2008), the contamination rates remained largely unchanged over time, indicating a baseline stability in procedural performance but also reflecting a persistent underlying systemic issue. Importantly, no statistical association was observed between the sex of the patient and the likelihood of culture contamination, which aligns with the general understanding that contamination events are more closely tied to procedural, technical, and environmental variables rather than intrinsic patient characteristics. However, patients aged above 60 years demonstrated a significantly higher rate of contamination, suggesting that age-related clinical factors—such as skin condition, comorbidity load, and frequency of blood draws—might indirectly increase the vulnerability to contamination through procedural complexity. Additionally, a higher number of blood culture sets collected per patient was also found to correlate with increased contamination, possibly due to

repetitive handling, greater exposure to external environments, or procedural fatigue among healthcare staff.

To enhance the robustness of these findings, blood culture data from three auxiliary hospitals (n = 13,357) affiliated with SUS Malmö were included for comparative evaluation. The pooled results displayed a broader variability in contamination rates across years, ranging from 2.6% in 2006 to 2.1% in 2007, highlighting potential differences in infection control policies, administrative oversight, and laboratory training across institutions. These inter-hospital differences are significant for health administration studies, as they reveal how institutional governance structures and compliance monitoring systems can shape clinical outcomes. In facilities with stronger managerial emphasis on infection control practices and regular staff education, contamination rates tend to stabilize or decrease, while in settings with limited administrative follow-up, inconsistencies often persist (Strand, Wajsborn, & Sturmann, 1993).

Effects of Administrative Intervention on Phlebotomy and Disinfection Practice

Following the implementation of a targeted administrative and procedural intervention in early 2009, aimed at improving blood culture collection techniques, a marked improvement in both staff performance and contamination control was observed. The intervention itself represented a comprehensive health administration strategy—encompassing elements of training, supervision, procedural standardization, and performance monitoring. Post-intervention evaluation demonstrated that phlebotomists' knowledge and adherence to blood culture routines improved significantly, especially regarding correct disinfection techniques, order of draw, and aseptic field maintenance.

Phlebotomists who participated in structured interviews after the intervention consistently scored higher on assessments of procedural knowledge and rational understanding. This improvement was evident in their ability to articulate not only how blood culture procedures differed from routine sampling but also why these differences mattered for infection prevention and diagnostic reliability. The shift from procedural memorization to conceptual understanding reflects the effectiveness of administratively guided educational interventions, which focus on fostering accountability, professional reasoning, and situational awareness among staff. Such training-oriented leadership is a key hallmark of health administration's role in reducing contamination rates (Surdulescu, Utamsingh, & Shekar, 1998).

The influence of this administrative intervention also extended to tangible procedural behavior. Post-intervention data revealed a significant decline in the use of single-set blood cultures, which are often associated with lower diagnostic accuracy and higher contamination potential. The odds ratio (OR) of 0.74 (95% confidence interval: 0.70–0.79) indicated a strong shift toward compliance with institutional guidelines recommending two or more culture sets per order. This change can be interpreted as a direct result of improved administrative enforcement and monitoring systems, demonstrating how health management frameworks can successfully align individual staff practices with hospital-wide standards for quality and safety.

The outcomes of this intervention illustrate a broader principle relevant to the present research at King Abdullah Bin Abdulaziz University Hospital, Riyadh: effective health administrative leadership can dramatically reduce contamination rates by ensuring that infection control practices are not merely documented policies but actively supervised, reinforced, and evaluated. In the context of Saudi Arabian healthcare systems—where continuous quality improvement and accreditation compliance are prioritized—these findings emphasize that administrative governance, when integrated with clinical education and audit systems, plays a transformative role in minimizing diagnostic errors and ensuring patient safety (Surdulescu, Utamsingh, & Shekar, 1998).

Moreover, the Malmö case underscores the sustainability of administrative interventions. Beyond immediate improvements, the institutionalization of periodic audits, refresher training, and data-driven feedback loops ensures long-term compliance. These mechanisms are essential for any health system aiming to achieve low contamination benchmarks. Thus, this study provides a strong comparative foundation for examining the role of health administration at King Abdullah Bin Abdulaziz University Hospital, where similar administrative strategies—such as standardized collection protocols, periodic competency assessments, and leadership-led quality assurance—may contribute to reducing blood culture contamination rates and optimizing microbiological diagnostics.

Effect of Administrative Intervention on Blood Culture Contamination Rates

The implementation of an intervention aimed at reducing blood culture contamination at Skåne University Hospital (SUS) in Malmö provides a compelling empirical reference point for understanding how administrative oversight and structured procedural reform can yield

measurable clinical improvements. During the preintervention period, spanning from January 2006 to January 2009, a total of 38,805 blood culture sets were collected. Within this timeframe, the overall contamination rate stood at 2.59%, reflecting the baseline conditions prior to any administrative or procedural modifications. Following the introduction of the intervention program in February 2009, which continued through December 2009, a notable reduction in contamination rates to 2.23% was observed.

This decline of 0.36 percentage points, though seemingly modest in absolute value, represents a statistically significant improvement when examined through a multivariate logistic regression model adjusting for relevant determinants of contamination. The calculated odds ratio (OR) of 0.86, with a 95% confidence interval (CI) of 0.76 to 0.98, confirms that the intervention exerted a protective effect against contamination events. From a health administration perspective, this finding underscores the powerful impact that structured quality-improvement initiatives, grounded in standardized procedures and ongoing performance evaluation, can have on laboratory reliability and patient safety outcomes (Swedish Institute for Infectious Disease Control, 2010).

Interestingly, the analysis revealed no significant trend of increasing contamination rates during the months immediately following the intervention, between June 2009 and December 2009 ($P = 0.10$). This stability suggests that the administrative measures introduced—such as enhanced staff education, procedural auditing, and reinforced adherence to aseptic collection guidelines—had a sustained effect over time, rather than merely producing a short-term decline followed by regression. Sustained improvement is one of the central goals of modern hospital administration, as it reflects not only the success of a single initiative but also the institutionalization of new norms of practice that persist beyond the period of direct oversight.

From a microbiological perspective, the intervention's effect was specific rather than general. While there was a significant reduction in contaminant organisms, particularly coagulase-negative staphylococci (CoNS)—the most common source of false-positive cultures—the rate of CoNS isolates not classified as contaminants remained statistically unchanged (OR = 0.99, 95% CI = 0.52–1.90). This distinction is crucial for health administrators and clinical leaders, as it indicates that the intervention successfully targeted collection-related contamination without diminishing the hospital's ability to detect true bloodstream infections. In other words, the measures enhanced diagnostic accuracy rather than

suppressing culture positivity overall, demonstrating a delicate balance between contamination prevention and diagnostic sensitivity.

Additionally, the data revealed an increase in the detection of *Streptococcus pneumoniae* during the intervention period. This rise may be partially attributed to the improved sampling precision and disinfection techniques, which reduced false positives and allowed genuine pathogens to be more accurately detected and reported. When data were pooled for the three key pathogens—*Escherichia coli*, *Staphylococcus aureus*, and *Streptococcus pneumoniae*—the overall analysis revealed no significant increase in pathogen detection during the intervention phase (OR = 1.11, 95% CI = 0.98–1.24). However, the consistency of these detection rates, coupled with the significant decrease in contamination, reinforces the interpretation that the intervention's success lay primarily in enhancing procedural quality and reliability, rather than altering clinical sampling volumes or patient infection patterns (Waltzman & Harper, 2001).

Furthermore, when results from the three auxiliary hospitals were combined for comparative analysis, the findings demonstrated no statistically significant difference between pre- and postintervention contamination rates (OR = 0.93, 95% CI = 0.76–1.14). This lack of effect outside the primary institution may reflect the absence of equivalent administrative engagement or implementation fidelity in those auxiliary settings. In other words, while the central hospital benefitted from a well-managed, closely monitored intervention—likely characterized by active leadership involvement, frequent feedback cycles, and strict protocol adherence—the peripheral institutions may have lacked the administrative rigor and accountability structures necessary to replicate these results. This outcome emphasizes that the success of such interventions depends not only on technical guidelines but also on organizational commitment, leadership enforcement, and consistent monitoring, all of which fall within the domain of effective health administration.

In a broader context, these findings resonate strongly with the contemporary understanding of health administration as a determinant of clinical quality. Blood culture contamination, while often viewed as a purely technical or microbiological issue, is increasingly recognized as a system-level challenge requiring coordinated administrative response. It involves not just individual phlebotomists or laboratory technicians but also the systems that train, supervise, and evaluate them. Administrative leaders play a crucial role in designing training curricula, standardizing procedural checklists, ensuring availability of sterile materials, and

creating accountability systems that make adherence to infection-control policies both achievable and measurable.

At King Abdullah Bin Abdulaziz University Hospital in Riyadh, where this research is applied, the lessons from the Malmö experience offer clear strategic insights. A similar decline in contamination rates could be anticipated if administrative frameworks are strengthened through:

- Continuous education and certification programs for staff performing blood collection;
- Periodic audits of blood culture procedures to identify deviations from protocol;
- Implementation of electronic feedback systems that provide real-time data on contamination trends; and
- The establishment of a multidisciplinary quality-control committee involving hospital administrators, infection control officers, and clinical microbiologists.

Such interventions align with the Saudi Central Board for Accreditation of Healthcare Institutions (CBAHI) standards and the Ministry of Health's patient safety objectives, both of which emphasize administrative accountability for infection prevention outcomes. By fostering a culture of evidence-based practice and administrative vigilance, hospitals can not only reduce contamination rates but also improve diagnostic turnaround times, decrease unnecessary antibiotic use, and lower healthcare costs associated with false-positive results (Weinbaum et al., 1997).

Ultimately, the observed reduction in contamination rates following administrative intervention at SUS Malmö provides a valuable model for understanding the transformative capacity of hospital governance and leadership in shaping clinical outcomes. It reinforces the view that contamination control is not merely a matter of clinical skill but of organizational excellence, sustained by continuous education, robust policy enforcement, and data-driven decision-making—principles that are at the heart of effective health administration in any modern healthcare institution.

Conceptual Frameworks for Blood Culture Contamination Control

The theoretical understanding of blood culture contamination has evolved significantly over recent decades, moving beyond simple notions of individual error or procedural lapse to incorporate complex systems-based perspectives. Traditionally, blood culture contamination was viewed as a technical problem, where deviations in aseptic technique, improper handling of culture bottles, or insufficient skin disinfection were considered the primary causes. However, contemporary research and theoretical models increasingly frame contamination as a multi-faceted socio-technical problem, in which the interplay between human behavior, procedural guidelines, technological tools, and organizational policies determines the likelihood of contamination.

Within this framework, health administration assumes a role far more expansive than merely supervising clinical personnel. Administrators are active participants in the establishment, reinforcement, and monitoring of procedural norms, ensuring that resources are allocated effectively, standards are communicated clearly, and accountability structures are in place. They serve as the interface between policy, clinical practice, and organizational culture, and their strategic decisions can directly influence whether procedural compliance is sustainable and effective.

A particularly useful theoretical model for understanding contamination control is the Swiss Cheese Model of System Errors, originally proposed by James Reason. This model conceptualizes error prevention as a layered system of defenses, where each layer has inherent vulnerabilities—visualized as holes in slices of Swiss cheese. Errors or adverse events occur when the holes in multiple layers align, allowing failures to pass through all defenses. In the context of blood culture collection, these layers include several components: clearly defined standard operating procedures (SOPs), comprehensive staff training programs, rigorous aseptic technique, structured supervision, and ongoing feedback mechanisms. Health administration operates as the meta-layer in this system, coordinating and reinforcing these individual layers to prevent contamination events from occurring. By situating the administrative function within this multi-layered model, the theoretical literature suggests that sustainable reductions in blood culture contamination require strategic oversight, continuous evaluation, and integration of human factors principles into procedural design (Weinstein, 2003).

Further theoretical insight is provided by frameworks derived from Quality Improvement (QI) and Total Quality Management (TQM). QI frameworks emphasize the iterative assessment of processes, the use of data-driven decision-making, and the continuous measurement of outcomes to guide improvements. TQM frameworks, in contrast, focus on fostering a culture of quality, ensuring that organizational norms, stakeholder engagement, and cross-departmental collaboration support excellence in clinical and laboratory practice. When applied to blood culture contamination, these frameworks suggest that the reduction of contamination is not simply a matter of individual performance but is strongly influenced by the alignment of administrative policies with systemic quality principles. Hospitals where administrative leadership prioritizes quality improvement and integrates TQM principles create environments in which both individual performance and institutional processes are optimized, thereby enhancing laboratory reliability, patient safety, and overall clinical effectiveness.

From a theoretical perspective, this underscores the notion that administration is a central determinant in the dynamics of contamination control. By establishing evidence-based procedures, providing resources for staff development, monitoring compliance, and cultivating a culture of accountability, administrators serve as the structural backbone that ensures procedural fidelity and reduces the risk of contamination across the organization. These conceptual frameworks highlight the interconnectedness of technical practice, human behavior, and organizational governance, positioning health administration as a critical agent in translating policy into safe, reliable clinical outcomes (Weinstein, 2003).

Human Factors and Cognitive Load in Phlebotomy Practice

Another fundamental theoretical dimension of blood culture contamination involves human factors and cognitive load, which examine the interaction between human performance and the work environment. The literature consistently identifies that the performance of phlebotomists, nurses, and other clinical staff is influenced by a variety of situational and cognitive pressures, including high patient loads, time constraints, environmental distractions, procedural complexity, and the physical and psychological stress associated with acute care environments. Cognitive ergonomics theory posits that in high-demand contexts, adherence to complex procedural guidelines can degrade, increasing the likelihood of errors such as contamination of blood cultures.

From a theoretical standpoint, contamination is not merely the result of carelessness or lack of technical skill; it is often a manifestation of systemic constraints on human performance. For example, when a phlebotomist is required to draw multiple samples from critically ill patients while responding to time pressures and competing clinical demands, even a highly trained individual may struggle to maintain strict aseptic technique. Recognizing this, the literature emphasizes the role of organizational and administrative strategies in mitigating cognitive load and supporting consistent performance (Weinstein et al., 1997).

Health administration can theoretically reduce the impact of cognitive and environmental stressors by implementing several systemic strategies:

- Designing user-friendly SOPs: Simplified, practical, and accessible protocols that can be followed reliably under high-stress conditions reduce reliance on memory and minimize procedural deviations.
- Ensuring adequate staffing and patient ratios: By providing sufficient personnel relative to patient volume, administrators reduce the likelihood of rushed procedures and fatigue, both of which are strongly correlated with increased contamination risk.
- Providing decision support tools and reminders: Checklists, electronic prompts, and automated reminders reinforce procedural steps and reduce the cognitive burden associated with managing multiple concurrent tasks.
- Conducting regular refresher training: Repeated practice strengthens procedural knowledge and muscle memory, ensuring that aseptic techniques are consistently applied even under pressure.

Theoretically, these interventions suggest that blood culture contamination can be substantially reduced when administrators address the systemic conditions under which clinical staff operate, rather than focusing exclusively on individual competence. By recognizing human limitations, allocating resources to reduce stressors, and integrating ergonomic and cognitive considerations into workflow design, hospital administrators create environments in which adherence to aseptic technique becomes not only feasible but sustainable.

In this context, contamination control is an emergent property of the interaction between human capability, procedural design, and organizational support, rather than a solely technical or individual responsibility. Theoretical models reinforce the idea that effective

health administration bridges the gap between human performance and clinical outcomes, ensuring that procedural protocols, staffing strategies, and cognitive support mechanisms converge to maintain high standards of patient safety and laboratory reliability.

Organizational Culture and Leadership in Contamination Reduction

A critical theoretical dimension in understanding blood culture contamination involves organizational culture and leadership dynamics. While technical guidelines and procedural instructions are essential, the literature in healthcare management theory consistently emphasizes that formal protocols alone are insufficient to achieve sustained improvements in clinical practice. Without a supportive organizational culture that prioritizes patient safety and quality, even the most rigorously developed procedures may fail to translate into consistent staff behavior.

Hospitals that cultivate a culture of safety tend to demonstrate superior performance in reducing contamination and other healthcare-associated errors. Such a culture is characterized by leadership visibility, active support for best practices, positive reinforcement of compliance, and structured accountability systems. The theoretical perspective is that when hospital leaders actively signal the importance of adherence to aseptic technique, staff perceive that contamination prevention is not merely a regulatory expectation but a core organizational value. This perception shapes behavioral norms, encouraging staff to internalize safe practices and maintain high vigilance even under high-stress conditions (Zwang & Albert, 2006).

Transformational leadership theory provides a compelling framework for understanding how administrators influence both staff behavior and institutional norms. Transformational leaders articulate a clear vision for excellence, communicate the rationale behind clinical protocols, and serve as role models for compliance. Within the specific context of blood culture contamination, transformational administrators engage directly with phlebotomy teams, fostering open communication, feedback mechanisms, and reporting of near-misses, which collectively create a psychologically safe environment. This environment encourages staff to remain alert, adhere strictly to disinfection and phlebotomy procedures, and continuously refine their practices.

Moreover, leadership extends beyond individual interactions to strategic culture-building. Health administrators theoretically shape the hospital ethos by integrating procedural compliance into performance evaluation, recognizing exemplary practice, and embedding quality metrics into operational objectives. This multidimensional role emphasizes that procedural adherence is not an isolated technical requirement, but an emergent property of a system in which culture, leadership, and policy converge. By actively influencing organizational norms and expectations, administrators transform adherence from a purely task-oriented activity into a shared institutional responsibility, thereby reinforcing continuous improvement and minimizing contamination risks across departments (Zwang & Albert, 2006).

Evidence-Based Standardization of Phlebotomy Procedures

The reduction of blood culture contamination is also heavily influenced by the standardization of clinical procedures, particularly when grounded in evidence-based practice. A substantial body of theoretical and empirical literature highlights the importance of implementing uniform, rigorously tested protocols for phlebotomy. These protocols typically include stepwise procedures for hand hygiene, skin antisepsis, selection of venipuncture site, blood volume collection per culture set, and multi-set sampling. By reducing variability in practice, standardization theoretically diminishes the primary contributors to contamination, which include procedural inconsistency, human error, and misinterpretation of guidelines (Gibb, Hill, Chorel, & Brant, 1997).

Theoretical models of quality assurance underscore that standardization promotes predictability, reliability, and reproducibility of clinical outcomes. When phlebotomy practices are standardized, deviations are easier to detect, performance metrics are measurable, and corrective interventions can be systematically implemented. From an administrative perspective, standardization serves multiple strategic functions:

1. **Monitoring and Evaluation:** Administrators can track adherence to protocols using audits, data dashboards, and compliance reports. This allows for identification of areas of improvement and targeted interventions, theoretically reducing contamination systematically rather than incidentally.

2. **Training and Competency Development:** Uniform procedures enable the development of structured training programs and skill assessments. Staff are trained consistently, which fosters higher competency, confidence, and procedural fidelity.
3. **Accountability and Governance:** Standardized procedures establish clear expectations for staff performance and provide a framework for accountability. Administrators can hold teams responsible for compliance while also providing constructive feedback to reinforce desired behaviors.

Furthermore, embedding standardization within organizational governance elevates its impact from the level of individual action to a system-wide intervention. Standardization, when integrated with leadership, culture-building, and feedback mechanisms, ensures that each procedural step is consistently applied across departments, shifts, and personnel. This approach supports the theoretical premise that contamination reduction is a function of administration-mediated systemic quality control. It is not merely the outcome of technical precision or staff diligence but a product of coordinated institutional design, where administration, culture, and evidence-based protocols converge to produce sustained, measurable improvements in patient safety and laboratory reliability.

In sum, organizational culture, leadership, and evidence-based standardization are intertwined theoretical constructs that collectively shape the likelihood of contamination. When health administration actively integrates these elements, hospitals can create resilient systems capable of maintaining low contamination rates, even in high-demand clinical environments. This theoretical perspective situates contamination prevention as a strategically managed, institution-wide responsibility, highlighting the centrality of health administration in translating evidence into safe and reliable clinical practice.

Global and Regional Comparisons: Lessons for Saudi Healthcare

From a theoretical standpoint, the prevalence of blood culture contamination and the impact of administrative interventions are not uniform across healthcare systems worldwide. Extensive multicenter studies conducted in the United States, Europe, and other high-income regions demonstrate that baseline contamination rates are influenced by a complex interplay of multiple factors, including but not limited to the level and consistency of staff training, the rigor of institutional oversight, the volumes of blood collected per culture set, adherence to

standardized protocols, and the existence of structured monitoring systems. Evidence from these studies also indicates that even in technologically advanced hospitals, where access to sophisticated laboratory equipment, automated phlebotomy devices, and electronic monitoring systems is readily available, contamination rates remain heavily contingent on organizational controls, procedural standardization, and administrative vigilance. In other words, technology alone cannot ensure low contamination rates without active, sustained administrative engagement and organizational support.

Theoretical models drawn from healthcare management and patient safety literature suggest that systematic and structured administrative oversight is a key determinant of successful contamination reduction. These models highlight that hospitals must not only implement evidence-based clinical protocols but also embed these protocols within a broader framework of governance, quality assurance, and cultural reinforcement. Such integration ensures that best practices are consistently applied across departments, shifts, and personnel, reducing variability and minimizing opportunities for error (Mirrett, Weinstein, Reimer, Wilson, & Reller, 2001).

For Saudi Arabian hospitals, and in particular for King Abdullah Bin Abdulaziz University Hospital, theoretical insights from global literature suggest several critical lessons. Adopting international best practices—such as specialized phlebotomy training, rigorous procedural standardization, continuous competency assessment, and robust monitoring mechanisms—can significantly enhance the reliability of blood culture collection and reduce contamination rates. This theoretical approach necessitates the integration of national standards, including CBAHI (Saudi Central Board for Accreditation of Healthcare Institutions) requirements, Ministry of Health regulations, and evidence-based infection control guidelines, into the operational and administrative governance of hospitals. In this context, administrators function as the central interface between global best practices, local regulatory requirements, and the practical realities of day-to-day clinical operations. They ensure that blood culture collection adheres to international quality benchmarks while remaining feasible, contextually appropriate, and sensitive to the unique clinical environment and resource availability in Saudi healthcare facilities (Swedish Institute for Infectious Disease Control, 2010).

Moreover, theoretical frameworks emphasize that sustainable contamination control is not achieved through isolated interventions or sporadic training alone. Instead, it requires a system-wide, multidimensional strategy in which administrative leadership, clinical staff,

laboratory protocols, and organizational culture are all aligned toward the shared goal of patient safety and quality care. This perspective underscores the importance of local adaptation of global evidence, where administrators must not only translate international guidelines into operational procedures but also contextualize and reinforce these guidelines within the cultural, logistical, and resource realities of the Saudi healthcare system.

Theoretical Implications for Health Administration and Patient Safety

Synthesizing the broader literature, it becomes evident that blood culture contamination should be understood primarily as a systemic and administrative challenge, rather than merely a technical or individual performance issue. While phlebotomy skill and technical proficiency are essential, the theoretical consensus highlights that organizational design, leadership, procedural standardization, and resource management collectively determine contamination outcomes. Theoretical frameworks in health administration and patient safety literature suggest several interrelated principles for effective contamination reduction:

1. **Procedural Oversight:** Health administrators must enforce clear, evidence-based, and standardized protocols for blood culture collection. Procedural oversight includes regular audits, performance monitoring, and timely corrective interventions to ensure adherence. From a theoretical perspective, oversight functions as a safeguard layer in a complex socio-technical system, mitigating the risk of human error and procedural deviation.
2. **Staff Training and Competency Development:** Continuous education, structured training programs, and competency assessments are essential to ensure that all personnel understand the rationale behind protocols and can apply them consistently. Theoretical models of adult learning and skill retention emphasize that repeated practice, feedback, and scenario-based training reinforce procedural adherence, reducing variability in performance across individuals and teams.
3. **Resource Allocation:** Proper distribution of staff, equipment, and workload is critical in minimizing procedural lapses. Theoretical perspectives on organizational ergonomics and cognitive load suggest that errors increase under conditions of stress, fatigue, and high workload. By strategically managing resources, administrators can

create environments that support consistent compliance with aseptic technique, thereby reducing contamination risk.

4. **Monitoring, Feedback, and Data-Driven Evaluation:** Administrators must implement systems to continuously track contamination rates, monitor adherence to protocols, and provide timely feedback. Data-driven evaluation serves a dual theoretical function: it reinforces accountability and enables iterative quality improvement, ensuring that interventions are responsive to observed trends and emerging challenges.
5. **Organizational Culture and Leadership:** Leadership commitment and culture-building are foundational to sustaining procedural adherence. Theoretical models in healthcare management suggest that organizational culture shapes the norms, attitudes, and behaviors of staff. Administrators who foster a culture of safety, transparency, and continuous learning create environments where procedural compliance becomes a shared institutional value rather than an imposed requirement.

Collectively, these principles suggest that contamination reduction is most effectively achieved through an integrated, system-wide approach in which clinical staff, laboratory systems, and administrative leadership operate in a coordinated manner. Health administration is therefore conceptualized not merely as a managerial function, but as a strategic driver of patient safety, clinical quality, and organizational excellence. Contamination prevention, from this perspective, is inherently a multi-level responsibility, requiring alignment of procedural standards, human factors considerations, resource management, and organizational culture (Piette & Verschraegen, 2009).

Theoretical frameworks also underscore that administrative interventions have cascading effects: effective governance improves staff competence, reinforces procedural fidelity, strengthens organizational culture, enhances laboratory reliability, and ultimately contributes to better patient outcomes. This systemic view highlights that health administration is central to the translation of evidence-based guidelines into real-world, sustainable clinical practice, demonstrating that contamination control is a strategically managed, institution-wide endeavor rather than a series of isolated technical fixes.

Technological Innovations and Automation in Contamination Prevention

A critical theoretical avenue in the literature emphasizes the role of technological innovation and automation in minimizing blood culture contamination. Advances in phlebotomy devices, laboratory instrumentation, and electronic monitoring systems have been widely theorized as key enablers of contamination control, complementing human skill and administrative oversight.

From a theoretical standpoint, closed-system blood collection devices are designed to reduce the risk of skin flora or environmental organisms contaminating specimens. These systems maintain a sterile pathway between the patient's vein and the culture bottle, limiting exposure to external sources of contamination. Health administration plays a central role in this context by evaluating cost-benefit considerations, procuring appropriate devices, and integrating their use into standardized protocols. The theoretical implication is that administrative decision-making directly influences procedural safety, as the adoption of technology without appropriate policy and oversight may fail to yield desired outcomes (Madeo & Barlow, 2008).

In addition to hardware innovations, automated monitoring and electronic alert systems provide a conceptual framework for quality improvement. These systems track adherence to procedural steps, flag deviations in real-time, and generate data for performance evaluation. Theoretically, such systems create a closed feedback loop, where human performance, technology, and administrative oversight converge to reinforce best practices. By integrating these tools, hospitals can theoretically reduce the influence of human error and cognitive load, ensuring that aseptic techniques are consistently applied even under high-pressure conditions.

Moreover, advanced laboratory information systems (LIS) can be utilized to monitor contamination trends, detect anomalies, and benchmark performance against institutional or national standards. Administrators can leverage this data to implement targeted interventions, adjust staffing patterns, and refine training curricula. From a theoretical perspective, the use of technology is not merely technical; it functions as an administrative enabler, amplifying the effectiveness of policy, oversight, and staff education while creating a data-driven culture of accountability.

Cost-Effectiveness and Administrative Economics of Contamination Reduction

Another theoretical dimension explored in the literature is the economic and operational impact of blood culture contamination. Contamination is not solely a clinical or microbiological issue; it imposes significant financial and resource burdens on healthcare systems. False-positive cultures often lead to unnecessary antibiotic prescriptions, additional laboratory testing, extended hospital stays, and sometimes unnecessary interventions, all of which translate into direct and indirect costs.

From a theoretical administrative perspective, reducing contamination aligns with principles of health economics and organizational efficiency. Health administrators are responsible for allocating resources in ways that maximize patient outcomes while minimizing unnecessary expenditures. Studies suggest that even small reductions in contamination rates can generate substantial cost savings, which can then be reinvested in staff training, technological upgrades, or other quality improvement initiatives. Theoretical models, such as cost-benefit and return-on-investment analyses, demonstrate that interventions aimed at contamination prevention—whether through staff education, process standardization, or technological adoption—are economically justifiable, particularly in large tertiary care hospitals (Gander et al., 2009).

Furthermore, health administration theory emphasizes the concept of opportunity cost. Contamination events not only consume financial resources but also divert staff time, laboratory capacity, and clinical attention from patients with true bloodstream infections. By theoretically reducing contamination, administrators enhance overall hospital efficiency, improve patient throughput, and optimize the allocation of skilled personnel. This aligns with broader healthcare management frameworks, which view quality, efficiency, and patient safety as interdependent objectives.

From a theoretical lens, administrative leadership is thus positioned as a strategic agent of cost containment and quality assurance. By combining procedural oversight, staff training, technological adoption, and continuous monitoring, administrators can mitigate the economic impact of contamination while enhancing clinical reliability. In essence, contamination control is not only a clinical imperative but also a strategically significant administrative function, linking operational efficiency, patient safety, and financial sustainability in a single framework.

In synthesizing the extensive body of literature on blood culture contamination, it becomes increasingly evident that the phenomenon cannot be adequately addressed through isolated technical interventions alone; rather, it must be conceptualized as a complex, multi-layered system influenced by human factors, procedural design, technological infrastructure, and organizational governance. Contemporary theoretical frameworks consistently emphasize that contamination emerges at the intersection of these domains, shaped not only by the immediate practices of phlebotomists but also by broader systemic factors such as staffing adequacy, cognitive load, institutional culture, leadership engagement, and the presence of robust monitoring and feedback mechanisms.

Expanding on this understanding, emerging models suggest that administrative strategy itself functions as an active determinant of clinical reliability, where decisions regarding procedural standardization, resource allocation, technology adoption, and culture-building collectively establish the conditions under which contamination can be minimized or perpetuated. Furthermore, comparative analyses across international healthcare systems indicate that contamination rates are not solely a function of technical sophistication; hospitals with similar technological capabilities can demonstrate markedly different outcomes depending on the effectiveness of administrative oversight, integration of evidence-based protocols, and organizational emphasis on continuous quality improvement.

From a theoretical standpoint, this suggests that sustainable reductions in contamination are achieved not merely through adherence to guidelines, but through a deliberate alignment of policy, culture, education, and system design, creating an environment in which adherence is inherently facilitated, cognitive load is optimized, and procedural variability is minimized. Extending these insights to the context of Saudi Arabian healthcare, particularly within academic and tertiary hospitals such as King Abdullah Bin Abdulaziz University Hospital, the literature implies that the integration of global best practices with locally tailored administrative policies, rigorous training programs, and context-sensitive monitoring systems can substantially enhance patient safety outcomes (Mirrett, Weinstein, Reimer, Wilson, & Reller, 2001).

Additionally, theoretical perspectives increasingly advocate for the proactive use of predictive analytics and data-driven decision support within laboratory and administrative frameworks, enabling administrators to identify high-risk scenarios, anticipate contamination events, and implement preemptive measures that go beyond reactive quality control.

Collectively, these insights converge on the principle that blood culture contamination should be addressed as a strategically managed, institution-wide responsibility, wherein human factors, procedural rigor, technological support, and leadership commitment are harmonized to create resilient, adaptive systems capable of sustaining high-quality patient care. By integrating these dimensions, the literature not only underscores the centrality of health administration in shaping clinical outcomes but also opens avenues for future research and innovation, including the exploration of artificial intelligence–assisted monitoring, adaptive workflow design, and culturally contextualized education programs that further enhance procedural fidelity and patient safety across diverse healthcare settings.

Previous Studies:

1. Hosni et al. (2024)

Hosni et al. (2024) conducted a focused intervention study at King Abdullah Hospital in Bisha, Saudi Arabia, implementing structured administrative strategies to reduce blood culture contamination (BCC). Intervention involved training of staff, standardizing of collection kits, improved governance reviews and interdisciplinary review meetings. They managed to reduce the rate of contamination by as much as 2.1 percent to about 5.2 percent in six months. The impact of the alignment of administration to clinical protocols was also shown by the sustainable improvement in performance of the hospital, conditioned by integration of contamination metrics in key performance indicators in the departments.

In addition to quantitative gains, the research emphasized the need of administrative support and resource commitments. Athena staff survey reflected the increased level of according awareness, an obvious system of accountability, and the management promotion as the most important factors of the intervention success. The results present a strong framework of how the secondary hospitals such as KAAUH can possibly replicate the low-cost management programs to improve the precision of diagnosis and safety of patients. The authors indicate the importance of regular monitoring and continuous re-training to sustain gain, presenting the process of BCC reduction as a quality improvement process.

2. He et al. (2019)

He et al. (2019) examined the effects of weekly contamination reports and feedback in an intensive care unit (ICU) setting. The intervention created a feedback circle, with weekly dashboards on contamination events, the performance of collectors, and trends at the departmental level given to the ICU personnel accompanied by administrative leadership meetings. Already after three months, the levels of contamination decreased to 2.7%; the positive results continued up to six months after the intervention.

The authors stated that the important considerations were the leadership endorsement, frequent data examination, and open performance correspondence. This organizational feedback influenced responsibility and made corrective training possible. In its conclusions, the study highlights the possibility of drastic changes in clinical quality outcomes after small, consistent investments at the administrative level and discusses the recommended systematic approach to data management and reporting as one of its key potential areas.

3. Hemeg et al. (2020)

In a one-year cross-sectional study at a tertiary Saudi hospital, Hemeg et al. (2020) analyzed contamination rates across units, including seasonal variations and collector roles. They recorded aggregate BCC rate of 6.6 with a maximum of 10.3 in the medical wards and when the hospitals were having high number of patients. The procedure of audits and interviews with staff members by the study found that inefficient training, discrepancy between aseptic techniques, and lack of administration control provided most of the contamination.

The value of the study consists in the fact that temporal and structural risk factors have been identified. Hemeg et al. strongly characterized the importance of long-term administrative surveillance and contingent resource allocation by pinpointing times of high contamination with employee shortages and workload demands. Their results act as an important basis of diagnosis signifying that administrative response to operation variability requires a structure.

4. Rupp et al. (2017)

Rupp et al. (2017) conducted a randomized controlled trial evaluating the impact of initial specimen diversion devices (ISDDs) compared to standard sampling methods. With ISDD

utilization there was a 50 per cent reduction in contamination-3.5 to 1.7 per cent- without the loss of diagnostic yield. The research highlighted that the possibility of incorporating ISDDs into regular practice at reasonable cost is achievable with assistance of resource planning on the part of the administration.

The trial of this nature demonstrates that even an administrative decision, e.g. using new technologies, can have real clinical effects. Asset-based decision-making, procurement, and protocol training enabled successful implementation. Their companion strategies, according to Rupp et al., include continual competency verification and outcome monitoring to achieve a lasting contamination reduction and remind that the adoption of the device must be supported by administrative processes.

5. Hall & Lyman (2006)

Hall and Lyman's (2006) comprehensive literature review systematically assessed blood culture contamination studies, offering procedural, educational, and contextual classification of causes and solutions. They stated that standardization of skin antisepsis, proper staff education, and planned phlebotomy operations were critical in pushing the rate of contamination to less than 3 percent. Notably, they noted that those interventions that did not have administrative backing in governance and monitoring tended to fail after a few weeks.

The review focuses on institutional accountability and prioritizing of resources as the key to procedural change. It cites incidences of system weaknesses that manifest more regularly, like organization turnover and lack of reinforcement of standards, as causes why most longterm interventions fail. The two authors suggest incorporating the measurements of contamination rates into the organizational quality concepts, an innovation that has become a source of direct guidance in conducting the presented study at KAAUH.

6. Eisenberg et al. (2024)

Eisenberg et al. (2024) studied structured interdisciplinary teams in a large healthcare network. With the suggested interventions of weekly meetings, sterile kits costed-in, and leader-demonstrated performance dashboards, they have reported a 45 percent cut-down in the rate of contamination, which was 3.76 percent in the initial stage and 2.07 percent in the

second. Notably, the decline in contamination was not traced to any one intervention strategy but was seen as result of the integrated strategy of governance as well as chain of accountability.

Their contribution highlights the importance of administration as the focal point of clinical best practice integration and upkeep. Such strategies as cross-departmental communication, latticed reporting, and resource allocation were found to be essential towards the achievement of long-term adherence to processes. The research presents convincing indications that the curtailment of enduring contamination enhancements is dependent on administrative ecosystem, and not limited to clinical interventions.

7. Halstead et al. (2020)

Halstead et al. (2020) evaluated contamination reduction programs across four U.S. hospitals, each adopting a variant of administrative-led intervention, including standardized collection kits, staff orientation, and performance feedback. Majority of hospitals reduced their contamination by at least 40 percent with baselines of 3.2-4.7% to 1.8-2.5 percent. The strength of success was associated with the existence of administrative champions ensuring the coordination across the functions and frequent reporting.

Their multi-site study confirms what they had described in their previous study that administrative leadership is the distinction between short-term improvements and long-term control of contamination. Halstead et al. cite the conclusion that integrating contamination prevention artifacts in administration form, including budget procedures, training planning, executive review enterprises, is fundamental in the sustainability of results and applicability.

Chapter Three

Methodology

Study Design

This study adopts a retrospective, quantitative design employing the analysis of Key Performance Indicator (KPI) data related to blood culture contamination (BCC) at King Abdullah Bin Abdulaziz University Hospital (KAAUH). The main goal will be to assess the improvement role of health administration in BCC reduction by comparing real life rates of contamination, measures connected with the latter as well as timeframes of given administrations. Drawing on established methodology in healthcare process evaluation, this approach ensures systematic collection and analysis of objective data aligned with the study's objectives.

Population and Data Sources

The study's population for data extraction will be all blood culture specimens collected and processed at KAAUH within the defined study timeframe.

The primary data sources for this study will be:

Hospital Records of Blood Culture Contamination Rates (KPIs):

This will comprise real data obtained on the regular basis regarding the incidences of the contaminated blood cultures in relation to the sum of blood cultures collected inside KAAUH.

This objective data will be used as the main outcome measure.

Associated Clinical and Administrative KPIs:

Additional relevant KPIs, such as antibiotic utilization (e.g., defined daily doses related to contamination episodes) and associated laboratory costs, will also be collected for comprehensive analysis. Furthermore, records of implemented administrative interventions, policy changes, or training programs related to blood culture collection within the study period will be sought from relevant hospital departments (e.g., Infection Control, Quality Assurance, Laboratory Management, Nursing Administration). Such data sources will allow the direct correlation of certain administrative actions or time horizons with quantifiable clinical results.

Study Instruments

Blood Culture Contamination Rate Data:

This will be extracted from the hospital's laboratory information system (LIS) and/or infection control databases. The specific definition of contamination used by KAAUH will be rigorously adhered to (e.g., growth of common skin flora in one of multiple bottles, without clinical suspicion of infection).

Administrative Intervention Records:

Documentation of specific administrative changes, training initiatives, or policy implementations will be obtained from relevant departmental records to define "pre" and "post" intervention periods for analysis.

Statistical Methods

Descriptive Analysis

Initial analysis will involve basic statistics (means, standard deviations, frequencies, percentages) to profile blood culture contamination rates, total cultures collected, average antibiotic utilization, and associated laboratory costs over the study period. Described data will be disaggregated to the department and month levels to detect the trends and baseline characteristics.

Delimitations of the Study

Institutional Scope:

In this work, the departments in which blood cultures were taken in KAAUH will be analyzed i.e., Emergency Department; Intensive Care Unit; general wards; phlebotomy services and microbiology laboratory. It does not count down other hospitals nor the outpatient clinic statistics.

Time Frame:

This factor predetermines the day of collection and analysis within a period of six months i.e. three months before intervention and three months after intervention. This paper does not include the analysis of long-term trends beyond this time range.

Unit of Analysis:

The primary unit of analysis will be departmental-level and overall hospital-level blood culture contamination rates (KPIs), along with associated aggregate clinical and financial metrics. Individual patient-level outcomes beyond contamination status will not be analyzed (e.g., morbidity or mortality related to contamination).

Geographic and Cultural Context:

The findings are unique to KAAUH in Riyadh, Saudi Arabia, and they are based on the organizational structure of hospitals and the policies of personnel and operations of hospitals. The results cannot be directly used in a context where the system is different or the culture is different without putting it in context.

Chapter four

Results and conclusion

Data Analysis

Section One: Demographic Characteristics of Participants

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	48	43.6%
	Female	62	56.4%
Age	Under 30	42	38.2%
	30–39 years	40	36.4%
	40–49 years	21	19.1%
	50 or above	7	6.3%
Job Title	Physician	20	18.2%
	Nurse	42	38.2%
	Laboratory Technician	25	22.7%
	Health Administrator	23	20.9%
Years of Experience	Less than 2 years	26	23.6%
	2–5 years	39	35.5%
	6–10 years	31	28.2%
	More than 10 years	14	12.7%

The demographic data show that **female respondents represented the majority**, which reflects the typical workforce distribution in Saudi Arabian tertiary hospitals where nursing and laboratory staff include a high proportion of women.

Regarding age distribution, **most participants were under 40**, indicating that the hospital workforce is relatively young and likely to be adaptable to new administrative-led interventions and continuous training programs.

In terms of job roles, **nurses formed the largest group**, followed by laboratory technicians and health administrators. This is significant because these categories are directly involved in blood culture

collection and contamination-prevention protocols, thereby providing reliable insights into operational policies and challenges.

As for experience, the distribution suggests a balanced mix of junior and mid-career employees. This diversity enhances the validity of the findings since both recently trained staff and highly experienced personnel contributed perspectives regarding administrative procedures, training, resources, and monitoring practices.

Section Two: Study Dimensions

Dimension 1: Administrative Policies and Procedures

Item	SA	A	N	D	SD
Clear written policies exist	72 (65.5%)	36 (32.7%)	2 (1.8%)	0	0
Policies are regularly updated	56 (50.9%)	46 (41.8%)	7 (6.4%)	1 (0.9%)	0
Staff compliance is monitored	52 (47.3%)	53 (48.2%)	4 (3.6%)	1 (0.9%)	0
Guidelines on proper collection are available	54 (49.1%)	52 (47.3%)	2 (1.8%)	2 (1.8%)	0

The results indicate a **very high level of agreement** across all items, showing that the hospital maintains clear written blood culture collection policies, regularly updates them, and ensures availability of procedural guidelines. Almost all respondents acknowledged active monitoring of staff compliance.

These findings suggest that **policy structure at KAAUH is strong**, forming an essential foundation for contamination reduction initiatives. However, the small proportion of neutral responses may indicate a need for further policy awareness sessions to ensure consistent understanding among all staff categories.

Dimension 2: Training and On-the-Job Development

Item	SA	A	N	D	SD
Staff receive regular training	52 (47.3%)	52 (47.3%)	5 (4.5%)	1 (0.9%)	0
Performance is evaluated after training	50 (45.5%)	56 (50.9%)	4 (3.6%)	0	0
Special training programs exist	60 (54.5%)	44 (40%)	5 (4.5%)	1 (0.9%)	0
New staff are trained before duty	66 (60%)	44 (40%)	0	0	0

The findings show **exceptionally strong agreement** on the availability and effectiveness of training programs. Respondents acknowledged the existence of specialized training specific to blood culture contamination prevention.

Particularly notable is the **100% agreement** regarding training of new staff prior to assuming duties, reflecting strong administrative commitment to competency-based onboarding.

These results support the notion that **training is a pivotal administrative mechanism at KAAUH**, playing a key role in maintaining protocol adherence and improving sample collection quality.

Dimension 3: Resources and Equipment

Item	SA	A	N	D	SD
Availability of sterile tools	82 (74.5%)	28 (25.5%)	0	0	0
PPE is adequately available	77 (70%)	33 (30%)	0	0	0
Tools/techniques exist to prevent contamination	66 (60%)	43 (39.1%)	1 (0.9%)	0	0
Adequate budget for infection control	48 (43.6%)	57 (51.8%)	5 (4.5%)	0	0

The responses reveal **near-unanimous satisfaction** with the adequacy of equipment and protective tools. The availability of sterile kits and prevention devices aligns with best practices recommended by CLSI and CDC.

Budget allocation also received strong approval, indicating that the administrative leadership invests sufficiently in infection-control resources. This dimension reinforces the idea that **resource readiness**

at KAAUH is strong, providing a favorable environment for successful administrative-led interventions.

Dimension 4: Monitoring and Evaluation

Item	SA	A	N	D	SD
Contamination rates are monitored regularly	76 (69.1%)	33 (30%)	1 (0.9%)	0	0
Causes of contamination are analyzed	69 (62.7%)	40 (36.4%)	0	1 (0.9%)	0
Committees/teams exist for monitoring contamination	66 (60%)	42 (38.2%)	1 (0.9%)	1 (0.9%)	0
Staff are informed of performance results	77 (70%)	31 (28.2%)	1 (0.9%)	1 (0.9%)	0

Monitoring and evaluation practices appear to be **highly institutionalized** at KAAUH. Respondents overwhelmingly affirmed regular tracking of contamination rates, existence of specialized oversight committees, and dissemination of performance findings to staff.

These practices are essential for sustaining quality improvement and align with international recommendations for diagnostic stewardship.

The consistency of agreement suggests that **monitoring systems are functioning effectively**, providing administrators with reliable feedback loops that support reduction of contamination rates.

Discussion of Findings

Administrative Policies and Procedures

The results demonstrated consistently high levels of agreement regarding the existence, clarity, and regular updating of blood culture collection policies. Respondents further confirmed that guidelines are accessible and that compliance is continuously monitored.

These findings highlight that **administrative structure at KAAUH is robust**, aligning with international recommendations from CLSI and CDC, which emphasize policy standardization as a key determinant of contamination reduction.

Training and On-the-Job Development

Training emerged as a central strength within the hospital. Nearly all respondents acknowledged receiving routine training, specialized programs, and structured onboarding for new staff.

The finding that **100% of participants confirmed pre-duty training for new personnel** underscores a strong organizational culture of competency assurance. This aligns with global evidence that continuous training significantly lowers contamination rates and improves adherence to aseptic techniques.

Resources and Equipment

The analysis revealed near-unanimous satisfaction with the availability of sterile equipment, personal protective equipment, and contamination-prevention tools. The majority also agreed that sufficient budget is allocated for infection control.

These results indicate that **resource readiness is not a limiting factor** at KAAUH. Adequate equipment availability supports optimal implementation of administrative policies and enhances compliance with blood culture collection standards.

Monitoring and Evaluation

Findings confirmed that contamination rates are regularly monitored, causes are analyzed, and results are communicated to staff. The existence of specialized committees further strengthens the hospital's oversight system.

This comprehensive monitoring culture suggests that **feedback loops are well-established**, enabling timely corrective actions and reinforcing best practices.

Recommendations

Administrative Policies

- Increase periodic awareness sessions to ensure that all staff—especially newly assigned members—fully understand the policies.

- Continue strengthening policy dissemination using digital platforms, such as internal portals and mobile alerts.

Training and Workforce Development

- Expand simulation-based training modules focusing on complex collection scenarios.
- Introduce competency re-evaluation every 6 to 12 months to maintain high technical standards.

Resources and Infrastructure

- Maintain continuous assessment of supply-chain management to prevent any shortages in sterile kits or PPE.
- Upgrade equipment when newer contamination-prevention technologies become available.

Monitoring and Evaluation

- Increase staff feedback sessions to promote a culture of transparency and shared responsibility.
- Develop detailed dashboards to track contamination trends and unit-specific performance indicators.

References

Reference list:

1. Aronson, M. D., & Bor, D. H. (1987). Blood cultures. *Annals of Internal Medicine*, 106, 246–253.
2. Bates, D. W., Goldman, L., & Lee, T. H. (1991). Contaminant blood cultures and resource utilization: The true consequences of false-positive results. *JAMA*, 265, 365–369.
3. Bekeris, L. G., Tworek, J. A., Walsh, M. K., & Valenstein, P. N. (2005). Trends in blood culture contamination: A College of American Pathologists Q-Tracks study of 356 institutions. *Archives of Pathology & Laboratory Medicine*, 129, 1222–1225.
4. Eskira, S., Gilad, J., Schlaeffer, P., Hyam, E., Peled, N., Karakis, I., Riesenber, K., Schlaeffer, F., & Borer, A. (2006). Reduction of blood culture contamination rate by an educational intervention. *Clinical Microbiology and Infection*, 12, 818–821.
5. Gander, R. M., Byrd, L., DeCrescenzo, M., Hirany, S., Bowen, M., & Baughman, J. (2009). Impact of blood cultures drawn by phlebotomy on contamination rates and health care costs in a hospital emergency department. *Journal of Clinical Microbiology*, 47, 1021–1024.
6. Gibb, A. P., Hill, B., Chores, B., & Brant, R. (1997). Reduction in blood culture contamination rate by feedback to phlebotomists. *Archives of Pathology & Laboratory Medicine*, 121, 503–507.
7. Hall, K. K., & Lyman, J. A. (2006). Updated review of blood culture contamination. *Clinical Microbiology Reviews*, 19, 788–802.
8. Lee, C. C., Lin, W. J., Shih, H. I., Wu, C. J., Chen, P. L., Lee, H. C., Lee, N. Y., Chang, C. M., Wang, L. R., & Ko, W. C. (2007). Clinical significance of potential contaminants in blood cultures among patients in a medical center. *Journal of Microbiology, Immunology, and Infection*, 40, 438–444.
9. Little, J. R., Murray, P. R., Traynor, P. S., & Spitznagel, E. (1999). A randomized trial of povidone-iodine compared with iodine tincture for venipuncture site disinfection: Effects on rates of blood culture contamination. *American Journal of Medicine*, 107, 119–125.
10. Madeo, M., & Barlow, G. (2008). Reducing blood-culture contamination rates by the use of a 2% chlorhexidine solution applicator in acute admission units. *Journal of Hospital Infection*, 69, 307–309.
11. Mirrett, S., Weinstein, M. P., Reimer, L. G., Wilson, M. L., & Reller, L. B. (2001). Relevance of the number of positive bottles in determining clinical significance of coagulase-negative staphylococci in blood cultures. *Journal of Clinical Microbiology*, 39, 3279–3281.

12. Piette, A., & Verschraegen, G. (2009). Role of coagulase-negative staphylococci in human disease. *Veterinary Microbiology*, 134, 45–54.
13. Richter, S. S., Beekmann, S. E., Croco, J. L., Diekema, D. J., Koontz, F. P., Pfaller, M. A., & Doern, G. V. (2002). Minimizing the workup of blood culture contaminants: Implementation and evaluation of a laboratory-based algorithm. *Journal of Clinical Microbiology*, 40, 2437–2444.
14. Rupp, M. E., & Archer, G. L. (1994). Coagulase-negative staphylococci: Pathogens associated with medical progress. *Clinical Infectious Diseases*, 19, 231–243.
15. Schiffman, R. B., Strand, C. L., Meier, F. A., & Howanitz, P. J. (1998). Blood culture contamination: A College of American Pathologists Q-Probes study involving 640 institutions and 497,134 specimens from adult patients. *Archives of Pathology & Laboratory Medicine*, 122, 216–221.
16. Souvenir, D., Anderson, D. E., Jr., Palpant, S., Mroch, H., Askin, S., Anderson, J., Claridge, J., Eiland, J., Malone, C., Garrison, M. W., Watson, P., & Campbell, D. M. (1998). Blood cultures positive for coagulase-negative staphylococci: Antisepsis, pseudobacteremia, and therapy of patients. *Journal of Clinical Microbiology*, 36, 1923–1926.
17. Strand, C. L., Wajsbort, R. R., & Sturmman, K. (1993). Effect of iodophor vs iodine tincture skin preparation on blood culture contamination rate. *JAMA*, 269, 1004–1006.
18. Surdulescu, S., Utamsingh, D., & Shekar, R. (1998). Phlebotomy teams reduce blood-culture contamination rate and save money. *Clinical Performance and Quality Health Care*, 6, 60–62.
19. Swedish Institute for Infectious Disease Control. (2010). Pneumococci infection (invasive infection). Swedish Institute for Infectious Disease Control. <https://www.smittskyddsinstitutet.se/in-english/statistics/pneumococci-infection-invasive-infection/?t=trend#statistics-nav>
20. Waltzman, M. L., & Harper, M. (2001). Financial and clinical impact of false-positive blood culture results. *Clinical Infectious Diseases*, 33, 296–299.
21. Weinbaum, F. I., Lavie, S., Danek, M., Sixsmith, D., Heinrich, G. F., & Mills, S. S. (1997). Doing it right the first time: Quality improvement and the contaminant blood culture. *Journal of Clinical Microbiology*, 35, 563–565.
22. Weinstein, M. P. (2003). Blood culture contamination: Persisting problems and partial progress. *Journal of Clinical Microbiology*, 41, 2275–2278.
23. Weinstein, M. P., Towns, M. L., Quartey, S. M., Mirrett, S., Reimer, L. G., Parmigiani, G., & Reller, L. B. (1997). The clinical significance of positive blood cultures in the 1990s: A prospective comprehensive evaluation of the microbiology, epidemiology, and outcome of bacteremia and fungemia in adults. *Clinical Infectious Diseases*, 24, 584–602.

24. Zwang, O., & Albert, R. K. (2006). Analysis of strategies to improve cost effectiveness of blood cultures. *Journal of Hospital Medicine*, 1, 272–276.
25. Hosni, A., Alshahrani, G. A., Albishi, S. M., Alshamrani, A. A., Albishi, M. A., Alsaluli, A. M., ... & Alshahrani, F. M. (2024). Reducing blood culture contamination rate in King Abdullah Hospital, Bisha, Saudi Arabia. *Journal of International Crisis and Risk Communication Research*, 7(S6), 1138.
26. He, M., Huang, S., Xiao, Q., Xiong, J., & Zou, D. (2019). Reducing blood culture contamination in an intensive care unit through weekly reports and feedback. *American Journal of Infection Control*, 47(4), 477–478.
27. Hemeg, H. A., Almutairi, A. Z., Alharbi, N. L., Alenezi, R. F., Alturkostani, M. A., Ozbak, H. A., & Islam, F. A. (2020). Blood culture contamination in a tertiary care hospital of Saudi Arabia: A one-year study. *Saudi Medical Journal*, 41(5), 508.
28. Rupp, M. E., Cavalieri, R. J., Marolf, C., & Lyden, E. (2017). Reduction in blood culture contamination through use of initial specimen diversion device. *Clinical Infectious Diseases*, 65(2), 201–205.
29. Hall, K. K., & Lyman, J. A. (2006). Updated review of blood culture contamination. *Clinical Microbiology Reviews*, 19(4), 788–802.
30. Eisenberg, A. P., Awad, F. M., Watson, B., & Faris, M. (2024). Enhancing patient safety: The role of interdisciplinary teams in reducing blood culture contamination. *HCA Healthcare Journal of Medicine*, 5(5), 559.
31. Halstead, D. C., Sautter, R. L., Snyder, J. W., Crist, A. E., & Nachamkin, I. (2020). Reducing blood culture contamination rates: Experiences of four hospital systems. *Infectious Diseases and Therapy*, 9(2), 389–401.
32. Filipe, S., Martins, T., Santos-Costa, P., Paiva-Santos, F., Castilho, A., & Bastos, C. (2024, August). Effectiveness of a nurse-led multimodal intervention in preventing blood culture contamination: A before-and-after study. In *Healthcare*, 12(17), 1735. MDPI.
33. Alshamrani, S., & Al-Surimi, K. (2018). Reducing the rate of blood culture contamination in the emergency department of a university teaching hospital. *Global Journal on Quality and Safety in Healthcare*, 1(1), 13–18.
34. Lalezari, A., Cohen, M. J., Svinik, O., Tel-Zur, O., Sinvani, S., Al-Dayem, Y. A., ... & Strahilevitz, J. (2020). A simplified blood culture sampling protocol for reducing contamination and costs: A randomized controlled trial. *Clinical Microbiology and Infection*, 26(4), 470–474.

35. Fleischmann, C., Scherag, A., Adhikari, N. K., Hartog, C. S., Tsaganos, T., Schlattmann, P., ... & Reinhart, K. (2016). Assessment of global incidence and mortality of hospital-treated sepsis: Current estimates and limitations. *American Journal of Respiratory and Critical Care Medicine*, 193(3), 259–272.
36. Zimmerman, F. S., Assous, M. V., Yinnon, A. M., & Wiener-Well, Y. (2018). Reducing blood culture contamination using a departmental report card. *Journal of Hospital Infection*, 99(2), 236–237.
37. Bowen, C. M., Coleman, T., & Cunningham, D. (2016). Reducing blood culture contaminations in the emergency department: It takes a team. *Journal of Emergency Nursing*, 42(4), 306–311.
38. Yan, Y. Z., Yang, H. Z., Zhao, J. X., & Xia, R. (2019). A quality control circle process to reduce blood culture contamination rates. *Infection Control & Hospital Epidemiology*, 40(1), 119–120.
39. Popa, A. I., Tălăpan, D., & Popescu, G. A. (2024). A five-bundle intervention to improve blood culture use in a tertiary hospital in Romania. *Antibiotics*, 13(11), 1040.

Appendices

نموذج الاستبيان

العنوان:

استبيان لدراسة دور الإدارة الصحية في الحد من تلوث مزارع الدم في مستشفى الملك عبد الله بن عبد العزيز الجامعي بالرياض

المقدمة / Introduction

السلام عليكم ورحمة الله وبركاته،

تحية طيبة وبعد،

يأتي هذا الاستبيان ضمن إطار دراسة بعنوان:

"دور الإدارة الصحية في الحد من تلوث مزارع الدم: دراسة تطبيقية في مستشفى الملك عبد الله بن عبد العزيز الجامعي بالرياض."

يهدف هذا الاستبيان إلى التعرف على مدى تطبيق السياسات والإجراءات التنظيمية، وبرامج التدريب، والرقابة الإدارية التي تساهم في خفض معدلات تلوث مزارع الدم، مما ينعكس على جودة الخدمات الصحية وسلامة المرضى. نؤكد لكم أن جميع المعلومات التي ستقدمونها سرية تماماً وسوف تستخدم فقط لأغراض البحث العلمي دون ذكر الأسماء أو أي معلومات تعريفية.

We kindly request your participation in this scientific study, noting that all provided information is confidential and used only for research purposes.

شاكرين ومقدرين حسن تعاونكم. / Thank you for your cooperation.

القسم الأول: البيانات الأولية / Section One: Demographic Data

1. الجنس / Gender:

ذكر (Male)

أنثى (Female)

2. العمر / Age:

أقل من 30 سنة (Under 30)

30 – 39 سنة

40 – 49 سنة

50 سنة فأكثر (or above 50)

3. المسمى الوظيفي / Job Title:

طبيب (Physician)

ممرض/ممرضة (Nurse)

فني مختبر (Laboratory Technician)

إداري صحي (Health Administrator)

أخرى / Other: _____

4. سنوات الخبرة / Years of Experience:

أقل من سنتين (Less than 2 years)

2 – 5 سنوات

6 – 10 سنوات

أكثر من 10 سنوات (More than 10 years)

القسم الثاني: محاور الدراسة (مقياس ليكرت الخماسي)

Section Two: Study Dimensions (5-Point Likert Scale)

(موافق بشدة = 5 ، موافق = 4 ، محايد = 3 ، غير موافق = 2 ، غير موافق بشدة = 1)

(Strongly Agree = 5 → Strongly Disagree = 1)

المحور الأول: السياسات والإجراءات الإدارية

Dimension 1: Administrative Policies and Procedures

1. توجد سياسات مكتوبة وواضحة لجمع عينات مزارع الدم.

.There are clear written policies for collecting blood culture samples

2. يتم تحديث السياسات الخاصة بجمع العينات بشكل دوري.

.Policies related to sample collection are regularly updated

3. يتم التأكد من التزام العاملين بالإجراءات المعتمدة.

.Compliance with approved procedures is monitored among staff

4. تتوافر أدلة إرشادية توضح خطوات جمع العينة الصحيحة لتقليل التلوث.

.Guidelines are available to ensure proper sample collection and reduce contamination

المحور الثاني: التدريب والتأهيل أثناء العمل

Dimension 2: Training and On-the-Job Development

5. يتم تدريب العاملين بشكل دوري على الطرق الصحيحة لسحب عينات الدم.

.Staff receive regular training on correct blood sample collection techniques

6. يتم تقييم أداء العاملين بعد التدريب لضمان الكفاءة.

.Performance is evaluated after training to ensure competency

7. تتوفر برامج تدريبية خاصة للحد من تلوث مزارع الدم.

.Special training programs are available to reduce blood culture contamination

8. يتم تدريب الموظفين الجدد قبل البدء في العمل الفعلي.

.New staff receive training before beginning their duties

المحور الثالث: الموارد والتجهيزات

Dimension 3: Resources and Equipment

9. تتوفر أدوات معقمة ومناسبة لجمع العينات لدى جميع الأقسام.

.Sterile and appropriate collection tools are available in all departments

10. تتوفر مستلزمات الوقاية الشخصية بشكل كافٍ.

.Personal protective equipment is adequately available

11. تتوفر تقنيات أو أدوات تساعد في منع التلوث أثناء جمع العينة.

.There are tools or techniques available to minimize contamination during sample collection

12. يتم تخصيص ميزانيات كافية لدعم إجراءات ضبط العدوى.

.Adequate budget is allocated to support infection control measures

المحور الرابع: المتابعة والتقييم

Dimension 4: Monitoring and Evaluation

13. يتم تسجيل ومتابعة معدلات تلوث مزارع الدم بشكل دوري.

.Blood culture contamination rates are recorded and monitored regularly

14. يتم تحليل أسباب التلوث عند حدوثه لاستخلاص الدروس التصحيحية.

.Causes of contamination are analyzed when it occurs to develop corrective actions

15. توجد لجان أو فرق مختصة بمتابعة وضبط نسب التلوث.

.There are dedicated committees or teams to monitor and control contamination rates

16. يتم إبلاغ العاملين بنتائج تقييم الأداء واتخاذ الإجراءات التصحيحية عند الحاجة.

.Staff are informed of evaluation results and corrective actions when necessary

الخاتمة / Conclusion

نشكر لكم وقتكم ومساهمتمكم في هذا العمل العلمي، ونسأل الله أن يسهم ذلك في رفع جودة الرعاية الصحية وسلامة المرضى.

Thank you for your valuable time and participation. Your contribution will support improving healthcare quality and patient safety

-الملخص-



يُشكّل تلوث مزارع الدم تحديات سريرية واقتصادية جسيمة، إذ يؤدي إلى تشخيصات غير دقيقة، واستخدام غير ضروري للمضادات الحيوية، وزيادة تكاليف الرعاية الصحية. هدفت هذه الدراسة إلى تقييم فعالية الممارسات الإدارية في الحد من تلوث مزارع الدم في مستشفى الملك عبد الله بن عبد العزيز الجامعي بالرياض. اعتمد تصميم كمي وصفي، وجمعت البيانات من 110 من أخصائيي الرعاية الصحية، بمن فيهم الأطباء والممرضون وفنيو المختبرات والمسؤولون الصحيون.

أشارت النتائج إلى مستوى عالٍ من التوافق فيما يتعلق بوضوح السياسات الإدارية وتحديثها بانتظام، وتوافر برامج التدريب المستمر، وتوفير معدات معقمة وموارد وقائية كافية. كما كشفت النتائج عن وجود آليات قوية للرصد والتقييم، بما في ذلك تتبع المنتظم لمعدلات التلوث، ووجود لجان متخصصة، والتواصل مع الموظفين لتلقي الملاحظات. وبشكل عام، خلصت الدراسة إلى أن الممارسات الإدارية في مستشفى الملك عبد الله بن عبد العزيز الجامعي مُهيكلّة بشكل جيد وتُساهم بشكل كبير في الحد من مستويات التلوث. وتوصي الدراسة بتوسيع نطاق التدريب القائم على المحاكاة، وتعزيز نشر السياسات، وتطوير لوحات معلومات رقمية لتحسين الجودة بشكل مستمر.

جامعة ميد اوثن

كلية الادارة

ماجستير الإدارة الصحية

العنوان باللغة العربية

دور الإدارة الصحية في تقليل تلوث مزرعة الدم: دراسة تطبيقية في مستشفى جامعة الملك عبد الله بن عبد العزيز،
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العام الاكاديمي

2025