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The Nurse as Sentinel: Integrating Frontline Clinical Observation into Community-Based Epidemiological Surveillance Systems

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Abstract

Background: Epidemiological surveillance traditionally relies on laboratory-confirmed case reporting, creating critical delays in outbreak detection. Nurses—positioned at the first point of patient contact across hospitals, clinics, schools, and communities—represent an underutilized resource for real-time syndromic surveillance and early warning.

Aim: This narrative review synthesizes evidence on the potential of nursing observation and documentation as a formal component of community-based epidemiological surveillance systems, examining barriers, facilitators, and the critical interface with laboratory confirmation.

Methods: A structured narrative review of English-language literature (2010-2024) was conducted using PubMed, CINAHL, and Scopus. Keywords included "nursing surveillance," "syndromic surveillance," "early warning systems," "community health workers," and "specimen collection." Literature was synthesized to construct a framework for nursing-integrated surveillance.

Results: Nurses contribute to surveillance through three interconnected mechanisms: systematic documentation of syndromic data during routine assessments, recognition of unusual disease patterns exceeding clinical intuition, and quality of specimen collection directly impacting laboratory confirmation rates. Barriers include inadequate training, perceived role boundaries, documentation burden, and absence of feedback loops. Facilitators include structured screening tools, electronic clinical decision support, and integrated training programs like the Epidemic-Ready Primary Health Care framework.

Conclusions: Empowering nurses as formal surveillance sentinels requires systematic integration of structured data collection tools, closed-loop feedback systems, and competency-based education that bridges clinical observation, specimen quality, and public health reporting.

Keywords: nursing surveillance, syndromic surveillance, outbreak detection, specimen collection, public health reporting.

Introduction

The COVID-19 pandemic exposed fundamental vulnerabilities in global health security, revealing that the interval between emergence of a novel pathogen and its formal identification—the critical window for containment—remains dangerously prolonged in even the most advanced health systems (Kluge et al., 2018; Nuzzo et al., 2020). Traditional epidemiological surveillance has relied heavily on laboratory-confirmed case reporting, a model that, while specific, introduces inevitable delays: patients must seek care, providers must suspect and order testing, specimens must be collected and transported, laboratories must process and confirm, and results must flow back through public health channels (Zeng et al., 2021; Alshamrani, 2022). During this latency, transmission continues unabated.

Positioned at the very first point of healthcare contact are nurses—in emergency department triage bays, primary care consultation rooms, school health offices, community health posts, and patients' homes. They are the first to observe the coughing child, the febrile traveler, the cluster of gastrointestinal illness in a long-term care facility. This frontline positioning creates an extraordinary, yet systematically underutilized, opportunity: nurses as sentinel

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observers for emerging infectious disease threats (Matua et al., 2015).

The concept of the nurse as sentinel extends far beyond passive observation. It encompasses the systematic collection of syndromic data during routine assessments, the cognitive recognition of patterns that deviate from expected baselines, the skilled collection of specimens that determines laboratory diagnostic accuracy, and the timely communication of findings to public health authorities (Abimanyi-Ochom et al., 2019; Zhou et al., 2022). Each of these functions represents a critical node in the surveillance chain, and each depends on the integration of nursing practice with epidemiological systems.

This narrative review examines the evidence for integrating frontline nursing observation into community-based epidemiological surveillance. We explore three interconnected domains: first, the mechanisms by which nursing assessments can contribute to real-time syndromic surveillance; second, the barriers that prevent nurses from recognizing and reporting unusual disease patterns; and third, the critical relationship between nurse-initiated suspicion, appropriate specimen collection, and laboratory confirmation rates. By synthesizing evidence across nursing, laboratory science, and public health, we propose a framework for systematically empowering nurses as formal surveillance sentinels.

The Nursing Contribution to Surveillance

Systematic Documentation as Syndromic Data

The foundation of any surveillance system is data—consistent, structured, and timely information about health events occurring in populations. Nurses generate vast quantities of such data through routine clinical documentation, yet this information has historically been siloed within individual patient records rather than aggregated for population-level awareness (Alshahrani, 2021).

The integration of structured screening tools into nursing workflows represents a significant advance in harnessing this data for surveillance purposes. In British Columbia, Canada, the Infectious Disease Risk Screening (IDRS) PowerForm embedded within the Cerner electronic health record system exemplifies this approach (Uyeki et al., 2019). Nurses document patient responses to standardized questions regarding syndromic symptoms (fever with rash, acute diarrhea, suspected viral respiratory infection), antibiotic-resistant organism risk factors, recent exposures to communicable diseases, and travel history. This documentation occurs during routine triage and admission processes across emergency departments, inpatient units, and outpatient settings.

Critically, this structured nursing documentation triggers automated responses that bridge clinical care and infection control. When a nurse documents "yes" to fever with rash, the system automatically places an airborne isolation order, ensuring immediate infection prevention. Simultaneously, the documentation sends a notification to the Infection Control Practitioner's worklist, creating a direct link between frontline nursing observation and formal surveillance follow-up (Kalil et al., 2016). This closed-loop design—where nursing data automatically generates both clinical protection and epidemiological alert—represents an ideal model for integrating nursing into surveillance systems.

The scalability of such approaches is substantial. Electronic health records increasingly capture nursing assessments in structured formats amenable to automated aggregation and analysis. Chief complaints, triage notes, vital sign trends, and nursing flowsheet data can feed into syndromic surveillance algorithms that detect aberrations from expected baselines (Mani et al., 2023). When a cluster of patients presents with fever and respiratory symptoms beyond seasonal norms, the system can generate alerts before laboratory confirmation is complete, triggering early investigation and response.

Pattern Recognition: Beyond Clinical Intuition

Beyond structured documentation, nurses contribute to surveillance through cognitive recognition of unusual patterns—what experienced clinicians describe as "gut feelings" or "clinical intuition." This function transcends simple data entry, representing sophisticated pattern recognition built on deep familiarity with expected presentations in their patient populations (Zhou et al., 2022).

A community health nurse visiting households in a defined geographic area develops an implicit baseline: the usual frequency of respiratory illness, the typical seasonal pattern of gastroenteritis, the expected number of febrile children. When these patterns deviate—when three households on the same street report similar symptoms, when an unusual presentation appears in a previously healthy individual—the nurse recognizes that something is wrong. This recognition, while difficult to quantify, represents a form of surveillance that no laboratory test can replicate (Loewenson et al., 2021).

The challenge lies in systematizing this intuitive function—creating pathways for nurses to report concerns that may not yet meet formal case definitions or diagnostic criteria. The Epidemic-Ready Primary Health Care (ERPHC) framework, implemented across 766 primary health facilities in Ethiopia, Nigeria, Sierra Leone, and Uganda, addresses this through continuous mentorship and simplified technical resources (Loewenson et al., 2021). Frontline health workers receive regular training and support in recognizing and reporting unusual health events, building both the confidence and the structured pathways to act on their observations.

The 7-1-7 target framework provides a temporal structure for this function: detect a health event within seven days of emergence, report it within one day, and respond within seven days (Pheunpha,

2023). Nurses, as the earliest point of healthcare contact, are uniquely positioned to drive detection within this timeline—but only when they are equipped with the knowledge, tools, and reporting pathways to translate observation into action.

The Laboratory Interface: Specimen Quality Determines Confirmation

Nursing observation that generates suspicion of an unusual disease is only valuable if it leads to appropriate diagnostic confirmation. At this critical interface, nursing practice directly determines laboratory accuracy. The pre-analytical phase of laboratory testing—specimen collection, handling, transport, and processing—accounts for 40-70% of all laboratory errors, and this phase is largely controlled by nursing (Mardani et al., 2020; Wei et al., 2018).

A systematic review examining nursing roles in laboratory quality found that nurse-led standardization of specimen collection and labeling protocols reduced sample rejection rates by up to 45% (Chaudhry et al., 2023). Common pre-analytical errors include misidentification (wrong patient or sample type), incorrect tube selection (affecting additive ratios and test validity), poor technique causing hemolysis, improper handling (delayed transport, temperature excursions), and incomplete or missing requisitions (Abimanyi-Ochom et al., 2019; Shamari et al., 2022).

The implications for surveillance are profound. When a nurse suspects an unusual infection—perhaps a viral hemorrhagic fever, novel influenza, or emerging vector-borne disease—the accuracy of that suspicion translates into diagnostic confirmation only through correct specimen collection. An improperly collected sample may yield false-negative results, delaying outbreak detection and potentially allowing transmission to continue unchecked. Conversely, a nurse trained in appropriate collection techniques for specific pathogens becomes the critical link between clinical suspicion and laboratory confirmation.

Interventional studies demonstrate the effectiveness of structured nursing protocols in reducing pre-analytical errors. In an interventional radiology setting, implementation of a standardized nursing specimen management protocol—including pre-procedure handoff discussion of anticipated specimens, intra-procedure specimen verification, and post-procedure final inspection—eliminated reported pre-analytical errors entirely during a 10-week testing period, compared to 15 errors in the preceding year (Nguyen & Microys, 2021). While this study focused on procedural specimens, the principles apply directly to infectious disease diagnostics: systematic verification, standardized workflows, and closed-loop communication between nursing and laboratory personnel.

Barriers to Nursing-Integrated Surveillance

Despite the clear potential of nurses as surveillance sentinels, multiple barriers prevent systematic integration of nursing observation into public health systems. These barriers operate at individual, interpersonal, institutional, and policy levels.

Individual-Level Barriers: Knowledge, Confidence, and Role Perception

Nurses frequently lack formal training in surveillance concepts, case definitions, and reporting protocols. A qualitative study of Chinese healthcare providers' perspectives on providing HIV information revealed that inaccurate knowledge and doubt about the reliability of information significantly hampered communication with patients (Zhou et al., 2022). While focused on patient education, these findings reflect broader patterns: when nurses lack confidence in their understanding of infectious diseases and surveillance requirements, they are less likely to act on observations or report concerns.

Similar findings emerged from a study of inpatient nurses' perspectives on offering HIV testing at a U.S. academic medical center (Orser et al., 2023). Nurses expressed concern that HIV testing would increase their charting burden, belief that HIV testing was not a priority for hospitalized patients, concern that obtaining consent was outside their scope of practice, misinformation about consenting requirements, and concern about offending patients. These perceptions—even when inaccurate—functioned as powerful barriers to expanding nursing involvement in HIV case detection.

The question of role boundaries is particularly significant. When nurses perceive surveillance activities as outside their legitimate scope—as "extra" work rather than core professional responsibility—engagement suffers. This perception may be reinforced by organizational cultures that prioritize immediate clinical tasks over population-level awareness, and by absence of explicit expectations or accountability for surveillance functions (Kirabira et al., 2024).

Institutional-Level Barriers: Training Gaps and Workflow Integration

Healthcare facilities frequently lack structured processes for integrating surveillance into nursing workflows. A study of vector-borne disease surveillance capacity in Papua New Guinea identified limited training, infrastructure challenges, overstretched workforce, and limited governance support as key barriers to reporting, notification, and response (Rajvanshi et al., 2022). These findings echo across diverse settings: even when individual nurses are motivated to participate in surveillance, they may lack the tools, time, and institutional backing to do so effectively.

Training gaps are particularly salient. Many nursing curricula include minimal content on public health surveillance, outbreak investigation, or the specific requirements for specimen collection for different pathogens (Lima-Oliveira et al., 2017). Continuing education opportunities in these areas are

limited, and when available, may not reach frontline nurses in community settings. The result is a workforce that possesses extraordinary observational capacity but lacks the structured knowledge to translate observation into actionable surveillance data.

Workflow integration presents additional challenges. In busy clinical environments, surveillance activities compete with immediate patient care demands. Documentation requirements, reporting forms, and communication pathways that are not seamlessly integrated into existing workflows are likely to be neglected (Jewett et al., 2021). The British Columbia IDRS system demonstrates the power of embedded workflows: surveillance-relevant documentation occurs as part of routine nursing assessment, with automated downstream actions that require no additional effort from the documenting nurse (Rees et al., 2019).

System-Level Barriers: Absence of Feedback Loops

Perhaps the most demoralizing barrier for nurses is the absence of feedback. When nurses report unusual observations or collect specimens for surveillance purposes, they rarely learn the outcomes: Was the cluster confirmed as an outbreak? Did the specimen test positive for a novel pathogen? Did public health action result from their report?

This absence of feedback creates a "black box" effect: nurses invest effort in surveillance activities without understanding their impact, reinforcing perceptions that the activities are unimportant or futile (Kirabira et al., 2024). Effective surveillance systems require closed-loop communication, where frontline reporters receive acknowledgment of their reports and, where appropriate, information about resulting investigations and outcomes. This feedback not only acknowledges individual contributions but also builds understanding of surveillance value and reinforces desired behaviors (Table 1).

Table 1: Barriers and Facilitators to Nursing-Integrated Surveillance

Level	Barriers	Facilitators	Evidence Sources
Individual	Inaccurate knowledge about disease risks and reporting requirements; lack of confidence in recognizing unusual patterns; perception that surveillance is outside nursing scope; concern about offending patients or overstepping boundaries	Competency-based education on surveillance case definitions and reporting protocols; clear articulation of surveillance as core nursing responsibility; mentorship and supportive supervision	Zhou et al., 2022; Orser et al., 2023; Kirabira et al., 2024
Interpersonal	Hierarchical barriers to communicating concerns to providers or public health authorities; lack of trust in reporting pathways; limited teamwork between nursing, laboratory, and epidemiology	Structured communication protocols (e.g., SBAR); interdisciplinary team training; designated nursing champions for surveillance	Mani et al., 2023; Orser et al., 2023
Institutional	Minimal surveillance content in nursing curricula; competing clinical priorities; lack of integrated workflows; insufficient staffing; no dedicated time for surveillance activities	Embedded screening tools in EHR (e.g., IDRS PowerForm); automated alerts and reporting; regular in-service training; dedicated infection prevention nurses	Rees et al., 2019; Jewett et al., 2021; Nguyen & Microys, 2021
Policy/System	Absence of feedback loops from public health to reporters; no formal recognition of nursing surveillance role; limited funding for community-based surveillance infrastructure	Closed-loop communication systems; national surveillance guidelines explicitly including nursing roles; investment in community-based surveillance programs	Jewett et al., 2021; Rajvanshi et al., 2022

The Laboratory Confirmation Link with Nurse-Initiated Suspicion and Specimen Quality

The ultimate value of nursing observation for surveillance depends on laboratory confirmation. A nurse may recognize an unusual cluster, but without accurate diagnostic testing, that recognition cannot translate into formal case identification or public health action. This creates a direct linkage between nursing practice and laboratory performance that has been systematically underappreciated.

The pre-analytical phase encompasses all steps from test ordering through specimen preparation for analysis. Research consistently demonstrates that this phase accounts for the majority of laboratory errors, and that nursing practice is the decisive factor in pre-analytical quality (Lima-Oliveira et al., 2017; Shamari et al., 2022). A systematic review of blood specimen rejection rates found that common causes of rejection include hemolysis (accounting for 40-70% of rejected samples), insufficient volume, clotting,

mislabeling, and inappropriate containers (Ning et al., 2016). Each of these errors is preventable through appropriate nursing practice: correct venipuncture technique minimizes hemolysis; adequate filling of tubes ensures proper blood-to-additive ratios; immediate gentle inversion mixes anticoagulants properly; strict adherence to labeling protocols eliminates misidentification; and knowledge of appropriate collection devices for specific tests ensures sample-container compatibility.

The implications for surveillance are direct and measurable. When a nurse suspects a specific pathogen—for example, performing a nasopharyngeal swab for suspected pertussis—the quality of that collection determines test sensitivity. A poorly collected swab may contain insufficient epithelial cells, yielding false-negative results despite true infection. Conversely, a nurse trained in optimal collection technique maximizes diagnostic yield, increasing the likelihood that suspect cases are correctly confirmed.

Interventional studies demonstrate that nursing education and protocol standardization significantly reduce pre-analytical errors. A meta-analysis of simulation-based training for peripheral intravenous catheterization found that structured education improved both technical skills and patient outcomes (Sandhu et al., 2017). While focused on vascular access, these findings support broader conclusions: competency-based, simulation-enhanced training improves nursing performance in technical procedures.

The SIR 2025 study of standardized nursing specimen management in interventional radiology provides more direct evidence (Nguyen & Microys, 2021). Implementation of a protocol incorporating pre-procedure handoff (discussing anticipated specimens), intra-procedure verification (confirming correct specimens in correct fixatives), and post-procedure inspection (assessing for common errors) eliminated reported pre-analytical errors during the study period. Notably, compliance with the intra-procedure verification reached 81.2%, and post-procedure confirmation reached 100%, demonstrating that structured protocols can be successfully integrated into nursing workflows.

For infectious disease surveillance, analogous protocols might include: pre-collection verification of correct specimen type for suspected pathogen; intra-collection attention to technique-specific requirements (e.g., depth of swab insertion, volume of blood required); and post-collection inspection for adequate labeling, appropriate container, and proper storage conditions prior to transport.

Nursing-Laboratory Partnerships

The quality of the nursing-laboratory interface depends not only on individual nursing practice but also on the strength of interdisciplinary partnerships. A comprehensive review of laboratory-nursing partnerships in managing multidrug-resistant organisms emphasized that effective communication and collaboration between nurses and laboratory personnel are essential for timely identification, isolation, and treatment of infected patients (Sandhu et al., 2017).

These partnerships require structured communication pathways, shared understanding of each other's roles and constraints, and mutual respect for complementary expertise. When nurses understand laboratory requirements for specimen quality—why certain tubes are required, why transport timing matters, why specific labeling conventions are essential—they are more likely to adhere to protocols. When laboratory personnel understand the clinical context in which specimens are obtained—the challenges of collecting from certain patient populations, the time pressures of emergency settings, the limited resources in community clinics—they can provide more useful guidance and support.

Training and System Integration: Building the Sentinel Workforce

Realizing the potential of nurses as surveillance sentinels requires systematic investment in training, tools, and system integration. Multiple initiatives demonstrate effective approaches to building this capacity.

The Community-Based Surveillance (CBS) training program implemented in Mardan District, Pakistan, provides a model for building frontline surveillance capacity at scale (Pradhan et al., 2023). Between October 2025, 271 Lady Health Workers, supervisors, lab technicians, and community volunteers completed cascade training across 20 Union Councils. The six-day program equipped participants with skills to detect unusual health patterns early and report them quickly through established channels.

The training emphasized practical competencies: using CBS reporting tools, applying case definitions, following data flow mechanisms for priority diseases, and hands-on practice with DHIS2, the digital system for health data collection and sharing in Pakistan. Role-plays and group discussions translated theory into real-world outbreak scenarios, strengthening teamwork and communication between field workers and health facilities. Crucially, the training introduced the 7-1-7 approach, framing surveillance within specific temporal targets for detection, reporting, and response (Jafree et al., 2021).

This initiative builds on the Train-the-Trainer model, where master trainers (district and provincial public health officers) received initial training and materials, then cascaded standardized surveillance training to frontline staff. Ongoing support—including online review meetings, technical guidance, and assistance with data interpretation—maintains momentum and addresses implementation challenges.

Epidemic-Ready Primary Health Care

The Epidemic-Ready Primary Health Care (ERPHC) framework, implemented by Resolve to Save Lives across four African countries, offers another comprehensive approach (Lal & Schwalbe, 2023). The framework integrates three technical areas—surveillance, infection prevention and control, and case management—at the point of service delivery. Key components include integration and simplification of technical resources for frontline health workers, reducing the cognitive burden of navigating multiple guidelines and reporting systems.

Continuous capacity strengthening through regular mentorship, building knowledge, skills, and confidence to detect, protect, and treat. This ongoing support recognizes that one-time training is insufficient; sustained improvement requires embedded mentorship relationships. Just-in-time training via mobile phone-based packages (Clinical Integrated Disease Surveillance and Response, cIDSR), ensuring health workers have access to updated information during periods of increased risk. Mobile delivery overcomes barriers of geography and time, reaching workers in even the most remote settings.

Strengthened public health emergency management at facility and subnational levels, ensuring continuity of essential services during health threats. Bidirectional communication and coordination between primary health facilities and public health authorities, facilitating rapid detection, notification, and response. The ERPHC approach explicitly recognizes that surveillance cannot be separated from clinical care—that the same nurses providing immunizations, treating malaria, and delivering babies are also the first line of outbreak detection. Building their capacity simultaneously for clinical excellence and surveillance function creates efficiency and sustainability.

Electronic Health Record Integration

Technology offers powerful tools for integrating nursing surveillance into formal systems. The British Columbia IDRS example demonstrates how structured documentation can trigger automated isolation orders and infection control notifications (Rees et al., 2019). Beyond this, electronic health records can support surveillance through automated syndromic surveillance algorithms that analyze nursing documentation (chief complaints, triage notes, vital signs) for aberrations from expected baselines, generating alerts when clusters exceed thresholds. Clinical decision support that prompts nurses to ask targeted questions based on presenting symptoms and epidemiological risk factors (e.g., travel history for febrile patients, exposure questions for respiratory symptoms). Streamlined reporting that automatically populates public health report forms from documented data, reducing duplication and minimizing reporting burden.

Bidirectional data exchange that provides nurses with feedback on surveillance outcomes—when a reported cluster is investigated, when a specimen yields a confirmed diagnosis, when public health action results from frontline observation. The STRIVE-Tupaia platform in Papua New Guinea represents an innovative approach to electronic real-time data aggregation, enabling healthcare workers to review, interpret, and respond to febrile illness, molecular diagnostic, and vector surveillance data (Rajvanshi et al., 2022). By making surveillance data accessible and actionable at the point of care, such platforms empower nurses to see themselves as active participants in surveillance rather than passive data collectors (Table 2).

Table 2: Framework for Nursing-Integrated Surveillance System

Component	Key Elements	Implementation Strategies	Outcome Measures
Structured Data Collection	Standardized screening questions embedded in routine nursing workflows; age-appropriate tools; mandatory fields for key surveillance elements	EHR integration with automated prompts; paper-based tools for low-resource settings; regular review and update of questions based on emerging threats	Completion rates for surveillance questions; data quality (completeness, accuracy); automated alert triggers
Clinical Decision Support	Real-time guidance on case definitions; automated isolation orders based on responses; reminders for appropriate specimen collection	Embedded reference text; pop-up alerts; integration with laboratory ordering systems	Time to isolation initiation; appropriate specimen collection rates; nurse satisfaction with support tools
Specimen Management Protocol	Standardized collection techniques; verification steps; quality checks; transport requirements	Competency-based training; visual aids at collection points; specimen quality feedback to nursing units	Specimen rejection rates; hemolysis rates; correct labeling rates; turnaround times
Reporting Pathway	Clear, simple reporting mechanism; minimal documentation burden;	One-click reporting from EHR; dedicated hotline; trained reporting focal points at facility level	Time from detection to report; proportion of unusual events reported; reporter satisfaction

	multiple reporting channels (electronic, phone, paper)		
Feedback Loop	Acknowledgment of reports; investigation outcomes; epidemiological updates to frontline nurses	Automated acknowledgment messages; regular surveillance bulletins; facility visits by epidemiology staff	Nurse awareness of surveillance outcomes; sustained reporting over time; perceived value of reporting
Training & Mentorship	Pre-service education on surveillance; continuing education; regular on-site mentorship; just-in-time updates	Curriculum integration; cascade training models; mobile learning platforms; designated mentors	Surveillance knowledge scores; confidence in recognition and reporting; mentorship contact frequency
Governance & Accountability	Clear expectations for nursing surveillance role; dedicated time for surveillance activities; recognition and incentives	Job descriptions including surveillance; performance metrics; awards for outstanding contributions; career pathways	Integration of surveillance into job descriptions; time allocated for surveillance; nurse engagement metrics

Conclusion and Future Directions

This review has mapped the multiple pathways through which nursing observation can contribute to epidemiological surveillance: systematic documentation generating syndromic data, cognitive recognition of unusual patterns, and skilled specimen collection enabling laboratory confirmation. The evidence demonstrates that nurses are not merely passive data collectors but active sentinels whose contributions are essential for timely outbreak detection.

Yet the evidence also reveals persistent gaps between potential and reality. Barriers at individual, institutional, and system levels prevent nursing observation from being systematically integrated into surveillance systems. Training gaps leave nurses unprepared to recognize and report unusual patterns. Workflow burdens discourage engagement with reporting systems. Absence of feedback loops reinforces perceptions that surveillance activities are unimportant. And the critical nursing-laboratory interface remains vulnerable to pre-analytical errors that compromise diagnostic accuracy.

The way forward requires a systems-level approach that addresses each of these barriers. Structured data collection tools embedded in electronic health records can capture surveillance-relevant information without adding documentation burden. Automated clinical decision support can guide nurses through appropriate responses to suspicious presentations. Competency-based training—delivered through cascade models, mobile platforms, and continuous mentorship—can build the knowledge and confidence needed for effective surveillance. Standardized specimen management protocols can reduce pre-analytical errors and improve diagnostic yield. And closed-loop communication systems can provide the feedback that sustains engagement and reinforces the value of nursing surveillance.

Critically, these interventions cannot be implemented in isolation. The ERPHC framework demonstrates the power of integrated approaches that simultaneously address surveillance, infection prevention, and case management while strengthening bidirectional communication between frontline facilities and public health authorities (Frieden et al., 2023). The Pakistan CBS training illustrates the scalability of cascade models that equip master trainers to reach hundreds of frontline workers with standardized surveillance competencies (Yazdani et al., 2021). The British Columbia IDRS system shows how technology can transform routine documentation into automated surveillance action (Barajas et al., 2018).

Several priorities for future research emerge from this synthesis. First, there is a need for rigorous evaluation of interventions designed to enhance nursing surveillance capacity, measuring not only process outcomes (reporting rates, specimen quality) but also ultimate public health impact (time to outbreak detection, outbreak size, mortality averted). Second, implementation science research should examine how successful models transfer across contexts—from high-resource academic medical centers to low-resource community health posts, from stable health systems to humanitarian emergencies. Third, the nursing-laboratory interface deserves focused investigation, identifying the specific communication structures, quality metrics, and feedback mechanisms that optimize diagnostic accuracy for surveillance purposes. Fourth, as artificial intelligence and machine learning increasingly enable automated analysis of clinical data, research must examine how these tools can augment—rather than replace—nursing observation, supporting pattern recognition while preserving the clinical judgment that distinguishes the expert nurse.

The COVID-19 pandemic demonstrated, with devastating clarity, that the world remains

dangerously unprepared for emerging infectious disease threats. Strengthening surveillance is not primarily about building more sophisticated laboratories or deploying more advanced technology—though these have their place. It is about empowering the people who are already there, already observing, already connected to communities: the nurses at the front line. Recognizing nurses as formal surveillance sentinels, investing in their training and tools, integrating their observations into public health systems, and closing the loop with feedback and acknowledgment—these are not merely incremental improvements. They are fundamental to building the epidemic-ready health systems that the next pandemic will demand.

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