A Homegrown Digital Solution for Ebola Healthcare Worker Monitoring: Development and Drill Implementation in an NYC Health System

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Abstract

As global Ebola virus disease (EVD) outbreaks continue to emerge, protecting healthcare workers (HCWs) remains a cornerstone of health security. Lessons from the 2014–2016 West Africa epidemic, during which two U.S. nurses were infected and 10 patients were repatriated to the United States for care, highlighted gaps in post-exposure monitoring. More recently, the 2024 case of travel-associated Lassa fever in Iowa reaffirmed the occupational risks faced by frontline clinicians: Among 180 disease contacts, 172 (96%) were healthcare-associated, and risk classification correlated with personal protective equipment lapses. These events underscore a practical reality in healthcare operations: Even a single uncertainty about an exposure can generate days to weeks of follow-up work across occupational health, infection prevention, and supervisory teams.

To strengthen preparedness, NYC Health + Hospitals developed a homegrown digital solution to monitor HCWs exposed to suspected or confirmed Ebola and other viral hemorrhagic fevers. Built in 2022, the solution automates twice-daily symptom reporting, alerting, and escalation workflows for occupational health services (OHS). A 33-day systemwide drill in 2023 evaluated usability, timeliness, and coordination. The solution achieved >95% compliance, transmitted alerts within one minute, and enabled OHS follow-up within 15 minutes. Users rated the interface intuitive and efficient. In drill use, the system also captured operationally important near miss moments, such as

a missed check-in during routine monitoring, that are easy to overlook in manual tracking but often consume disproportionate staff time when discovered late.

The NYC Health + Hospitals Ebola HCW monitoring solution proved operationally feasible, user-friendly, and adaptable, demonstrating a scalable, sustainable approach to biopreparedness for health systems worldwide.

Introduction

Ebola virus disease (EVD) remains a recurring global threat, with multiple outbreaks reported in Africa since its identification in 1976[1] and periodic international exportation events.[1,2] The 2014–2016 West Africa epidemic exposed critical vulnerabilities in healthcare worker protection, including inconsistent post-exposure monitoring.[3] In the United States, two nurses were infected while caring for an Ebola patient in Texas, underscoring the need for structured, technology-enabled monitoring systems.[4] That episode also illustrated a communication challenge that persists in outbreak response: Information must move quickly not only to bedside teams, but also to occupational health services (OHS) staff responsible for monitoring potentially exposed personnel over time.

A recent case of travel-associated Lassa fever in Iowa[5] in October–November 2024 illustrated ongoing occupational risk even outside outbreak zones. Among 180 identified contacts, nearly all were healthcare-associated, and risk classification hinged on personal protective equipment (PPE) adherence. Such incidents reinforce the need for systematic, real-time exposure monitoring and escalation mechanisms. In practical terms, this means that seemingly small details, such as whether eye protection was worn continuously or whether a donning/doffing step was interrupted, can determine both risk categorization and the intensity of follow-up.

NYC Health + Hospitals, the nation's largest municipal health system and one of 13 federally designated Regional Emerging Special Pathogen Treatment Centers (RESPTC), developed a secure digital monitoring platform to ensure rapid symptom tracking, automated escalation, and efficient reporting during potential Ebola or viral hemorrhagic fevers (VHF) exposures.

Digital Solution Development

In 2022, the NYC Health + Hospitals System Biopreparedness Program, recognized internationally for infectious disease preparedness, assembled a multidisciplinary team of epidemiologists, occupational health clinicians, infection preventionists, and software engineers to design a secure, adaptable monitoring platform. A key design principle emerged early from these cross-functional discussions: the tool had to work not only for highly specialized biocontainment staff, but also for personnel such as environmental services, transport, and support staff who may have less frequent exposure to infectious disease monitoring workflows.

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The solution was built per Centers for Disease Control and Prevention (CDC) and World Health Organization (WHO)[6,7] guidance for healthcare worker (HCW) monitoring during VHF responses. It automates exposure tracking, integrates with existing OHS workflows, and ensures secure communication. This emphasis on workflow integration was deliberate; in prior responses and drills, staff often relied on phone calls, spreadsheets, and email chains, which can be effective for small numbers but become difficult to sustain when monitoring periods extend to 14–21 days with twice-daily check-ins.

Core Functions

- Twice-daily symptom survey: HCWs log temperature and symptoms every 12 hours via web or mobile interface.
- Automated alerts: Any symptomatic entry triggers an immediate alert to OHS for follow-up and isolation guidance.
- Nonresponse escalation: Missed surveys prompt reminders. After 24 hours without response, OHS is alerted; after three unresolved attempts (including outreach to an emergency contact), the supervisor is notified.
- Compliance dashboard: Displays real-time reporting rates, alerts, and follow-up status across the health system.
- Secure data sharing: Enables information sharing to public health authorities when required, with full HIPAA compliance.

The solution is hosted entirely within the NYC Health + Hospitals secure network, ensuring data security and compliance requirements. Monitoring intervals can be customized for 14 or 21 days, depending on pathogen risk. The design prioritizes scalability for adaptation to Marburg virus disease, Lassa fever, and other high-consequence pathogens. From an administrative perspective, this flexibility is important because different pathogens and different public health guidance can require different monitoring durations and symptom triggers, and hardcoding a single pathway can quickly make a tool obsolete.

The system creates a shared operational picture for OHS, infection prevention, and supervisors, reducing uncertainty about who has reported, who needs outreach, and what actions have already been taken.

Drill Implementation (2023)

A 33-day systemwide simulation was conducted across multiple NYC Health + Hospitals sites, including Bellevue Hospital (RESPTC), Central Office Emergency Management, and Lincoln Hospital, to evaluate usability, escalation efficiency, and cross-departmental coordination through four mock exposure scenarios. The scenarios were intentionally selected to reflect the range of personnel who may be involved in a special pathogen response, from direct clinical care staff to support roles, because real-world exposure monitoring programs must function across job categories and shifts.

Scenario 1: Environmental Services Exposure

An environmental services worker entered a suspected Ebola patient's room without PPE. The worker was monitored for 10 days. On Day 6, a missed symptom survey triggered automated escalation. After three failed contact attempts, including an emergency contact call, the supervisor was notified, validating the escalation workflow. This scenario was particularly useful operationally because it tested a common real-world challenge: nonresponse does not necessarily indicate illness, but it still requires rapid verification to avoid delayed recognition of a potentially symptomatic exposure.

Scenario 2: Physician Exposure

A physician assigned to the biocontainment unit cared for a confirmed Ebola patient. On Day 7, the physician reported nausea and weakness, automatically alerting OHS. The staff member was promptly evaluated and cleared. When reexposed during subsequent care, the system automatically reset the 21-day monitoring period, demonstrating dynamic recalibration. This scenario highlighted an important point for users and administrators alike: Symptoms entered into the system are treated as actionable signals rather than assumptions of disease, allowing rapid evaluation while minimizing ambiguity about next steps. It also demonstrated a frequently misunderstood operational rule in VHF monitoring, that a new qualifying exposure can restart the monitoring clock, something that is easy to miss in manual tracking when staff rotate across repeated patient encounters.

Scenario 3: Infection Prevention Exposure

An infection prevention professional entered the room of a patient later confirmed to have Ebola. The individual completed 21 days of twice-daily monitoring without incident, confirming reliability for routine use. Although clinically uneventful, this scenario mirrored a high-frequency administrative reality: Many monitoring episodes are precautionary and remain asymptomatic, yet they still require consistent documentation, reminders, and closure tracking over the full monitoring period.

Scenario 4: Nursing Exposure

A registered nurse providing direct care to a confirmed patient completed 21 days of monitoring with 100% compliance, confirming user acceptability in clinical settings. This scenario was informative because it demonstrated sustained adherence during a full monitoring interval in a frontline clinical role, supporting the feasibility of the workflow beyond short test windows or single-shift participation.

Results

Compliance and Response Rates

Overall, survey completion exceeded 95%. All nonresponses were detected within the programmed two-hour alert window, and escalation steps proceeded as designed. From an operations standpoint, this high completion rate is notable because the drill required repeated check-ins over days to weeks, a pattern in which adherence typically declines without reminders and visible follow-up processes.

Alert Performance

- Symptom alerts sent to OHS immediately upon submission.
- OHS follow-up averaged 15 minutes from alert receipt.
- Nonresponse alerts triggered calls and escalations according to protocol.

Usability and Feedback

Participants described the interface as intuitive, requiring less than one minute to complete. OHS staff highlighted dashboard visibility and automated time stamps as valuable for audit and reporting. Recommended enhancements included:

- Mobile push notifications
- Offline functionality
- "Off-shift" pause option for nonworking hours

Discussion

This initiative demonstrates how a large urban health system can operationalize biopreparedness through internally developed digital solutions that integrate seamlessly into existing occupational health and infection control systems. Importantly, the drill findings suggest that the value of digital monitoring extends beyond symptom collection itself. The system creates a shared operational picture for OHS, infection prevention, and supervisors, reducing uncertainty about who has reported, who needs outreach, and what actions have already been taken.

Global Relevance

The solution's modular design and minimal infrastructure requirements make it adaptable for diverse health systems, including low-resource settings. Its principles—automation, escalation, and compliance monitoring—can be applied to Marburg virus disease, Lassa fever, or emerging pathogens requiring post-exposure surveillance. In many settings, the immediate challenge is not the absence of clinical expertise but the burden of maintaining reliable follow-up across dozens of contacts over multiple weeks. A simple, rules-based monitoring workflow can therefore provide outsized benefit even before deeper interoperability is achieved.

Key Advantages

1. Operational integration: Fully aligned with OHS workflows and infection control protocols.
2. Automated escalation: Ensures timely follow-up with minimal manual oversight.
3. Scalability: Easily repurposed for other high-consequence pathogens.
4. Data security: Hosted within the health system's secure network with appropriate safeguards and guardrails.
5. Validation through simulation: The 2023 drill confirmed usability and reliability in a real-world hospital environment.
6. Human-factors fit: The drill showed the platform could support different staff roles (e.g., environmental services, nursing, physicians, infection prevention) with the same core workflow while preserving role-appropriate escalation.

Limitations

- Small-scale exercise limited statistical inference.
- Full interoperability with local and state public health systems remains under development.
- Sustained compliance during prolonged real-world monitoring requires reinforcement.

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Implications for Global Health Systems

Digital monitoring platforms can close critical gaps in post-exposure follow-up, particularly where manual tracking is resource-intensive. For countries establishing or strengthening biopreparedness programs, integrating such tools with electronic health records or REDCap databases can improve timeliness, accuracy, and coordination across agencies. Even in highly resourced systems, the anecdotal experience from drills and responses is consistent: Manual systems often depend on a small number of individuals remembering when to call, document, and escalate. Digitizing those repetitive steps helps preserve human attention for clinical judgment and risk assessment.

Lessons Learned and Future Directions

- Automation complements, not replaces, human oversight. OHS review remains crucial for contextual judgment.
- User experience drives compliance. Simplicity, reminders, and clear escalation build trust and consistency.
- Interoperability is the next frontier. Integrating with laboratory and health department databases will enable unified outbreak response.
- Regular drills sustain readiness. Routine exercises reinforce familiarity and ensure systems remain operational.

Initial Challenges

- Translating disease-specific operational logic into intuitive workflows (e.g., exposure/re-exposure rules, monitoring status changes, and escalation pathways).
- Evolving requirements such as public health guidance, and internal policies changed.
- Extensive collaborative testing across technical, clinical, and operational teams to confirm critical requirements and end-to-end functionality.

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Conclusion

The NYC Health + Hospitals Ebola HCW monitoring solution represents a practical, scalable innovation that strengthens health system readiness and workforce protection. As Ebola and other VHFs continue to emerge globally, proactive digital monitoring enables earlier detection, faster response, and improved HCW safety, cornerstones of modern biopreparedness. The drill scenarios also reinforce a broader implementation lesson: Preparedness tools are most credible to frontline users when they can handle ordinary operational friction, missed check-ins, repeat exposures, and after-hours escalation as reliably as they handle idealized workflows.

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Notes

This manuscript describes development and implementation of a health system preparedness monitoring platform and results from a systemwide drill/simulation. No patient data were used.

The monitoring program is hosted within NYC Health + Hospitals' secure network and operational data are not publicly available.

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