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# Infectious Disease Prevention and Vaccination Programs in Military Populations: Lessons from Recent Global Outbreaks

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## Abstract

**Background:** Military populations face unique infectious disease risks due to close-quarter living, global deployments, and operational exposure to endemic pathogens. Recent global outbreaks—including COVID-19, mpox, and Ebola—have tested military health systems and revealed critical lessons for prevention and vaccination programs. **Aim:** This narrative review synthesizes evidence on infectious disease prevention and vaccination programs in military populations, examining lessons learned from recent global outbreaks and their implications for social work, nursing, emergency response, and health management. **Methods:** A narrative synthesis of peer-reviewed literature, government reports, and organizational case studies from 2015–2026 was conducted, focusing on military vaccination efforts, outbreak responses, and health system adaptations. **Results:** Key findings highlight the military's dual role as both a vulnerable population requiring protection and a strategic asset for public health response. Successful programs demonstrate the importance of civil-military coordination, specialized vaccine care for adverse events, adaptive vaccination strategies, and integration of social and behavioral sciences. Challenges include vaccine hesitancy, logistical barriers in deployment settings, and trust deficits with local communities. **Conclusion:** Military infectious disease prevention requires multidisciplinary approaches combining clinical excellence, operational readiness, and community engagement. Lessons from recent outbreaks inform frameworks for future pandemic preparedness across health disciplines.

**Keywords:** military health, vaccination programs, infectious disease prevention, pandemic preparedness, civil-military coordination, vaccine hesitancy

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## Introduction

Military populations occupy a unique position at the intersection of public health and national security. By virtue of their operational requirements, service members experience distinctive infectious disease risks that demand specialized prevention and vaccination strategies (1,2). The convergence of close-quarter living environments, international deployments to diverse ecological zones, and exposure to both endemic and emerging pathogens creates a vulnerability profile substantially different from civilian populations (3,4). Recent global outbreaks—COVID-19, mpox, and Ebola—have starkly illuminated these vulnerabilities while simultaneously demonstrating the military's potential as a strategic asset in pandemic response (5,6).

The COVID-19 pandemic, which official records cite as causing approximately 5.42 million direct deaths during 2020–2021, with the World Health Organization estimating 14.83 million excess deaths globally (7), exposed the fragility of health systems worldwide and the critical importance of vaccination as a medical countermeasure (8,9). For military organizations, the pandemic necessitated rapid adaptation of existing vaccination infrastructure, innovative approaches to mass immunization, and unprecedented collaboration with civilian health authorities (10,11). The subsequent mpox outbreaks of 2022 and 2024, declared Public Health Emergencies of International Concern, presented distinct challenges characterized by targeted transmission patterns and the emergence of more virulent viral strains (12,13). The 2014–2016 West African Ebola epidemic, meanwhile, highlighted the complex sociocultural dimensions of outbreak response in fragile health systems (14,15).

This narrative review examines infectious disease prevention and vaccination programs in military populations through the lens of recent global outbreaks. We synthesize evidence from peer-reviewed literature, organizational case studies, and government reports to identify lessons relevant to social work, nursing, emergency response, and health management (16,17). The review addresses three interconnected domains: the unique infectious disease vulnerabilities of military populations, the evolution of military vaccination programs in response to emerging threats, and the implications of recent outbreaks for multidisciplinary practice (18,19).

Understanding these dynamics is essential not only for protecting military personnel but also for leveraging military capabilities in broader public health emergencies (20,21). As nations increasingly recognize the interconnectedness of global health security, the lessons from military experiences with infectious disease prevention offer valuable insights for health systems worldwide (22,23).

## Unique Infectious Disease Vulnerabilities of Military Populations

### Epidemiological Risk Factors

Military populations experience a convergence of epidemiological risk factors that distinguish them from civilian groups and amplify their susceptibility to infectious diseases (1,2). Close-quarter living arrangements in barracks, ships, and field encampments facilitate rapid person-to-person transmission of respiratory pathogens (3,11). The frequent movement of personnel across geopolitical boundaries increases exposure to regional endemic diseases and contributes to the global dissemination of emerging pathogens (5,4). Service members often operate in resource-limited environments where local health infrastructure may be compromised, creating additional barriers to disease prevention and treatment (6,10).

The demographic composition of military forces—predominantly young, healthy adults—creates a paradox in infectious disease management (8,17). While younger populations generally experience

lower morbidity from infections, their high mobility and social connectivity can render them efficient vectors for disease transmission (12,16). This demographic profile also means that military outbreak responses must account for unique occupational demands, including physical fitness requirements, deployment schedules, and the potential for mission degradation due to illness (18,21).

Furthermore, military personnel frequently encounter environmental conditions that compromise immune function (19,23). Sleep deprivation, physical exhaustion, psychological stress, and nutritional inadequacies commonly experienced during training and operations can increase susceptibility to infection and reduce vaccine efficacy (20,22). These factors collectively create a complex risk environment that requires comprehensive, multidisciplinary prevention strategies (9,14).

## Operational Exposures and Deployment-Related Risks

Deployment represents the most significant infectious disease risk period for military personnel (13,15). Service members deployed to tropical regions face exposure to vector-borne diseases, including malaria, dengue, and Zika virus (11,12). Deployments to areas with poor sanitation infrastructure increase risks of enteric infections and waterborne diseases (8,10). The 2014 West African Ebola outbreak demonstrated how military personnel in support roles could become vectors for disease transmission, requiring the implementation of strict infection control protocols and specialized medical evacuation systems (14,15).

Humanitarian and peacekeeping missions introduce additional infection risks through extended community engagement (6,19). Military medical personnel working in civilian hospitals and clinics during outbreaks face dual hazards of occupational exposure and potential contribution to healthcare-associated transmission (3,21). The COVID-19 pandemic revealed that even routine deployments could accelerate viral spread, with military ships and bases becoming early epicenters requiring immediate public health interventions (4,16).

Sexual networks, both within military communities and with local populations, present another dimension of infectious disease risk (20,22). The mpox outbreaks of 2022 and 2024, predominantly transmitted through close physical contact, including sexual networks, disproportionately affected young adult populations analogous to military demographics (12,13). This highlights the need for comprehensive prevention approaches addressing behavioral as well as environmental risk factors (5,18).

## Psychological and Behavioral Dimensions

The psychological burden of military service significantly influences infectious disease prevention behaviors (2,23). Combat exposure, operational stress, and deployment-related trauma can contribute to risk-taking behaviors that increase infection vulnerability (1,17). Research has demonstrated higher rates of substance use, sexually transmitted infections, and inconsistent preventive healthcare engagement among service members with deployment-related mental health conditions (9,11).

Trust in military leadership and medical authorities plays a crucial role in vaccination acceptance (10,16). Studies of COVID-19 vaccine uptake among U.S. service members revealed that trust in command and confidence in military medicine were stronger predictors of vaccination than individual health beliefs (8,19). Conversely, experiences of medical mistreatment, including historical abuses in military medical research, have contributed to vaccine hesitancy among minority service members (12,21).

The collective nature of military identity creates both opportunities and challenges for health behavior change (3,18). Unit cohesion can facilitate prosocial preventive behaviors, as service members adopt protective measures to maintain unit readiness and protect their colleagues (5,6). However, the same peer dynamics can promote resistance to medical interventions perceived as unnecessary or incompatible with military culture (22,4). Understanding these psychological and social dimensions is essential for designing effective vaccination programs (14,20).

## Evolution of Military Vaccination Programs

### Historical Development and Traditional Vaccination Protocols

Military vaccination programs have a long history dating to the American Revolutionary War when George Washington mandated smallpox inoculation for Continental Army recruits (2,14). Since then, military medicine has been at the forefront of vaccine development and implementation, driven by the need to protect forces during conflicts and deployments (1,9). The establishment of the U.S. Army Medical Research Institute of Infectious Diseases and comparable organizations globally reflects the military's sustained commitment to vaccine research (8,10).

Traditional military vaccination protocols have focused on diseases endemic to deployment regions and those with epidemic potential in close-quarter environments (11,12). Routine immunizations include adenovirus, influenza, tetanus, diphtheria, pertussis, and measles-mumps-rubella, with additional vaccines based on deployment location (3,21). The anthrax and smallpox vaccination programs initiated in response to bioterrorism concerns represent the most significant military-specific vaccination mandates (5,18).

These traditional programs have faced implementation challenges related to vaccine supply chain management, adverse event monitoring, and religious or medical exemptions (4,16). The anthrax vaccine, in particular, generated significant controversy due to perceived side effects and mandatory administration, contributing to vaccine hesitancy among service members (13,17). These historical experiences provide important context for understanding responses to newer vaccines introduced during recent outbreaks (19,23).

### Adaptation to Emerging Infectious Disease Threats

The twenty-first century has witnessed a succession of emerging infectious disease threats that have challenged traditional military vaccination approaches (22,24). The 2009 H1N1 influenza pandemic prompted the development of military pandemic response plans that would later inform COVID-19 strategies (6,14). The 2014–2016 Ebola outbreak necessitated the rapid deployment of military medical teams and the development of experimental vaccines under emergency use authorizations (12,15).

The COVID-19 pandemic represented the most significant test of military vaccination infrastructure since the Cold War era (8,11). Military health systems rapidly established mass vaccination clinics, leveraging existing medical infrastructure and personnel (3,25). The U.S. Department of Defense achieved over 90% vaccination rates among active-duty service members by mid-2021, demonstrating the effectiveness of systematic approaches (4,21). However, the vaccination mandate was controversial and faced legal challenges, highlighting tensions between operational necessity and individual liberties (5,16).

Military research organizations made substantial contributions to COVID-19 vaccine development and testing (1,9). The U.S. Army participated in clinical trials for multiple vaccine candidates and conducted studies on vaccine efficacy and safety in military populations (18,19). This research demonstrated that mRNA vaccines were highly

effective in preventing COVID-19 among service members, although breakthrough infections remained a concern (13,17).

### Novel Vaccination Strategies and Technologies

Recent outbreaks have accelerated the adoption of novel vaccination strategies and technologies in military settings (2,23). The development of mRNA vaccines during COVID-19 established a platform that can be rapidly adapted to emerging threats, potentially reducing vaccine development timelines from years to months (22,24). Military research organizations have invested in mRNA technology for future use in both existing disease prevention and potential biothreat countermeasures (6,14).

Pre-exposure prophylaxis approaches, including the use of monoclonal antibodies alongside traditional vaccines, have gained attention in military medicine (4,12). The mpox outbreaks highlighted the value of ring vaccination strategies—targeted immunization of contacts of confirmed cases—that have been adapted for military settings (3,13). This approach is particularly useful for emerging outbreaks where vaccine supply may be limited initially (8,15).

Digital health technologies are transforming vaccination program management and monitoring (1,25). Electronic health records and vaccination tracking systems enable real-time monitoring of vaccination status and adverse event reporting (21,26). Deployment of mobile vaccination clinics and telemedicine consultations during COVID-19 demonstrated the potential of technology-enabled approaches in military settings (9,27). Artificial intelligence and predictive modeling are being explored to identify at-risk populations and optimize vaccination deployment (5,19).

## Lessons from Recent Global Outbreaks

### COVID-19: System Stress and Adaptation

The COVID-19 pandemic exposed both strengths and vulnerabilities of military health systems (17,28). Military vaccination programs demonstrated remarkable agility in scaling up mass immunization operations while maintaining essential military functions (6,23). However, the pandemic also revealed fragmentation between military and civilian health systems, highlighting the importance of robust civil-military coordination frameworks (22,24).

The experience of COVID-19 in military populations generated important data on vaccine effectiveness and safety (12,14). Studies on military personnel provided evidence of waning immunity and the need for booster doses, informing national and international policy recommendations (3,26). Research conducted in military settings also demonstrated the value of rapid diagnostic testing as a complementary infection control measure (4,8).

The psychological impact of pandemic restrictions on military personnel emerged as a critical concern (13,25). Deployment delays, separation from families, and prolonged operational stress during the pandemic contributed to mental health deterioration requiring intervention (9,21). Social workers and mental health professionals played essential roles in supporting service members and their families during this period, offering lessons for future pandemic preparedness (19,27).

### Mpox: Targeted Transmission and Vaccine Equity

The mpox outbreaks of 2022 and 2024 highlighted the importance of targeted vaccination strategies for diseases with defined transmission pathways (1,2). Unlike COVID-19, which required universal vaccination approaches, mpox control could be achieved through ring vaccination of contacts and high-risk populations (5,15). This distinction has significant implications for military vaccination programs, which must balance comprehensive protection with efficient resource utilization (6,24).

The mpox experience underscored the importance of addressing health inequities, as outbreaks

disproportionately affected marginalized populations (12,13). In military contexts, this lesson translates to careful consideration of how vaccination programs may differentially impact service members based on race, gender, sexual orientation, and socioeconomic status (17,23). Social work perspectives are essential for identifying and addressing barriers to equitable vaccine access (22,26).

The evolution of the mpox virus and the emergence of more virulent strains in 2024 demonstrated the ongoing threat of viral evolution and the need for adaptive vaccination strategies (8,28). Military medical surveillance systems must remain vigilant for emerging variants and be prepared to modify vaccine recommendations accordingly (21,25). The mpox outbreak also highlighted the importance of vaccination acceptance in specific at-risk military subgroups (14,27).

### Ebola: Civil-Military Coordination and Community Engagement

The 2014–2016 West African Ebola epidemic provided critical lessons in civil-military coordination and community engagement that have informed subsequent outbreak responses (4,29). Military medical teams deployed to Liberia, Sierra Leone, and Guinea provided essential healthcare infrastructure and personnel, yet their effectiveness depended significantly on relationships with local communities and international partners (1,9). The trust deficit between military organizations and local communities represented a persistent challenge (5,19).

Community engagement emerged as essential for successful outbreak control in the Ebola response (13,15). Military forces that worked through local leaders and respected cultural practices achieved better outcomes in case finding and vaccination acceptance (6,12). This lesson has been integrated into subsequent military public health planning, with social workers playing key roles in community liaison (2,23).

The Ebola experience also highlighted the importance of infection prevention and control in military healthcare settings (8,25). Military medical personnel required specialized training in personal protective equipment use and biosafety procedures (29,30). The development of Ebola vaccines during this outbreak demonstrated the potential of accelerated vaccine development through international collaboration and public-private partnerships (14,17).

### Synthesis of Outbreak Lessons

The synthesis of lessons from COVID-19, mpox, and Ebola reveals several cross-cutting themes that inform military vaccination programs. Table 1 summarizes the key lessons from each outbreak, their implications for military practice, and supporting references. The table highlights that while each outbreak presented unique challenges, common themes emerged around the need for flexible vaccination protocols, targeted strategies for specific transmission patterns, community engagement, and multidisciplinary collaboration.

**Table 1: Key Lessons from Recent Global Outbreaks for Military Vaccination Programs**

| Outbreak | Key Lessons | Implications for Military Practice | References |
|---|---|---|---|
| **COVID-19 (2020–2023)** | System agility, mass vaccination capacity, and civil-military coordination needs | Flexible vaccination protocols, surge capacity planning, and formal coordination agreements | 3,8,26 |
| **Mpox (2022–2024)** | Targeted vaccination, addressing health inequities, and behavioral risk factors | Ring vaccination strategies, equity-focused outreach, behavioral health integration | 12,13,28 |
| **Ebola (2014–2016)** | Community engagement, trust-building, and infection control | Community liaison roles, cultural competency training, and enhanced PPE protocols | 14,15,29 |
| **Combined Lessons** | Multidisciplinary collaboration, adaptive strategies, and technology integration | Interprofessional teams, scenario planning, and digital health platforms | 5,6,23 |

As Table 1 demonstrates, the COVID-19 pandemic taught military health systems the importance of agility and surge capacity, while mpox highlighted the value of targeted, equity-focused approaches. The Ebola experience emphasized community trust-building as foundational to outbreak response. Collectively, these lessons point toward the integration of multidisciplinary teams, adaptive planning, and digital health technologies as essential components of future military vaccination programs.

## Multidisciplinary Implications for Practice

### Social Work: Addressing Vaccine Hesitancy and Trust

The integration of social work perspectives has emerged as essential for addressing vaccine hesitancy and building trust in military vaccination programs (22,24). Social workers are uniquely positioned to address the psychosocial factors that influence vaccination decisions, including historical trauma, mistrust of medical institutions, and cultural beliefs about health and illness (21,28). Their training in communication and counseling enables them to facilitate respectful conversations about vaccination concerns (9,30).

During COVID-19, social workers in military settings provided crucial support to service members and families navigating vaccination decisions (19,26). They addressed misinformation through evidence-based education while validating legitimate concerns about vaccine safety and side effects (4,8). Social workers also played key roles in supporting military families separated by deployment during the pandemic, addressing the broader psychosocial impacts of prevention measures (1,5).

Community-based social work approaches have particular relevance for military vaccination programs (13,31). Working through military family support networks, chaplains, and informal leadership structures can enhance vaccine acceptance (12,17). Social workers can facilitate dialogue between military leadership and service members about vaccination policies, addressing concerns about mandatory vaccination from a rights-based perspective (6,14).

### Nursing: Clinical Excellence and Patient Education

Nursing professionals have been at the forefront of vaccination delivery in military settings (23,29). The clinical skills required for mass vaccination campaigns—including vaccine preparation, administration, and adverse event recognition—align with core nursing competencies (2,9). Military nurses demonstrated remarkable adaptability during COVID-19, expanding their roles to include management of vaccination clinics, vaccine supply chain oversight, and public health education (1,32).

Patient education is a critical nursing function in vaccination programs (22,31). Military nurses provide essential information about vaccine benefits and risks, addressing the specific concerns of active-duty service members about potential impacts on fitness, deployment status, and career progression (21,24). The nurse-patient relationship, built on trust and communication, is fundamental to overcoming vaccine hesitancy (28,30).

Nursing leadership has been essential for the successful implementation of military vaccination programs (4,26). Nurse administrators have developed protocols for vaccination delivery in operational environments, including field settings and deployment contexts (5,12). Nursing research has contributed to evidence-based practices for vaccine storage and handling, adverse event monitoring, and special populations (14,19). The integration of advanced practice nurses in vaccination programs enhances clinical capacity and improves patient outcomes (13,17).

### Emergency Response: Rapid Deployment and Crisis Management

Emergency response professionals have been instrumental in military vaccination efforts during outbreaks (6,23). The rapid deployment of vaccines during COVID-19 required emergency management systems capable of distribution to military installations worldwide (32,33). Emergency managers coordinated with logistics, transportation, and medical personnel to ensure vaccine availability at points of administration (9,31).

Crisis management skills are essential for managing public health emergencies in military contexts (1,21). Emergency professionals have developed protocols for surge capacity in military medical facilities during outbreaks, ensuring that vaccination efforts do not compromise essential healthcare delivery (12,30). Communication during crises—providing timely, accurate information to service members and leaders—is a core function of emergency management (4,5).

The integration of emergency response with vaccination programs has created synergies that strengthen overall outbreak preparedness (17,34). Emergency exercises now routinely include vaccination scenarios, testing supply chain

resilience, and communication networks (19,26). Lessons from recent outbreaks have been incorporated into emergency response frameworks, emphasizing the importance of flexible, adaptive strategies (2,14).

## Health Management: Policy, Systems, and Strategic Planning

Health management professionals play essential roles in military vaccination programs through policy development, systems design, and strategic planning (13,22). The COVID-19 pandemic demonstrated the importance of comprehensive vaccination policies that balance operational requirements with individual rights and public health considerations (31,33). Health managers have developed frameworks for mandatory vaccination that are legally defensible, ethically sound, and operationally feasible (1,32).

Health systems design is critical for effective vaccination delivery in military settings (9,23). Managers have developed electronic health record systems that track vaccination status, facilitate scheduling, and enable adverse event monitoring (5,12). Supply chain management, including vaccine procurement, storage, and distribution, has been a significant focus of health management during recent outbreaks (21,30).

Strategic planning for future outbreaks requires health management expertise to anticipate challenges and develop preparedness frameworks (4,6). Managers have developed scenario planning tools that incorporate lessons from COVID-19, mpox, and Ebola to inform future responses (17,28). Resource allocation decisions, particularly in budget-constrained military health systems, benefit from the analytical skills of health managers (19,34).

## Synthesis of Multidisciplinary Roles

Table 2 synthesizes the distinct yet complementary roles of each discipline in military vaccination programs, highlighting key responsibilities, essential competencies, and outbreak-specific contributions. This table illustrates how social work, nursing, emergency response, and health management collectively address the complex challenges of infectious disease prevention in military populations.

**Table 2: Multidisciplinary Roles in Military Vaccination Programs**

| Discipline | Key Responsibilities | Essential Competencies | Outbreak-Specific Contributions |
|---|---|---|---|
| **Social Work** | Addressing vaccine hesitancy, building trust, community liaison | Communication, cultural competency, counseling, advocacy | Facilitated dialogue on COVID-19 mandates; addressed mpox-related stigma; built community trust in Ebola response |
| **Nursing** | Vaccine administration, patient education, adverse event monitoring | Clinical skills, patient education, infection control, leadership | Led mass vaccination clinics; educated on COVID-19 vaccine safety; monitored mpox vaccine adverse events |
| **Emergency Response** | Rapid deployment, crisis management, supply chain coordination | Emergency management, logistics, risk communication, coordination | Managed COVID-19 vaccine distribution; deployed mpox vaccine teams; coordinated Ebola treatment units |
| **Health Management** | Policy development, systems design, strategic planning | Policy analysis, health systems management, strategic planning, resource allocation | Developed COVID-19 vaccination policies; designed mpox vaccination protocols; planned Ebola response frameworks |

Table 2 demonstrates that social workers contribute behavioral and community engagement expertise essential for addressing the psychosocial determinants of vaccination acceptance. Nurses provide clinical excellence and patient education, serving as the frontline of vaccine delivery. Emergency response professionals ensure operational readiness and crisis management capacity. Health managers develop the policy frameworks and systems that enable coordinated, effective vaccination programs. Together, these disciplines form an integrated team capable of addressing the multifaceted challenges of military infectious disease prevention.

## Challenges and Barriers to Effective Implementation

### Vaccine Hesitancy and Trust Deficits

Vaccine hesitancy has emerged as a persistent challenge in military vaccination programs, despite mandatory vaccination policies for many diseases (22,26). Among service members, hesitancy often

stems from concerns about vaccine side effects, particularly those that might affect deployment fitness (12,35). Historical mistrust of military medicine, particularly among African American and other minority service members, contributes to lower vaccination acceptance (4,5). The experience of the anthrax vaccination program, where side effects generated significant concern, has created skepticism toward new vaccines (1,9).

Trust deficits extend beyond individual service members to military communities and their civilian populations (28,32). In joint operations and humanitarian missions, military medical personnel may be viewed with suspicion by local communities, particularly in conflict-affected areas (6,21). The perception of military vaccination programs as instruments of power rather than public health creates barriers to community acceptance (2,30). Building and maintaining trust requires sustained engagement, transparency, and respect for community autonomy (13,14).

Misinformation and disinformation have become significant drivers of vaccine hesitancy, both within military populations and the communities they serve (17,23). The COVID-19 pandemic demonstrated the rapid spread of vaccine misinformation through social media, which affected service members despite their access to official military communications (19,33). Countering misinformation requires active communication strategies that leverage trusted messengers within military communities (12,34).

## Logistical Barriers in Deployment Settings

Vaccination in deployment settings presents unique logistical challenges that complicate infectious disease prevention (1,22). Maintaining the cold chain for temperature-sensitive vaccines in field environments requires specialized equipment and constant monitoring (32,35). Remote locations may lack the refrigeration capacity needed for mRNA vaccines, necessitating the use of alternative vaccine formulations or innovative cooling technologies (13,26).

Security concerns can impede vaccination efforts in operational zones (12,21). Combat zones and unstable regions present risks to vaccination teams, limiting their ability to reach service members and local populations (5,30). Medical evacuation and casualty evacuation systems may be overwhelmed by vaccination-related adverse events, creating competing priorities (4,17). The integration of vaccination with other operational requirements requires careful coordination and prioritization (6,28).

Personnel constraints represent another significant logistical barrier (9,34). Deployment of qualified medical personnel to vaccination sites may reduce capacity for other healthcare functions (14,23). Military medical personnel have multiple competing demands, including readiness training and combat casualty care, that can limit their availability for vaccination efforts (2,19). Innovations such as telemedicine and peer-administered vaccines may help address staffing constraints (22,33).

## Ethical and Legal Considerations

Mandatory vaccination in military settings raises significant ethical and legal considerations (12,32). Service members have limited freedom to decline vaccines compared to civilians, creating tension between individual rights and the military's need for force protection (1,35). The use of experimental vaccines under emergency use authorizations has generated particular concern, as service members may have less opportunity to refuse than the civilian populations (13,26).

Religious and medical exemptions to mandatory vaccination require careful handling to balance individual rights with operational requirements (5,30). The process for granting exemptions must be transparent, consistent, and respectful of individual beliefs while maintaining military readiness (17,21).

Legal challenges to vaccination mandates have arisen in multiple military contexts, highlighting the need for clear legal frameworks (4,6).

Resource allocation decisions during outbreaks raise additional ethical questions (14,34). When vaccine supply is limited, military health managers must make decisions about prioritization that can have life-or-death consequences (9,22). The allocation of vaccines between military and civilian populations during international outbreaks raises questions about fairness and global health equity (19,23). Ethical frameworks developed for military public health provide guidance for these challenging decisions (2,12).

## Future Directions and Recommendations

Future military vaccination programs must integrate behavioral and social sciences to address vaccine hesitancy through interdisciplinary approaches and community-based participatory research (22,33). Strengthening civil-military coordination frameworks through formal agreements, joint training, and shared communication systems is essential for effective outbreak response, with cross-sector collaboration and international partnerships enhancing surveillance and resource utilization (6,17). Advancing vaccine technologies—including mRNA platforms, needle-free delivery systems, thermostable formulations, and digital health tools such as electronic health records and artificial intelligence—will address logistical challenges in deployment settings and improve program efficiency (13,34). These strategic directions collectively aim to enhance force protection, global health security, and pandemic preparedness through multidisciplinary, coordinated, and technologically innovative approaches (5,9).

## Conclusion

This narrative review demonstrates that military populations face unique infectious disease vulnerabilities requiring specialized vaccination programs addressing clinical and psychosocial dimensions of prevention. Lessons from COVID-19, mpox, and Ebola highlight the importance of civil-military coordination, targeted vaccination strategies, health equity, community engagement, and trust-building. Multidisciplinary implications are substantial: social workers address vaccine hesitancy and build trust, nurses provide clinical excellence and patient education, emergency response professionals ensure rapid deployment, and health managers develop policies and systems. Persistent challenges include vaccine hesitancy, logistical barriers, and ethical dilemmas requiring continued investment in behavioral research, civil-military coordination, and vaccine technologies. Integrated multidisciplinary approaches remain essential for force protection and global health security.

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