

# Insights from Evidence-Based Medicine Method for Building Security Systems Against Terrorist Attacks in Hospitals

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**Abstract:** Hospitals have become soft targets for terrorism, with increasing terrorist attacks observed in the last two decades. Not only the counter-terrorism and law enforcement agencies but the hospitals also need to be actively involved and undertake the responsibility of safeguarding hospital security by establishing an effective security system. Evidence-based medicine emphasizes the significance of scientific evidence, and in practice, research methods for the generation, collection, and utilization of evidence may offer new insights to overcome the issue of terrorism. The present study discusses the potential application of methods in evidence-based medicine for developing security systems against terrorist attacks in hospitals. First, hospitals can use simulated scenarios of terrorist attacks to generate evidence. For example, combining virtual technology with virtual reality technology and selecting appropriate algorithms or models to generate evidence. Second, they can apply tabletop exercises to propose measures, as a means of collecting evidence. The collection of data can be obtained through questionnaires or interviews. Some biological methods, such as collecting salivary markers of acute stress ( $\alpha$ -amylase and secretory immunoglobulin A), can also be used to assess emotional states. Third, they can use the collected evidence to practically test and refine the implemented measures. To verify the effectiveness and feasibility of the formulated solutions in real-life scenarios, simulations, models, drills, and similar methods can be used. This approach may provide new perspectives for the development of hospital security systems.

**Keywords:** hospital security against terrorist attacks, security system development, evidence-based medicine method

## Introduction

Hospitals are instrumental in providing emergency medical assistance in the face of terrorist attacks.<sup>1</sup> However, their counter-terrorism security systems exhibit inherent limitations, making them soft targets of an increasing number of terrorist attacks.<sup>2</sup> In a terrorist attack on a maternity hospital in Kabul, the capital city of Afghanistan, in May 2020, 16 pregnant women, two newborns, and one healthcare worker were killed and over 100 people were injured, sparking international protests and condemnation.<sup>3</sup> Moreover, terrorist attacks cause fear and anxiety, disrupt essential healthcare services, and subsequently attract global media attention, making hospitals and medical facilities potential targets for terrorism.<sup>4</sup>

A review of data from the Global Terrorism Database (GTD) for the period 1970–2020 with “hospital” as the search term revealed the total number of terrorist attacks against hospitals as 1371. Recent studies indicate a significant increase in the number of terrorist attacks on medical facilities in the last two decades. Although relatively rare, secondary attacks on hospitals should also be taken seriously.<sup>5</sup> Hospitals have been targeted by terrorists in every inhabited continent except Australia, and approximately 61 countries have witnessed terrorist attacks against hospitals, making the protection of hospitals an international security concern.<sup>6</sup> To counter the increasing threat of terrorism,<sup>7</sup> hospitals must establish security systems for safeguarding patients, healthcare personnel, and their facilities.

Although preventing terrorist attacks is the responsibility of counter-terrorism and law enforcement agencies, some countries have started establishing security systems for hospitals to prevent such attacks, which is a giant step forward. Dutch law requires hospitals to have a prevention plan for terrorist attacks, and some scholars have started to focus on the level of threat awareness and counter-terrorism preparedness in Dutch hospitals, providing specific recommendations.<sup>8</sup> In the Philadelphia area of the United States, hospitals have developed an Incident Command System to combat terrorist attacks,<sup>9</sup> formulated legal and policy measures against biological terrorism attacks,<sup>10</sup> and started using analytical methods for terrorism risk prevention and control.<sup>11</sup> Similarly, medical institutions in China have begun conducting emergency drills for preventing terrorist attacks.<sup>12,13</sup> In Sichuan Province, a working mechanism for the “Specification for Anti-Terrorism Precaution has been established at Medical and Health Institutions”,<sup>14</sup> and anti-terrorism emergency management models are being proposed.<sup>15</sup>

Everything flows and nothing stays. Despite the increasing awareness of security in medical institutions, the use of “Trojan horse” vehicles, such as trustworthy ambulances, to transport an improvised explosive device has emerged as a threat.<sup>16</sup> The ever-changing methods of terrorist attacks make it challenging to strengthen hospital security systems for combating such attacks. Evidence-based medicine (EBM) method may offer a new perspective to the improvement of hospital security system construction.

EBM is a paradigm introduced in the 1990s,<sup>17</sup> which emphasizes the significance of scientific evidence.<sup>18</sup> This paradigm asserts that all medical interventions should be based on the latest and best scientific research results. It represents a set of research, methods, principles for the algorithms for clinical medicine, management guidelines, and sources of evidence.<sup>19</sup> EBM paradigm aims to bring scientific rigor to clinical medical decision-making. Typically, EBM method involves three consecutive stages.<sup>20</sup> The first stage is the generation of evidence through medical research, especially clinical trials. In the second stage, evidence is collected to develop clinical guidelines. The third stage involves the use of evidence in medical practice through the implementation of recommended guidelines.

These three stages offer valuable insights for establishing hospital counter-terrorism systems. Hospitals can create simulated scenarios of terrorist attacks to observe the response of healthcare professionals, thus generating evidence. Evidence generated in the real-world context is subjected to tabletop exercises to formulate solutions, which corresponds to the process of evidence collection. Finally, the solutions are placed back into the scenario system to validate whether they are effective in practice and can be transformed into policies, indicating the use of evidence.

## Discussion

### Generate Evidence: Creating Virtual Terrorist Attack Scenarios

Virtual terrorist attack scenarios can be established using virtual reality technology, which has been demonstrated to have strong potential for use in the medical field.<sup>21–23</sup> Hospitals can create virtual terrorist attack scenarios and generate evidence using the following steps and methods:

1. Clearly defining objectives and scenarios: A. The type of terrorist attack to be simulated should be identified (eg, the spread of anthrax in a biological terrorist attack). B. The location for the simulation, such as specific areas or rooms within the hospital, and the personnel prone to be affected should be determined.
2. Developing simulation tools and materials: A. The virtual environment required for simulating the terrorist attack should be created using simulation software or virtual reality technology. B. Simulators, artificial wound models, special effects makeup, and other elements needed for the chosen attack scenario should be established. These scenarios can be based on data from the GTD or created to cater specific needs.
3. Recruiting participants and conducting simulations: A. Healthcare professionals and other relevant personnel should be recruited to participate in the simulation. B. The virtual terrorist attack scenario should be established in the simulation environment, and the actual response and behavior of the healthcare professionals should be observed.

At this stage, it is necessary to integrate virtual technology with virtual reality technology in order to achieve more accurate simulation results. Regarding the selection of algorithms and models, existing relevant research can serve as a guide and be adjusted according to one’s own needs. Such as, it includes a model with three different situations: simulation, safety training,

and preventive maintenance training.<sup>24</sup> A framework called INTERVALES. This model aims to facilitate virtual and augmented environments and coordinate complex operations.<sup>25</sup>

This immersive virtual environment can provide evidence that is difficult to obtain in real-life scenarios—generating evidence.

## Collecting Evidence: Analyzing and Deducting Data Generated

Once evidence is generated through the virtual scenarios, the first step is to simulate it by organizing, categorizing, and conducting desktop exercises on the data, observation records, and other information generated in the simulated terrorist attack scenarios. The collection of data can be done by administering a survey questionnaire to participants after the experiment in order to gather their feedback. Semi-structured interviews can also be conducted with participants to understand the challenges they face while navigating virtual environments.<sup>26</sup> Some biological methods, such as collecting salivary markers of acute stress ( $\alpha$ -amylase and secretory immunoglobulin A),<sup>27</sup> can also be used to assess emotional states.

Evidence generated from the simulated scenarios is then compared with actual medical institutions or specific situations. In the real-world context, factors including the allocation of resources, personnel, equipment, and systems are considered to ensure that the solutions are applicable to real-life scenarios. Specific requirements of real-world scenarios, such as geographic location, population density, and the distribution of medical facilities, must also be considered because they can influence the selection and applicability of solutions. Finally, targeted measures should be developed, which should be practical, actionable, and directive. Undoubtedly, the adoption and analysis of all the aforementioned data require approval from medical ethics committees.

## Using Evidence: Testing Effectiveness and Feasibility

To verify the effectiveness and feasibility of the formulated solutions in real-life scenarios, simulations, models, drills, and similar methods can be used. Counter-terrorism experts and scholars can be invited to analyze the validation results, identify potential weaknesses in the solutions, and make necessary adjustments and improvements.

The adjusted measures should be reintroduced into the virtual scenarios to confirm their effectiveness and feasibility. Response strategies should be frequently updated to ensure that they align with the evolving real-world requirements and conform to the latest and best scientific research results.

The above statement highlights the valuable insights gained from evidence-based medicine methods in developing a system to prevent terrorist attacks on hospitals. The selection and utilization of algorithms or models in each step, as well as data collection and the methods employed, should be thoroughly discussed in future research. In future research, the key and challenging aspect is to select and optimize models and algorithms in order to efficiently develop a set of equipment that can be readily utilized. This article presents inspiring viewpoints for discussion, aiming to provide guidance for future research.

## Conclusions

Inspired by EBM methods, some hospitals have already started using virtual technologies and have achieved positive results.<sup>28,29</sup> Security measures against terrorist attacks that are being used include equipping hospital entrances with metal detectors to prevent explosives from being carried inside, establishing police stations within hospitals, installing alarm systems in critical locations within hospitals to ensure rapid reinforcement notification during emergencies,<sup>30</sup> radiological testing of the hospital's air environment, and chemical testing of domestic water supplies; these measure can prevent terrorists from launching nuclear or biochemical attacks.<sup>31</sup> While military-style protection for hospitals may pose logistical and financial challenges, proactively establishing hospital security systems<sup>32</sup> is imperative to mitigate the risk of terrorist attacks. These practices may have a positive impact on the development of hospital security systems and serve as a valuable reference for other medical institutions worldwide to build security systems for combating terrorism.

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