Factors Affecting the Effectiveness of Hospital Incident Command System; Findings from a Systematic Review

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Objective: To examine all aspects affecting the functioning of the system and the most important factors in its assessment through a systematic review during 1990 to 2017.
Methods: This systematic review of the current literature study was conducted during July 2017, and all articles, books, guidelines, manuals and dissertations pertaining to the Incident Command System were analyzed. A total of articles and relevant documents were identified and finally these articles, which we found, were analyzed based on the specified indicators.
Results: In this research 992 articles and relevant documents were identified and eventually, 48 articles were included and analyzed. The results were categorized into 6 main groups including 65 subgroups and 221 variables: features of hospital incident command system (14 subgroups and 53 variables), strengths of the system (15 subgroups and 70 variables), weaknesses of the system (10 subgroups and 15 variables), factors influencing the system’s performance improvement (12 subgroups and 42 variables), factors that reduce the effectiveness of system include 11 subgroups (10 internal factors and 1 external factor) and 22 variables and important factors in assessing system performance (2 sub-groups and 19 variables).
Conclusion: According to the results, Evaluating the effectiveness of a hospital accident command system (HICS) in a valid method can improve the efficiency of this system. In this appraisal, hospital managers and health decision-makers should consider principles, characteristics, strengths and weakness of it.

Keywords: Hospital; Incident command system; Assessment; Effectiveness.
Introduction

Today, the occurrence of unexpected incidents around the globe affects governments and nations causing a great number of fatalities and significant economic losses. Despite many recent advances, incidents and disasters remain one of the most important concerns of a man’s life [1]. Therefore, it is important to pay more attention to the development of plans, principles on natural disaster reduction and their effects, as well as the proper management of disaster risk reduction [2]. Among the many components involved in crisis management, relief and rescue in emergencies, healthcare centers, especially hospitals, play a major role [3]. Due to the lack of predetermined structures for proper management and focus on activities and training programs, these healthcare centers may expose to multiple risks and performance dysfunction [4]. Therefore, hospital preparedness is the main element of disaster management programs, which should be based on a standard protocol [5]. One of the invaluable management instruments which has an effective role in empowering services of healthcare centers according to global experiences is the Hospital Incident Command system (HICS) [6]. Hospital Incident Command system is a management system used to help manage incidents in unexpected situations and makes an attempt to build a coordination between hospitals and other institutions involved through using a rational and integrated management structure, responsibilities and duty description, creation of transparent reporting channels, and building a simplified and commonplace terminology system [4, 7]. Regardless of their size or ability to provide care for the patient, health centers, especially hospitals, can use the system for planning and responding at all-hazard emergency situations [8]. According to the reports published by the organizations in the United States, the system has been able to improve the quality of delivered hospital services in crisis situations very effectively and offered many effective crisis management plan and strategies for the hospital [4]. HICS was designed in 1991 as one of the strategies of hospitals for contrast with disasters with the mission of prevention, mitigation, response, and recovery in hazards [6]. The Hospital Incident Command System (HICS) is widely used by hospitals, yet there is a paucity of research and a lack of developed models to examine HICS implementation [6, 9]. In addition, our review shows that there has been no comprehensive study analyzing the positive or negative aspects of the system [9]. Perhaps the importance to develop HICS for emergencies has led scholars to ignore its qualitative aspects [6]. Therefore, in order to improve the effectiveness of Hospital Incident Command System, the current study aimed to assess the effectiveness of system with a focus on its features, strengths, weaknesses, factors contributing to the increasing and decreasing of system effectiveness, as well as important factors involved in system assessment. The aim of the current study was investigating and categorize factors affecting HICS effectiveness with a focus on its features, strengths, weaknesses, factors contributing to the increasing and decreasing of system effectiveness, as well as important factors involved in system assessment to improve the effectiveness of HICS. Therefore, the findings of this study can increase the knowledge of decision makers about the HICS in order to improve hospital readiness and respond appropriately during accidents and disasters.

Materials and Methods

Data Source

A systematic review was conducted to investigate published studies and documents relating to the factors affecting the performance of Incident Command System.

This research was conducted during July 2017. All articles, books, guidelines, manuals and related dissertations were extracted from January 1, 1990 to July 15, 2017. We searched databases including PubMed, Ovid, Springer, Scopus, science of the Web and Google Scholar, Medline for foreign articles, and Iran’s Medicine and SID for Persian articles. In addition, we searched ProQuest databases for relevant dissertations. Relevant articles were identified by searching citations and using the snowball mechanism.

Search Strategy

Other than the articles searched using the snowball method, the rest of the articles included in the study was searched using Medical Subject Headings (MeSH) resource: ICS OR “Incident Command Systems” OR “hospital incident command system” OR “hospital emergency incident command system” “OR” Incident Command Structure “OR” Incident management framework “AND utilization OR evaluation OR effectiveness” OR “performance OR implementation OR assessment OR application OR ORGANIZATION or strengths OR weak points AND” Emergency Operation Center “OR out -of hospital “OR” EOC “OR” Pre hospital “” hospital “OR” Emergency medical system “. 

Inclusion Criteria

The inclusion criteria were: articles published in the scientific journals and were relevant to research questions, published in English language and only allocated to Hospital Incident Command System in hospital and pre-hospital settings, Hospital Emergency Operation Center (HEOC) and health centers.

Exclusion Criteria

The exclusion criteria were as follows: published
papers before 1990, published in non-academic journals, not relevant to research questions, not in English and duplicate publications. Further, articles and texts were analyzed using descriptive and thematic approaches. Quality assessment of included studies was done via PRISMA checklist. Figure 1 presents a flow diagram of data collection and its analysis.

**Quality Assessment**

A 7-question checklist was produced to assess the quality of the retrieved publications by authors (Table 1). The Quality-related questions investigated the following components: 1- Number of subgroups mentioned in the main group of hospital incident command system features, 2- Number of subgroups mentioned in the main group of strengths of the system, 3- Number of subgroups mentioned in the main group of weaknesses of the system, 4- Number of subgroups mentioned in the main group of factors influencing the system’s performance improvement, 5- Number of subgroups mentioned in the main group of factors that reduce the effectiveness of system, 6- Number of subgroups mentioned in the main group of variables and important factors in assessing system performance, 7- The number of main groups referenced.

**Thematic Analysis**

In the first step, one researcher analyzed the extracted data of each publication by thematic method (PB). In the second phase, the draft analysis was reviewed by the second researcher (AY), this appraisal continued until two researchers had agreed on themes and sub-themes was attained. Any disagreement or mismatch was resolved through discussion and involvement a third researcher (AOT).

**Results**

A total of 992 articles and documents were searched and finally 52 articles were analyzed based on the specified indicators. The data were analyzed descriptively. Most of the reported citations were related to the United States (59.6), Iran (19.2), China (3.8), Saudi Arabia (3.8) and Australia (3.8). About 92.26% of the articles included in the study published from 2014 to 2017 and 9.51% from 2006 until the end of 2013, concurrent to the fifth and fourth editions, respectively, by the Hospital Incident Command System. An approximately 23% of the articles used either absolute or qualitative approaches and 5.11% were case studies. In addition, the focus of the selected articles ranged from the application of the system in the hospital or pre-hospital system (4.63%), health centers (3.17%), both hospital and health centers (6.7%) and Hospital Emergency Operation Center (HEOC) (7.5%). Therefore, according to the results, the hospital and pre-hospital settings had the highest rate of system referrals. The abstracts of the relevant articles and documents are shown in Table 2.

**Thematic Analysis**

The results were categorized into 6 main groups, 65 subgroups and 221 variables as follows: features of hospital incident command system (14 subgroups and 53 variables), strengths of the system (15 subgroups and 70 variables), weaknesses of the system (10 subgroups and 15 variables), factors influencing the system’s performance improvement (12 subgroups and 42 variables), factors that reduce the effectiveness of system include 11 subgroups (10 internal factors and 1 external factor) and 22 variables and important factors in assessing system performance (2 subgroups and 19 variables) (Table 3).
Table 1. Quality assessment based on the number of subgroups and main groups cited by the authors of the article

| First Author                  | Number of subgroups mentioned in the main group of hospital incident command system features | Number of subgroups mentioned in the main group of strengths of the system | Number of subgroups mentioned in the main group of weaknesses of the system | Number of subgroups mentioned in the main group of factors influencing the system’s performance improvement | Number of subgroups mentioned in the main group of factors that reduce the effectiveness of the system | Number of subgroups mentioned in the main group of variables and important factors in assessing system performance | The number of main groups referenced | Total |
|-------------------------------|-------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|---------------------------------|--------|
| Backer H                      | 7                                                                                              | 6                                                                       | 0                                                                         | 0                                                                                               | 0                                                                                               | 0                                                                                               | 2                               | 15     |
| Molino Sr LN                  | 5                                                                                              | 6                                                                       | 0                                                                         | 0                                                                                               | 0                                                                                               | 0                                                                                               | 2                               | 13     |
| O’Neill PA                    | 7                                                                                              | 5                                                                       | 0                                                                         | 0                                                                                               | 0                                                                                               | 0                                                                                               | 2                               | 14     |
| Akhavan Moghaddam J           | 7                                                                                              | 6                                                                       | 0                                                                         | 2                                                                                               | 0                                                                                               | 0                                                                                               | 3                               | 18     |
| Shams I                       | 6                                                                                              | 4                                                                       | 0                                                                         | 2                                                                                               | 0                                                                                               | 0                                                                                               | 3                               | 15     |
| Subbarao I                    | 0                                                                                              | 1                                                                       | 0                                                                         | 0                                                                                               | 0                                                                                               | 0                                                                                               | 1                               | 2      |
| TakashiUKai M                 | 1                                                                                              | 2                                                                       | 0                                                                         | 0                                                                                               | 2                                                                                               | 0                                                                                               | 3                               | 8      |
| Xu M                          | 3                                                                                              | 1                                                                       | 0                                                                         | 0                                                                                               | 0                                                                                               | 0                                                                                               | 2                               | 6      |
| Schoenthal L                  | 6                                                                                              | 1                                                                       | 0                                                                         | 4                                                                                               | 1                                                                                               | 2                                                                                               | 5                               | 19     |
| Adams EH                      | 1                                                                                              | 4                                                                       | 0                                                                         | 0                                                                                               | 0                                                                                               | 0                                                                                               | 2                               | 7      |
| Aitken P                      | 1                                                                                              | 4                                                                       | 0                                                                         | 0                                                                                               | 0                                                                                               | 0                                                                                               | 2                               | 7      |
| Al-Shareef AS                 | 1                                                                                              | 1                                                                       | 0                                                                         | 0                                                                                               | 0                                                                                               | 0                                                                                               | 2                               | 4      |
| Arnold JL                     | 0                                                                                              | 0                                                                       | 0                                                                         | 2                                                                                               | 0                                                                                               | 0                                                                                               | 1                               | 3      |
| Andrew SA                     | 0                                                                                              | 1                                                                       | 1                                                                         | 2                                                                                               | 0                                                                                               | 0                                                                                               | 3                               | 7      |
| Ayers KJ                      | 1                                                                                              | 1                                                                       | 0                                                                         | 0                                                                                               | 0                                                                                               | 0                                                                                               | 2                               | 4      |
| Autrey P                      | 0                                                                                              | 2                                                                       | 0                                                                         | 3                                                                                               | 0                                                                                               | 0                                                                                               | 2                               | 7      |
| Briggs SM                     | 2                                                                                              | 1                                                                       | 0                                                                         | 2                                                                                               | 0                                                                                               | 0                                                                                               | 3                               | 8      |
| Burkle FM                     | 0                                                                                              | 0                                                                       | 1                                                                         | 1                                                                                               | 0                                                                                               | 0                                                                                               | 2                               | 4      |
| Kanter RK                     | 1                                                                                              | 4                                                                       | 0                                                                         | 0                                                                                               | 0                                                                                               | 0                                                                                               | 2                               | 7      |
| Born CT                       | 4                                                                                              | 2                                                                       | 0                                                                         | 1                                                                                               | 0                                                                                               | 0                                                                                               | 3                               | 10     |
| Morse S                       | 4                                                                                              | 1                                                                       | 2                                                                         | 0                                                                                               | 0                                                                                               | 0                                                                                               | 3                               | 10     |
| Djalali A (2016)              | 1                                                                                              | 2                                                                       | 0                                                                         | 0                                                                                               | 0                                                                                               | 0                                                                                               | 2                               | 5      |
| Yarmohammadian MH (2011)      | 5                                                                                              | 4                                                                       | 0                                                                         | 4                                                                                               | 0                                                                                               | 7                                                                                               | 4                               | 24     |
| Born CT                       | 3                                                                                              | 2                                                                       | 0                                                                         | 0                                                                                               | 0                                                                                               | 0                                                                                               | 2                               | 7      |
| Author                  | Year | Country     | Category       | Methodology                           | Objective                                                                 |
|------------------------|------|-------------|----------------|---------------------------------------|---------------------------------------------------------------------------|
| Howard Backer          | 2014 | USA         | Guidebook      | Reviewing qualitative studies         | Updating the Incident Command System Guide                               |
| Louis N. Molino, Sr    | 2006 | Canada      | Book           | Reviewing qualitative studies         | This book points to the applicability of this system for the management of hospitals at the incident scene, and even to the use of it for incidents involving a large number of patients with trauma-induced stress. |
| P. A. O’Neill          | 2005 | USA         | Original article | Reviewing of qualitative texts, results of hospital teaching | Familiarizing surgeons with some principles of responding to incidents of high casualties, including the structure and principles of Hospital Incident Command System |
| Jamal Akhavan Moghaddam| 2006 | Iran        | Original article | Reviewing of qualitative texts, results of hospital teaching | Familiarity with Hospital Incident Command System and Hospitals experiences |
| Lisa Shams             | 2011 | Canada      | Original article | Reviewing of qualitative texts        | Hospitals Preparedness for Establishing a Hospital Emergency Command System |
| ItaloSubbarato         | 2011 | USA         | Letter to editor | Reviewing of qualitative texts        | Familiarity with Hospital Incident Command System and Hospitals experiences |
| Takashi Ukai           | 2005 | Japan       | Letter to editor | Reviewing of qualitative texts        | Evaluation of the effectiveness of Hospital Incident Command System         |
| Lisa Schoenthal        | 2015 | USA         | Original research literature review | Reviewing of qualitative texts, results of hospital teaching | Performance Evaluation of the Public Health Emergency Operations Center |
| Peter Aitken           | 2012 | Australia   | Original Article | Case study                            | Application of the incident command system in DTM teams                   |
| Jeffrey L. Arnold      | 2005 | USA         | Theoretical discussion | Reviewing of qualitative texts        | Implementation of corrective actions plan of hospital emergency management to meet challenges. |
| Simon A. Andrew        | 2012 | USA         | Original Article | Case study                            | Assessing hospital preparedness against disasters                         |

Table 2. Papers analyzed for the systematic review of literature.
| Author(s)                           | Country | Year | Document Type | Methodology | Title                                                                 | Setting/Study Method                                                                 |
|-----------------------------------|---------|------|----------------|-------------|----------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Karyn Jester Ayers               | USA     | 2013 | Thesis         | Qualitative | Assessing the roles and capabilities of hospitals during a catastrophic response (disaster) | Hospital Interview                                                                      |
| Pamela Autrey                    | USA     | 2006 | Original Article | Qualitative | Investigating the Effect of Knowledge of Highly Valid Location and Teams on Implementing the Incident Command System | Hospital Exercise and interview                                                        |
| Susan Miller Briggs              | USA     | 2009 | Review article | Literature review | Exploring the principles of the incident command system | Firefighting centers - police and hospitals                                               |
| Frederick M. Burkle Jr           | USA     | 2007 | Original Article | Peer-reviewed literature | Investigating the structure and functions of the incident command system needed for decision making in biological events | HEOC                                                                                    |
| Robert K. Kanter                 | USA     | 2011 | Book (chapter 18) | -            | Principles used for responding to public health threats by pediatricians | Hospitals - ICU                                                                        |
| Christopher T. Born              | USA     | 2007 | Original Article | -            | Better response to disasters and high-casualties incidents with an emphasis on hospital management system. | Hospitals                                                                              |
| Stephen S. Morse                | USA     | 2006 | BOOK(chapter 13) | -            | Disaster preparedness at health centers and emergency rooms and hospitals | Health Centers - Emergency departments - Hospital                                         |
| Ahmadreza Jalali                 | Iran    | 2016 | Original Article | Qualitative | Personnel competencies required to respond to CBRN incidents and their training needs | Hospital Delphi                                                                        |
| Mohammad Hossein Yarmohammadian  | Iran    | 2011 | Educational Research Article | Qualitative | Examining the Challenges, Opportunities and Strategies of the Emergency Hospital Command System (HEICS) for hospital readiness | Hospital Semi-structured interview                                                      |
| Christopher T. Born              | USA     | 2011 | Instructional Course Lectures | -            | Assessing the importance of the existence of an incident command system in orthopedic surgeons in order to manage disasters in response to disasters | Hospital (surgeons)                                                                  |
| Saleh Fares                      | Dubai   | 2014 | Original Article | Review study-instrumentation | Analyzing Hospital Preparedness Levels against Disasters Using HVA Tool | Hospital Texts - Examining Hospital Experience                                           |
| Nidaa A. Bajow                   | Saudi Arabia | 2014 | Original Article | Cross sectional | Assessing hospital preparedness against disasters | Hospital Questionnaires collected from hospitals                                        |
| Pam Hoffner                      | USA     | 2009 | Original Article | Cross sectional | Application of hospital accident command system in physicians with different specializations | Hospital Modeling                                                                    |
| Ahmadreza Jalali                 | Iran    | 2012 | Original Article | Observational study | Measuring the decision-making function using the task descriptions of hospital accident command system | Hospital Orbital Maneuvering                                                          |
| Dick A. Buck                     | USA     | 2006 | Original Article | Literature review | Conclusion on the use of Hospital Accident command System as an Organizational Management Tool at Disaster Time | Labor Organizations - Public Health - Fire Department - Law Enforcement Agency Several sources of information related to the nine different incidents |
| Name                      | Country   | Year  | Article Type         | Methodology                                | Title                                                                 | Institution                                                                 | Notes                                                                 |
|---------------------------|-----------|-------|----------------------|--------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------|
| Rouhollah Zaboli          | Iran      | 2014  | Original Article     | Mixed qualitative and quantitative approach | Assessing hospital preparedness                                     | Hospital                                                                  | Collected questionnaires from hospitals and group discussions        |
| David A. Bradt            | Australia | 2003  | Original Article     | Case study                                 | Settlement management and health issues in the recovery and disaster incident rescue phase | Health care centers                                                        | -                                                                  |
| Amy H. Kaji               | USA       | 2006  | Original Article     | Descriptive, cross-sectional survey         | Assessing hospital preparedness                                     | Hospital                                                                  | Questionnaires collected from hospitals                              |
| Jessica Jensen            | USA       | 2016  | Literature review    | Literature review                          | Knowledge system and the direction of future research               | Hospital - fire department and others                                     | Literature review                                                     |
| Donald Lendorf            | USA       | 1995  | Special report       | Qualitative study                          | Application of Hospital Accident command System                   | Hospital                                                                  | -                                                                  |
| Hesam Seyedin             | Iran      | 2013  | Original research    | Qualitative study                          | Assessing the effects of major accidents on the preparedness of health organizations in future disasters | Health organizations                                                      | Semi-structured interview                                             |
| Wendin M Gulbransen       | USA       | 1997  | Thesis               | Cross sectional literature review           | Mobile application in the Hospital Accident command System of various disaster phases | Health systems                                                            | Texts - teamwork assessment                                           |
| George U. Njoku           | USA       | 2015  | Thesis               | Quantitative design and used survey approach | Studying the compliance of hospitals with the implementation of the components of the National Accident Command System (Incident Command System) Hospital (as one of the ways to estimate hospital preparedness | Hospitals and health systems                                           | Collecting online information from hospitals                          |
| Allison T. Chamberlain    | USA       | 2012  | Original Article     | Qualitative study                          | Reviewing the experiences of H1N1 flu immunization program managers in the United States | Immunization plan                                                        | Electronic survey                                                     |
| Robert Powers             | USA       | 2007  | Feature Article      | Case study                                 | Description of the successful integration of the principles of incident command in the multi-hospital disinfection program | Multiple-hospital disinfection plan                                      | Teamwork and practice                                                 |
| Robert W. Rendin          | USA       | 2005  | Original Article     | Case study                                 | Reviewing the implementation of comprehensive tuberculosis screening programs in health care units based on the principles of the system Incident Command | Health care units                                                        | Data on the implementation of the screening plan                      |
| Rune Rimstad              | Norway    | 2015  | Comprehensive review | Systematic literature review                | Focusing on the commanders at the scene in emergency pre-hospital services with High casualties | Pre-hospital emergency department                                      | Pretext                                                               |
| Marsha Fishbane           | USA       | 2012  | Supplement article   | Case study                                 | Use of the Incident Command System in Influenza Vaccination Clinics in Populated classes | Vaccination clinic                                                      | Teachings                                                            |
| Carl H. Schultz           | USA       | 1996  | Review articles      | Literature review                          | Medical response to sudden deaths after an earthquake              | Health care Centers                                                      | Texts                                                                |
| Tamara L. Thomas          | USA       | 2004  | Original research    | Survey                                     | Assessment of hospital training based on the incident command system | Hospital                                                                 | Information obtained from the questionnaire after the exercise      |
| Ernest Sternberg          | USA       | 2004  | Special report       | A Searching for methods and planning terminologies in hospital incidents to promote resilience | Hospital                                                             | Texts                                                                    |                                                                      |
Principles and Features Effective in the Success of the Hospital Emergency Hospital System

The hospital incident command system is a management system for controlling, commanding and coordinating the activities of independent groups. This system is designed to achieve the common goal of incident prevention, reduction of mortality, financial losses and severe damage. The system has several features that contribute to achieving these goals and affect its success. The present study indicated that there are several significant features affecting the effectiveness of hospital incident command system including the organized command structure [10] based on the same principles and compliance with the key structure of the incident command [9, 11, 12] use of a bureaucratic framework based on military principles [13]. This system is characterized by an organizational form of the structure [6], hierarchical structure [13-15], and a specific command chain [16]. In addition, this system provides an appropriate and reliable structure for leadership regardless of the incident type [17]. A clear spoken language — based on the common [4, 6, 9, 12-18, 16], simple and commonplace [4, 18] terminology is another feature of the system. The hospital incident command system can define specific organizational functions and roles through job descriptions [11, 19, 20], rational tenets for the allocation and organization of occupational activities [14], clarify the precise managerial tasks and responsibilities [21], access to a list of personal job descriptions [22], positions [4, 18], responsibilities [4, 18, 20, 23, 24], external organizations [28], responsibilities of hospital incident command system team [29], specifying specific roles in an organizational table [22, 23], and consequently prioritize tasks based on the job description worksheets [6] and recruit the personnel when it becomes necessary [30]. Additionally, numerous studies have focused on other structural features of Hospital Incident Command System including modularity [12], flexibility [13-16, 19, 23, 31], both flexibility and modularity [4, 6-8, 11, 14, 18, 32], analogy and comparison [9], compatibility [17], adaptability in crisis situations at a variety of scales [17, 18, 23], and category [26, 31] and concordance with planned and unplanned events [33] and effective for management in potentially changing environments [10]. The hospital incident command system is based on the principles and characteristics mentioned. Applying these principles and features will ensure the utilization of resources and reduce policy discrepancies and the operations of accountable organizations.

Strengths of System Use

Setting up a precise, efficient and cost-effective management system is one of the main pillars of disaster management programs in hospitals. The hospital incident command system brings significant
Table 3. Categorization of final articles based on features, strengths, weaknesses, enhancing performance factors, decreasing performance factors, and important factors in assessing the Hospital Accident Command System.

| Domain | Sub category | Variable |
|--------|--------------|----------|
| System features that help to succeed | Structure | Command- Inter-organizational command- Bureaucratic- Based on military principles- Hierarchical- Rational framework- A distinct chain of Organized command |
| | Language | Common lexical and linguistic structure- simple- common- common language |
| | Flexibility and compatibility | Modular design- flexible- Compatible- comparable- Adapted to a variety of events- Adaptation to program events- Scheduled and not-Adhere to the management structure in Changing environments |
| | Approach | All hazards from top to bottom- Predetermined calling mechanism- Multiple protocols for response |
| | Application at various levels | Global and international- local- National- daily activities |
| | Having a command area and control | Specific command area- Appropriate Size Control- Specific monitoring area- Predictable Chain Leadership- Clarity in monitoring |
| | Providing an appropriate response | Fitted the size of the hospital- Proportional to the extent of the incident- Assigning individuals based on the extent and magnitude of the incident- Activating the sections according to the type and size of the incident |
| Management style | Based on precise and extensive goals- Centralized- Defining interactive management components and disaster management structure- Standard System Management Tool- Predictable Management Chain |
| Transparency and appropriateness of duties and responsibilities | Posts- responsibilities- Duties Roles- Managerial tasks- Job Descriptions Individual- Description of the tasks of external organizations- Task description sheets |
| Performance style | The Emergency Response technique at disaster time is not based on a real scenario |
| Simplicity | Be simple |
| Counting feature | Positions Team performance |
| Dependency | Components of response |
| Coloration | Specific coloration |
| Strengths of system use | Improved coordination | Operational-Organizational- Inter-organizational- Independent groups- Response actions- Teamwork |
| | Improved response | Standard response- Facilitating the response- Structured and organized response- Effective- Fast- successful- Effective and efficient- Increased effectiveness- Empowerment- A powerful framework for responding- Proper operation- Resilience promotion |
| Resources and facilities | Provision of facilities- Providing enough medical personnel- Effective use of resource- Employing regular human resources- Sharing resources |
| improved management | Valid management protocol- Enhancing managerial empowerment - Comprehensive crisis management strategy |
| Preparedness status | Preparedness items- Increased hospital readiness- Increased human resource preparedness |
| Assessment | Quantitative and targeted structural Assessment of disaster relief- Assessment tool- Assessment system |
| Discipline | Reduced chaos caused by disaster- Reduced disruption of decision making |
| Planning | Improved planning |
| Costs and resources | Reduced costs- Cost Stability- Documentation of costs and resources- Reduced financial losses and injuries- Effective use of resources |
| Communications | Providing communication system- Quick communication- Easy connection- Promotion of administrative communications- Preventing unnecessary communications for communication- Effective communication plan |
| Organizational capability | In achieving multiple goals |
| Reporting and Information | Facilitating information gathering- Facilitating reporting- Information acquisition- Information dissemination- Shared information |
| Service delivery | Saving time- Improving the quality of services- Continuity of service- Provide expansion of services |
| Weakness                                      | Factors affecting in increasing efficiency |
|----------------------------------------------|--------------------------------------------|
| Patients Improve the care- Treatment- Triage- Maintaining security | Understanding the system Promoting understanding- Understanding and conceptualization- Knowledge Improving the advanced skills of the system- Promoting an acquaintance culture |
| Personnel Security- Increased efficiency- increasing the self confidence- team encouragement | Training and retraining Staff- Managers-Development of educational materials |
| Lack of efficiency In big-complex incidents | Practice Planning to practice- implementation |
| Structure Unknown military structure         | Commitment to implement the system Organizational Commitment Leadership and Leadership Commitment- Staff Commitment |
| Lack of duplicate and reassure              | Coordination Regional                      |
| Working with system Complicated health systems | Financing Removing Financial Barriers- Allocating funds- Providing Purchase opportunities |
| Inefficient response and confusion          | Updating and improved compliance Plans-Policies- Practices-educational packages- Structures-activities- Processes-Executive Boundaries Compliance with New Threats - New Technologies -Adaptation of the planning stage with the response |
| Inefficient sharing Between partner organizations | Assessing the Challenges Disaster program before response |
| Failure in health organizations             | Facilitating procedures Removing complex administrative procedures |
| System Language Lack of familiarity with personnel | Advanced Communications Use of state of art technologies |
| Inactivation of system by the leader despite training | Improved Command Structure and Managers Appointment of competent managers- Leadership eligibility- Compilation of Command Description-Holding the Committee of Directors-Remove Daily Anxieties |
| Scope of job descriptions Wideness          | Compilation and adherence to the rules Design instructions-Follow the rules-Compliance with the principles of the system |

**Factors affecting in increasing efficiency**

- **Understanding the system**
  - Promoting understanding- Understanding and conceptualization- Knowledge
  - Improving the advanced skills of the system- Promoting an acquaintance culture

- **Training and retraining**
  - Staff- Managers-Development of educational materials

- **Practice**
  - Planning to practice- implementation

- **Commitment to implement the system**
  - Organizational Commitment Leadership and Leadership Commitment- Staff Commitment

- **Coordination**
  - Regional

- **Financing**
  - Removing Financial Barriers- Allocating funds- Providing Purchase opportunities

- **Updating and improved compliance**
  - Plans-Policies- Practices-educational packages- Structures-activities- Processes-Executive Boundaries
  - Compliance with New Threats - New Technologies - Adaptation of the planning stage with the response

- **Assessing the Challenges**
  - Disaster program before response

- **Facilitating procedures**
  - Removing complex administrative procedures

- **Advanced Communications**
  - Use of state of art technologies

- **Improved Command Structure and Managers**
  - Appointment of competent managers- Leadership eligibility- Compilation of Command Description-Holding the Committee of Directors-Remove Daily Anxieties

- **Compilation and adherence to the rules**
  - Design instructions-Follow the rules-Compliance with the principles of the system

**Points to be considered in the organization’s assessment**

- **Measurement of system functions**
  - Coordination functions-Command-Control-Decision making-System performance-Quantitative analysis

- **Assessing the administrative departments of the system**
  - Administrative-executive- Communication-Planning- Adaptation-coordination- Levels of command and personnel -Activating trainings- Comparative time intervals in triage-treatment - transportation - holding meetings, debriefing

**Factors decreasing system efficiency**

- **Internal barriers**
  - Cultural Lack of cultural management-Organizational Culture
  - Lack of assessment method Lack of a general method for assessing HICS - lack of a methodology for assessing health-based trainings
  - Problems related to managers Lack of need - support - commitment and belief in the system-Not eligible-Lack of shared management language
  - Legal barriers Lack of legal requirements-Change in the rules and the lack of unity in the command
  - Decision making Large number of decision makers
  - Financial barriers High expenditure
  - System incompatibility Incompatibility with existing structures in the hospital
  - Lack of a comprehensive plan Response to hospital disasters and hospital headquarters
  - Poor communication and coordination External and internal team communication and coordination
  - Lack of competitive space Development- Planning

- **External barrier**
  - Parallel work of accountable organizations Internal- External
benefits to hospitals and plays an important role in improving the quality and delivery of services during emergencies and disasters in hospitals. Hospital incident command system provides a powerful framework [10] standard template [8], structured and organized incident response [16] and facilitates emergency incident response [19]. Various advantages for hospital incident command system including provision of the most reliable management protocols [18], and comprehensive crisis management strategy [8] can apply to improve the management capabilities of the emergency [31]. HICS develops strategies for effective and efficient dealing with crisis situations [4], accelerates effective and quick response [8, 11], increases effectiveness [18, 23], enhances efficiency and effectiveness of the response plan [31, 34], facilitates communication between different units of the system in emergency incidents [35], fosters problem solving process among the organizations involved [22, 25] and ultimately, reduces the chance of errors and parallel work [25].

Hospital incident command system provides a response planning [36] this system can offer hospital of all sizes with an opportunity to plan, prepare and respond to both emergency and non-emergency situations, make other relevant units and organizations take part in the emergency response depending upon the size and type of incident [4, 18], extend or limit the size, scope, and complexity of an incident, assign particular tasks or position based on the magnitude of the incident [8] accelerates effective and quick response [8, 11] and consequently guarantees the successful implementation of the plan [37]. Furthermore, numerous studies have mentioned another strength of the system including: detection of system capabilities by other organizations [8], providing a system for coordination [12] coordination between hospitals [4, 23, 38] and accountable organizations [4, 6-8, 23], coordinating activities among independent groups and coordinated response actions [6] coordinated response to emergencies situations [8, 11, 35, 39], coordinated multi-disciplinary response to public health threats [28], mutual efforts [40], decentralization in decision-making [10] and building unity in dealing with complex and extreme crises, making incident command system known to the public [7].

Additionally another advantages for hospital incident command system including improvement of administrative communications [8, 9], developing a system [12] and communication plan [6], quick and easy communication with other crisis management systems in various rescue and relief departments [4], and facilitated communications [16, 24] between hospitals, Medical emergencies and other responsible organizations [12] and foreign organizations [10], clear inter-organizational communication [39], inter-team environmental awareness [41], avoidance of unnecessary communications [26], improved communication [42, 43], and existence of effective communication plans [6]. Hospital incident command system with some its features can lead to the cost minimization [4, 18, 22, 23]; provision of accurate and timely documentation on spending and resource utilization, [11] reduced financial losses and severe injuries, [6] effective use of resources, [22] provision of adequate and efficient medical facilities and personnel [39], effective use of all resources for problem solving [17], provision of resources and equipment [30, 44], provision of health care facilities for emergency management [33], use of manpower on a regular basis [45], providing health facilities needed for emergency management [33], regular staffing [45] and sharing resources in organizations and health care centers [6, 11]. So considering the strengths of this system, HICS has been identified as one of the factors necessary to boost resilience [42], hospital empowerment [6], incident management and reduced fatalities [6], response to daily operations and emergency and non-emergency situations [22].

Weakness of System Use
According to reports, since the system was initially developed for use in a military and hierarchical structure, it makes hard for the providers of public health system to use the system because of cultural differences [19]. Buck DA and colleagues also stated in their study that although the system was successful in firefighting organizations, it has not been successful in some organizations, such as public health [45]. Similarly, SA Andrew et al. questioned the usefulness capabilities of system in reducing organizational disputes, especially at large-scale incidents and events [46] and FM Burkle et al. found that the system is unable to manage the complexities of a large-scale health-related disaster, especially epidemic situations [47], the main disadvantage is that the structure cannot be changed or be reliable in terms of training, coordination and administrative capability [48]. Furthermore, Timm NL et al. reported that hospital staff were completely unfamiliar with the language system and were unable to use terms such as logistics, operations, financial to explain leadership roles [48]. The vastness of the range of job descriptions in the system is another weakness of the system [48] Likewise, NL Timm et al. noted the inefficiency of the system in real time response and exposure to stress [48]. Some studies have also referred to high cost as one of the other problems in the system [23]. R Rimstad’s findings suggesting that system sharing between partner organizations is a major problem [13].

Factors Affecting in Increasing Efficiency
Considering the importance of the incident command system in managing and responding effectively to emergencies and disasters, and given the widespread use of this system in hospitals in the world, it is essential to pay attention to factors that increase its efficiency. Therefore, it is important to
pay special attention to several factors for increasing the effectiveness of the system within the hospitals, including familiarity with the organizational structure of the system [18], creation of cluster structures for the system at the planning stage depending on the response phase [47] determining the organizational hierarchy of the structure based on the requirements rather than the titles [17] development of units, positions, description of new duties in accordance with hospital requirements [14] definition of job description and supervision of managers [22] and providing training and information to managers at all levels for creation of a common language and building culture [23].

The application of advanced communication technology to coordinate and provide critical information between incident command teams [41] has been one of the most important elements in improving system performance, furthermore It is necessary to pay special attention to regional coordination plays a significant role in the promotion of system efficiency [49]. Also the existence of transparent reporting channels [7, 20, 23-25] and transmission of information to high-level authorities [10] are the two main aspects of the incident command system, which can facilitate the information collection, reporting [28], sharing information [31], information acquisition and information dissemination [50]. In order to improve the effectiveness of the system, some additional measures need to be taken: removing financial barriers to implement the system, [23] financing the hospital to establish the system, [23] providing procurement opportunities for staff and offices to strengthen the crisis management culture [15], supporting the Ministry of Health and taking into account additional funding for promotion of system [22], compliance with the rules and regulations [23], compliance with instructions and guidelines among the personnel and medical staff [37], enhancing compliance with the system principles [35] developing guidelines and regulations for hospitals and legal requirements [22].

Taken together, improving the effectiveness of the Hospital Incident Command System depends on understanding and recognizing the features and principles of the system [12, 18, 23, 37], training employees in order to understand the system [9, 23, 50], holding continues specialized training courses [9], implementing exercises and procedures [10, 24, 41], building an administrative commitment and support for managers [9], creating an interest in the personnel [22], matching the system to the needs, updating and implementing the native version of the system [4, 49] eliminating financial barriers [22, 23] and complex and challenging administrative obstacles [22], appointment of competent, experienced and qualified managers [13, 22] and understanding the strengths and weaknesses of the system.

Factors Decreasing System Efficiency
In contrast to the above finding, Timm NL et al. showed that while implementing the system, the conflicts from confused job responsibilities and roles can lead to inefficiencies in response and real implementation of the system may be failed [48] and the incompatibility of this system with the management structure of hospitals can decrease the system’s effectiveness [49]. YarMohammadinia et al. found that the lack of legal requirements with continuous regulatory change, and the absence of unity of command [23], can weaken and decrease the system’s efficiency and effectiveness [23]. Furthermore, the lack of a general method for assessing HICS and hospital-based exercise programs [25], lack of cultural management for crisis command, lack of the need to create this system by managers, lack of support and commitment from authorities and managers, shortage of qualified managers at all levels, paying attention to daily activities by managers, lack of a common management language [23] and lack of senior management commitment to system implementation of the [9] can attenuate system performance.

Points to be Considered in the Organization’s Assessment
Assessing the hospital incident management system leads to identifying the weaknesses, strengths, decreasing factors and increasing the efficiency of the system. By identifying these factors and improving them, the efficiency of the incident command system can be improved.

The hospital incident command system has been recognized as a vital tool for meeting the compliance with accreditation requirements [8]. The hospital incident command system also provides opportunities for quantitative and targeted structural assessment [51], assessment of hospital preparedness, processes, identifying, locating and recovering errors [41], exercises for preparedness against disasters [51], and finally creates an assessment system [12]. Also, in evaluating the system, all the levels and functions of the system [51], including the administrative and executive support, planning and adaptation, communication, decision-making, exercises, training and retraining [9] in a real or simulated disaster to be quantitatively and accurately analyzed [23]. Assessing the functions of the hospital incident command system is essential and useful, for example, the effectiveness of the coordination function of the system can be assessed by examining the implementation of cross-measures in accordance with the instructions of the mutual interlocutors [35] and reviewing the coordination with local and foreign authorities [9].

Conclusion
Hospital incident command system is one of the
hospital’s essential requirements for coping, respond and managing emergencies and disasters. The condition of applying and improving the efficiency of this system is to recognize the principles, characteristics, strengths and weakness of it by hospital staff and managers. It is also necessary to assess and evaluate the performance of the system and its functions with a scientifically valid method. Continuous assessment and recognition of the problems and strengths of the system will improve its efficiency. Therefore, hospital managers and health decision-makers need to plan and done the HICS’s assessment, identify its strengths and problems, and train its principles and characteristics for hospital settings.

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