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Abstract

Background: Occupational chemical accidents have increased in recent years in the Islamic Republic of Iran. In June and August 2015, three large explosions occurred at chemical warehouses in Rey, Tehran Province, and toxic vapours were released.

Aims: This study reviewed the three chemical accidents and assessed the extent to which the requirements for chemical safety and preparedness for chemical incidents under the International Health Regulations (IHR) are in place, and implemented at local and national levels in the Islamic Republic of Iran.

Methods: Data were obtained from secondary data and field visits to selected chemical plants. The secondary data were used to complete a 33-item checklist based on the IHR and the Ministry of Health and Medical Education checklist. A sample of 15 warehouses in Kahrizak district, Rey County, were visited to assess their capacity in relation to the IHR using a 15-item checklist.

Results: Some weaknesses were seen in the IHR capacity in the study area. The main weaknesses were lack of an effective surveillance system for chemical accidents and low levels of safety in chemical plants and warehouses. Other weaknesses included the lack of awareness of residents about chemical hazards and poorly equipped health centres for the management of victims of chemical accidents. The study area was not prepared for chemical accidents both within industrial plants and residential areas.

Conclusions: Action is needed to improve the areas of weakness so as to achieve the necessary capacities for chemical safety, and preparedness and response to chemical incidents in line with the IHR.

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Introduction

The Islamic Republic of Iran is a developing country with a lot of capacity in the manufacturing sector. Industrialization has been growing quickly because of market demands in the country (1,2). Rapid industrialization without the provision of established infrastructures to prevent industrial accidents can cause problems for countries (3–5). The statistics on industrial chemical accidents have shown an increase in accidents between 2010 and 2013 in the Islamic Republic of Iran (6). Figure 1 shows the distribution of industrial chemical accidents in the Islamic Republic of Iran between 2010 and 2013 according to type and number. In addition, in 2014, over 230 people were hospitalized for the release toxic gases in the city of Zahedan, in the south of the country (7).

In some industrial cities of the Islamic Republic of Iran, the distance between chemical installations and residential areas has not been taken into consideration (8). As a result, concern is growing about the public health effects of chemical plants, particularly the release of chemicals, as happened at Flixbrough, Bhopal and Seveso (9–13).

The province of Tehran has 38 counties and Rey is one of the largest and most industrial of them. In June and August 2015, 3 large chemical incidents occurred in Rey.

Case 1

A fire broke out at a warehouse at kilometre 3 of the Qom–Tehran road on the morning of Friday, 12 June 2015. The blaze was caused by a tanker containing chemical liquids which then extended to 11 other chemical tankers that were parked in the 4 000 square metres of the warehouse. Police and firefighters put out the fire within 4 hours. More than 25 0000 L of chemical liquids completely burned which resulted in the release of toxic vapours several kilometres away from the warehouse where the incident occurred. Three firefighters had minor chemical burns to their skin and were taken to the hospital but there are no data on injuries, such as respiratory distress, and eye and skin irritation in the residents of the area.

Case 2

On the evening of Tuesday, 18 August 2015, a fire broke out at a chemical warehouse, with an area of 1 500 square metres, in Kahrizak district. The local fire station requested help from the cities of Rey and Tehran, and 6 firefighters and 8 fire trucks were sent to the scene. The fire brigade stated that the fire was under control within 2 hours. A hazardous materials (Hazmat) team also accompanied the firefighting teams. There were no injuries to workers, residents or firefighters but one building of the warehouse was completely destroyed by fire and several tons of chemicals, including glycerin and raw materials, were damaged.

Case 3

On Thursday evening, 20 August 2015, 2 days after case 2, fire destroyed another chemical warehouse at the same place, Shourabad, Kahrizak. Many chemicals, sponges and large rolls of paper were stored in 2 buildings of the warehouse in over 6 000 square metres. The local fire station called for help, and 4 teams of firefighters and 10 fire trucks managed to put out the fire within 3 hours. The emergency responders and residents were exposed to chemical vapours but there are no accurate data about the number of injuries.

Figure 2 shows the location of the 3 chemical accidents in June and August 2015.

The International Health Regulations (IHR) specifically deal with human health hazards. Chemical events such as fires, explosions, leakages or release of chemicals are health hazards that could have serious harmful effects on human health and the environment. Chemical events may affect human health directly or indirectly. Therefore, providing the minimum chemical core capacities under the IHR could help decrease human vulnerability in the areas at risk of chemical accidents.

The aim of this article was to identify compliance with the IHR for chemical safety management in industrial zones and the neighbouring residential areas in the Islamic Republic of Iran.

Methods

This study was conducted in 2015. The sources of data were secondary data and field visits. The secondary data included censuses, information collected by local health centres, regional health networks, organizational records, protocols and data that were originally collected for other research purposes. In order to complete the data, 15 chemical warehouses, out of 80 in Kahrizak, were randomly selected for a visit. We developed a 15-item checklist, based on IHR core capacities, to complete during the visit to each selected chemical warehouse by observation (14). All field visits were conducted during 1 week in Kahrizak, Rey. We developed another checklist also based on IHR and the checklist of the Ministry of Health and Medical Education. This 33-item checklist was used to analyse the management of chemical events at the local and national levels. We also interviewed the local authorities and competent experts at the Ministry of Health and Medical Education, and reviewed available documents, reports and other literature (e.g. websites of the Ministry of Health and Medical Education and the Ministry of Labour) for information related to chemical accident management at local and national level in the Islamic Republic of Iran. We used content analysis for the subjective interpretation of the interviews to identify concepts, and the information from interviews and secondary data were used to complete the checklist.

The data collected were used to assess the extent to which the minimum requirements of the IHR for mitigation of chemical hazards were in place in the surveyed area and nationally.

Results

According to the field visits, more than of 80% of the warehouses had a material safety data

sheet for all the chemicals they have stored and maintained. In addition, 10 of the 15 warehouses report their chemical events to the Ministry of Health and Medical Education. The IHR elements that were least present were: providing facilities such as equipped hospitals with trained staff for management of chemical health emergencies, having a safety committee at the workplace and having established alert levels for chemical events; only 1 of the 15 warehouses had these requirements in place (Figure 3).

The requirements for the management of chemical accidents were extracted from secondary data and using the health inspection checklist of the Ministry of Health and Medical Education. Some of these requirements are established at the national level but not at the local level because of weak supervision, the lack of a strategic plan or insufficient capacity to implement them. However, we tried to check the extent of implementation of the requirements by reviewing documents and through the field visits in order to analyse the management of chemical events in the country. In total, 7 of the 33 core elements required for the management of chemical incidents were present at national and local levels. Almost half (14) of the core elements of the checklist were not established at the national level or the local level. Also, 12 of the 33 core elements were established at the national level but not at the local level. The main differences between the national and local levels related to: having the required components for the management of chemical incidents, having a policy and road map for the surveillance of and response to chemical emergencies, having access to a hazmat team for chemical incidents and having case management and poison centres available for chemical exposures and poisoning (Table 1).

Discussion

The aim of this study was to explore compliance with the IHR related to chemical accidents which should be in place in industrial zones and the neighbouring residential areas. Our findings showed that the most important factor was the lack of a coordinated approach to prevent, prepare for, respond to and recover from chemical accidents in the area under study. Further investigations showed that the lack of a coordinated approach for management of chemical incidents was also evident at the national level. Implementing the core IHR capacities in the filed is the foundation for managing chemical incidents correctly.

The 6 main IHR capacities (14) were assessed.

National legislation, policy and financing

Chemical regulations, standards, codes and management systems were established after major accidents such as Seveso, Flixborough (15). At the present time in the Islamic Republic of Iran,

there are chemical safety legislations for manufacturing, storing, transporting and using chemicals at the national level in order to prevent chemical events and harmful health effects on the general public (8). However, through our field observation and review of the relevant documents, there are clearly some difficulties in the implementation of the regulations. For example, there is a lack of adequate supervision by the authorities of chemical plants and warehouses at the local level, and a lack of knowledge updates, such as the use of a global harmonized system of classification and labelling of chemicals in companies and warehouses which are exposed to hazardous materials. In addition, chemical safety principles at work and in public environments were not a priority in chemical plants, probably because the authorities are more concerned with industrialization and increasing the manufacturing output of factories.

Coordination

The effective implementation of relevant chemical regulations requires a multidisciplinary approach with partners and stakeholders in order to have effective alert and response systems. Developing a national chemical profile is a multisectoral effort that was started by the Iranian Ministry of Health and Medical Education in the past five years. However, it will not be possible to do this without the cooperation of other ministries, agencies, and governmental and nongovernmental organizations. In addition, efficient and effective management of the victims of a chemical incident depends upon a coordinated response between the Emergency Medical Services and other first responders (police and firefighters) who attend the scene (16).

Surveillance

Having an effective surveillance system for chemical accidents and their public health impact requires a strong reporting and analysis process (17). This surveillance system should be able to identify high-risk locations, provide early detection of major events, and plan an emergency response programme (18,19). Surveillance and lessons learned from major chemical accidents may lead to new legislative and regulatory actions just as changes took place in the United States chemical safety legislation following Bhopal (17).

In the past 2 years, some measures have been adopted to integrate the surveillance system for chemical accidents into primary health care in the Iranian Ministry of Health and Medical Education. However, this requires the necessary infrastructure to be in place, such as communication lines, and equipped laboratories and hospitals in the areas exposed to chemical hazards. At the same time, the Ministry of Labour has its own surveillance system for chemical accidents. It would be more effective to coordinate and integrate the activities and systems of these 2 ministries.

Preparedness

Preparedness for chemical events includes the development of public health emergency response plans at national, regional and local levels. Chemical risk assessment at the hazardous sites, mapping of human vulnerability to chemical hazards, planning emergency evacuation if there is a disaster in residential areas, and the identification of available resources and capacities are other components of preparedness (12,20,21).

Apart from the chemical plants seeking international certification, conducting risk assessment is not compulsory for the rest of the chemical installations in the Islamic Republic of Iran. However, risk assessment is a good opportunity to identify hazards and make local authorities focus more on the hazardous sites. Moreover, the authorities should include some private companies and factories, which have resources for chemical emergencies, in the local planning of this industrial district (22,23). Having knowledge about what chemicals exist in the community, establishing a database, and providing appropriate training to health care workers and first responders in relation to chemicals are the first steps that should be taken for preparedness in the study area.

Response

Hazmat teams are essential for responding to the accidental or intentional release of dangerous chemical agents into the environment (24). Hazmat teams are also responsible for rapid assessment of the situation and controlling the operations to deal with such an event, including case management and the decontamination process in the area exposed to chemical accidents.

One of the priorities should be to establish and distribute hazmat teams in appropriate locations throughout the country so they are quickly available in the required areas when needed. Having a rapid response in the areas exposed to chemical accidents helps to mitigate later and worse effects (12,25).

In addition, the public health service is responsible for public health protection against chemical incidents, and health care workers should have enough knowledge and capacity to manage the victims (26). At the present time, the Iranian public health system does not have specific training courses on chemical injuries for health workers. Furthermore, the health centres do not have the necessary capacity to manage chemical incidents.

Risk communication

Risk communication is a multilevel process which aims to sensitize stakeholders to chemical risk management in the areas that might be affected by chemical events (20). The stakeholders are different groups including the authorities, policy-makers and the general population. An

essential part of risk communication is the dissemination of information to the public about chemical incidents, including their mitigation or relevant disease outbreaks (27). Risk communication should consider the social, religious, cultural, political and economic aspects associated with the chemical event (28).

All stakeholders in the country need to be identified for risk communication. A timely and robust communication mechanism should also be established to coordinate correct responses at the time of an incident. Because of the points mentioned earlier, any emergency communication plan needs to be developed and tested in the study area. In addition, risk communication to the population living in this area is essential. They should have information about hazards in the vicinity and the protective actions that they can benefit from if a chemical incident occurs. For instance, many lives would have been saved in Bhopal if people had been aware of the simple safety measure to stay in an enclosed space and put wet cloths on the face (23).

Conclusion

Our results show that Rey County is not well prepared for chemical accidents both in industrial and residential areas. The situation analysis of chemical warehouses in Kahrizak demonstrated weaknesses related to chemical hazards with regard to IHR capacities, including poor coordination among stakeholders in chemical legislation, few hazmat teams, the lack of an integrated chemical surveillance system, and the lack of preparedness among the general public and local health centres.

Further studies are needed on the risks to the population, and the action taken to rectify the weak points outlined in this report and to provide adequate capabilities at national and local levels in the 6 capacities of the IHR discussed. Determining the factors that make people vulnerable to chemical incidents could reduce the chemical harm within the chemical plants and also to the residents living close to such industrial installations.

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Accidents chimiques industriels : un risque sanitaire croissant en République islamique d’Iran

Résumé

Contexte : Le nombre d'accidents chimiques en milieu de travail a augmenté au cours des dernières années en République islamique d'Iran. En juin et août 2015, trois explosions majeures se sont produites dans des entrepôts de produits chimiques de Rey, dans la province de Téhéran, provoquant le dégagement de vapeurs toxiques.

Objectifs : La présente étude s'est penchée sur les trois accidents chimiques et a évalué dans quelle mesure les exigences du Règlement sanitaire international (RSI) en matière de sécurité chimique et de préparation aux accidents chimiques sont respectées et mises en œuvre aux niveaux local et national en République islamique d'Iran.

Méthodes : Les données ont été obtenues en recourant à des données secondaires et des visites sur le terrain dans des usines chimiques sélectionnées. Les données secondaires ont été utilisées pour remplir une liste de contrôle en 33 items inspirée de la liste de contrôle du RSI et du ministère de la Santé et de l'Éducation médicale. Un échantillon de 15 entrepôts du district de Kahrizak, dans le comté de Rey, ont été visités pour évaluer leurs capacités au titre du RSI en utilisant une liste de contrôle en 15 items.

Résultats : Certaines faiblesses ont été identifiées dans la zone étudiée en ce qui concerne les capacités au titre du RSI. Les principales faiblesses étaient l'absence de systèmes efficaces pour la surveillance des accidents chimiques et le faible niveau de sécurité dans les entrepôts et les usines chimiques. Les autres faiblesses incluaient le manque de sensibilisation des résidents aux risques chimiques et la piètre qualité des équipements dont disposaient les centres de santé pour traiter les victimes d'accidents chimiques. La zone étudiée n'était pas préparée à faire face aux accidents chimiques dans les usines industrielles et les zones résidentielles.

Conclusions : Des mesures doivent être prises pour corriger les faiblesses observées et se conformer au RSI en mettant en place les capacités nécessaires en matière de sécurité chimique et de préparation et de riposte aux accidents chimiques.

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