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Commentary

Building national public health capacity for managing chemical events: A case study of the development of health protection services in the United Kingdom

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Abstract The revised International Health Regulations (2005) require that countries develop plans for chemical threats. In 2012, the World Health Assembly reported that most countries had not yet achieved 'adequate capacity'. We review the evolution of chemical hazards services in the United Kingdom, the result of 15 years of grass-roots pressure and an accumulating weight of chemical incidents that eventually convinced the UK Department of Health of the need for a new national public health function, culminating, in 2003, in the creation of the Chemical Hazards Division of the new Health Protection Agency. Ten years later, public health services are again being radically reorganized with the creation of Public Health England, potentially destabilizing health protection arrangements and creating confusion among roles in managing chemical emergencies. Incorporating health protection into a broader public health organization, however, offers a new opportunity to broaden the scope of health protection services to embrace prevention of non-infectious environmental diseases.
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Introduction

In 1980, the World Health Organization (WHO), the International Labor Organization, and the United Nations Environment Program set up the International Program on Chemical Safety (IPCS) to advise

governments on the scientific basis for chemical safety and to strengthen national capabilities.[1] Initially, the IPCS focused on safety of production, storage, and transport of chemicals, but high-profile chemical disasters with potential long-term impact on the wider public, such as the Seveso disaster in Italy in 1976 (resulting in the highest known exposure to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in residential populations),[2] the Spanish toxic oil incident in 1981,[3] and the Bhopal explosion in 1984,[4] led to a general recognition of the public health impact of chemical events.[5] In 1992, an IPCS expert panel found that countries commonly lacked public health capacity, training, and plans with clear lines of accountability. There was commonly confusion over roles of emergency responders, police, local, regional, and national government, and over the responsibilities of government departments for environment, health, and homeland security, as well as a lack of appreciation of the psychological impact on the population and the effect of exposures on vulnerable groups such as children, pregnant women, and the frail elderly.[6] Compounding these systemic weaknesses, the 1995 Tokyo Sarin terrorist attack,[7] and then the 9/11 2001 New York atrocity,[8] raised international concern and exposed weaknesses in national capability to deal with chemical threats.[9]

The prospect of 'white powder' and 'dirty bomb' incidents that might involve simultaneously infectious, chemical, and radiological agents signalled the need for public health responses to be planned around the management of complex situations in an integrated manner, rather than organized vertically through the individual specialist disciplines of infectious disease control, toxicology, and radiological protection.[10] And this conclusion has been reinforced by the most contemporary public health concerns about climate change and complex emergencies.[11]

In May 2003, the 56th World Health Assembly (WHA) adopted a resolution (WHA56.28) to revise the International Health Regulations (IHR) to cover not just cholera, plague, and yellow fever, but also biological, chemical, or radiological events of 'international concern'.[12] (A global surveillance study in 2002/3 identified 35 major chemical incidents in 26 countries that met IHR criteria,[13] and chemical incidents have now been added to the responsibilities of the WHO's Global Outbreak and Response Network.) The IHR place new requirements on countries to cooperate in any public health incident that has serious international implications. The IPCS recommends that chemical

hazards be dealt with within comprehensive public health systems that embrace:

- incident planning and preparedness,
- training and simulation exercises,
- commissioning of emergency medical services to deal with chemical casualities and decontamination,
- emergency medical toxicology and poisons information services,
- hazard analysis, risk assessment, risk communication,
- environmental public health tracking,
- environmental epidemiology, and
- environmental monitoring and modelling.[14]

At the 65th WHO General Assembly in 2012, most countries admitted to poor readiness for chemical threats, with average capacity scores of only 45 per cent (compared with 70 per cent for food safety events). Many countries requested a 2-year extension for establishing core capacities.[15] Even when statutory duties and functional arrangements for chemical safety, emergency response, and clinical toxicology[16]are well established, there remain considerable gaps in public health capability to deal with wider population health aspects. [17]

As other countries work to develop health protection systems to comply with IHR responsibilities, we offer an analysis of the evolution of health protection services in the United Kingdom designed to deal with chemical incidents.

Evolution of Public Health Chemical Events Services in the United Kingdom

In 1974 in the United Kingdom, when general and clinical public health services were split from non-medical environmental health services, they were transferred from local government control to local National Health Service (NHS) authorities.[18] The opportunity to set up a national public health service as proposed by Galbraith in 1972[19] was not taken. When, in 1978, the government-funded Public Health Laboratory Service established a national epidemiology unit[20] following the review of an outbreak of smallpox in London, chemical incidents were not perceived as a significant threat and thus excluded from its remit. Through the 1980s, however, growing concern about chemical hazards led to a new

focus on medical management of mass casualties and injuries from major incidents.[21,22] Then the clustering of leukaemia around the Sellafield Nuclear plant led to a public enquiry and a recommendation for an expert unit to support the NHS, but only in the interpretation of routine statistics on clusters.[23] In 1989, Scotland established a small environmental public health unit with a broader remit[24] and it quickly proved its value in the management of the health risks of the Braer oil spill.[25]But in England, the Government's Department of Health was satisfied with the status quo.[26]

Nevertheless, major drinking water contamination incidents (phenol in 1984[27] and aluminum in 1988[28]) exposed serious inadequacies in public health capability. The ability of local public health services to cope with chemical emergencies was widely questioned;[29] there was no provision for deploying back-up for local emergency services; 'and no central government responsibility for coordinating major chemical incidents in peacetime'.[30] Public health specialists remained almost exclusively focused on communicable disease control;[31] the Government's Health Department circular that set out public health responsibilities of local NHS authorities did not even mention non-infectious hazards.[32] Two public enquiries into the Lowermoor aluminum incident (where 20 tonnes of aluminium sulphate were inadvertently emptied into the water supply at the Lowermoor treatment works in north Cornwall on 6 July 1988) pointed up inadequacies in understanding the longer-term health consequences[33,34] and recommended an expert panel to advise local public health professionals. Although a 'panel of volunteers' was created, its advice could only have been accessed through the Government's Chief Medical Officers, and in fact it was never activated. There was no capability to deploy teams of experts and no attempt to address the shortfall in local expertise.[29] Consequently, calls persisted for a properly resourced national public health agency;[35,36] government advice still lacked clarity on roles and responsibilities[37] and local plans remained inadequate.[38]

In the absence of central government strategy, in the early 1990s, some medical toxicology units attached to the National Poisons Information Service (NPIS)[39] and university academics undertook initiatives to fill the gap. These so-called *Regional Provider Units* depended on generating income from contracts for 24/7 response to incidents, surveillance, and research,[40–42] but there was no common pattern of service provision, nor national evidence-based standards of practice. In some parts

of the country, units competed for contracts; a local municipality might contract with one unit and the local NHS authority covering the same population contract with another.

In 1996, the UK Government Health Department, under increasing grass-roots pressure,[43–45] funded a very small unit, the 'National Focus for Chemical Hazards', that operated from 1997 to 2003 to undertake national surveillance, disseminate good practice and training, provide a reference point in emergencies, and help coordinate health aspects of emergency planning across government.[46] This unit achieved its limited objectives, but the National Focus had no authority to standardize and coordinate the work of the regional provider units. The role of NHS public health departments in chemical events remained confused,[47] and rapid access to authoritative expertise continued to be a problem.[48] Though the various units undertook a growing number of public health investigations of chemical incidents,[49–55] capacity was limited and there was no national field epidemiology resource.[56]

The Health Protection Agency

In 2001, because of increasing threats from deliberate release plus recent experience with complex emergencies of flooding and of a foot and mouth epidemic, the UK Government eventually accepted the need for a national agency.[56,57] The new Health Protection Agency (HPA), established in 2003, created teams at area and regional levels supported by national specialist centres, but it took several years to achieve reasonable clarity about the relative responsibilities of the NHS and the HPA.[58,59] Creation of the HPA's Chemical Hazards and Poisons Division – by incorporating the National Focus and the regional provider units – allowed the HPA to reallocate relatively modest resources from infectious disease services to double the chemical hazards budget within 12 months. The Division introduced national standards and guidelines, training, and research. It significantly increased the number of clinical toxicologists available to the HPA through the NPIS. To exploit the potential synergies, the HPA co-located the Chemical Hazards and Poisons Division with the National Radiological Protection Board. Then, in 2005, it merged the two organizations[60] to create the HPA's Centre for Radiation, Chemical and Environmental Hazards. The service initially focused on acute incident management, but piecemeal transfer to HPA from the Government's Health Department of central advisory functions (the consequence of

growing confidence in the ability of the HPA and a Government political imperative to cut the numbers of civil service staff in central London) largely shaped its early development from 2004 to 2006. HPA's Centre for Radiation, Chemical and Environmental Hazards absorbed transferred functions including advice on the health effects of chemicals in air, soil, water, and consumer products; the approvals process for pesticides, biocides, and veterinary medicines; and the secretariat for the expert advisory committees on toxicity, mutagenicity, and carcinogenicity of chemicals; as well as the expert group on the medical management of casualties from chemical terrorism.

Several major incidents, including the London bombings,[61] the deliberate fatal polonium poisoning of a Russian in London,[62] and an influenza pandemic,[63]fully and successfully tested the HPA model of national health protection services. But other incidents revealed persistent weaknesses in managing chemical events. The massive explosion and subsequent fire at a major oil depot in 2005 led to a huge plume of smoke over London and the south east of England for 4 days. The HPA provided advice on health risks nationally, but the incident exposed the lack of national capability to sample the plume and make appropriate public health risk assessments.[64] The Government asked the armed forces to assist. (Environmental sampling in emergencies is now clearly the responsibility of the Government's Environment Agency.) In 2007, serious flooding in England provoked a public enquiry that revealed general satisfaction with the overall civil response, but noted 'there was confusion over the respective roles and accountabilities in law of staff of the Health Protection Agency, primary care trusts, strategic health authorities … the Drinking Water Inspectorate and their interface with Gold Command'.[65] The public as well as the building industry found it difficult to acquire consistent advice in the response and early recovery phases, and 'information was particularly lacking or inconsistent on the sources of support available and possible longer-term health impacts'.[65] Confusion persisted about the roles of national and local advisory committees. In response, the HPA rapidly developed advisory fact sheets for its website, but the structural issues related to coordination across complex organizational arrangements remain.

One unintended consequence of including regional and university-based provider units for chemical response within the new HPA in 2003 was a narrowing of their scope of activities. Previously, units were free to use a broad definition of environmental public health and some were

working with local authorities on the built environment, housing and health, and on burns, injuries, and violence prevention, in addition to their core responsibilities for chemical events. From the outset, it was the ambition of the HPA's Chemical Hazards and Poisons Division to build on this broader approach and develop services for environmentally related diseases such as asthma, allergy, congenital anomalies, other chronic diseases, as well as reproductive health. However, the Division competed for diminishing resources with the much larger and longer established infectious disease divisions. Government funders and the HPA Board lacked enthusiasm. The HPA Board did commission a major programme of work to measure disease burden in order to prioritize investment,[66]but this ambition remained an aspiration. Had it followed this line, development of services for environmentally induced morbidities such as asthma and injuries would have featured much more prominently, as would the HPA-led national Children's Environmental Health Strategy.[67]

In 2009, the newly elected UK Government announced plans for reconfiguration of the NHS and public health services in England, including abolition of the HPA as a separate legal entity and its incorporation in 2013 in a new broader public health national service for England.[68] (Devolution produced a variety of models for health services and public health in Scotland, Wales, and Northern Ireland.)[69] The plans for England represent a radical step.[70] The United Kingdom's Faculty of Public Health expressed serious concerns about destabilizing emergency response arrangements and sought 'clarification of roles and responsibilities during public health emergencies'.[71] General public health responsibilities would return to local governments from the NHS, with Public Health England created as a new executive agency of the Government's Department of Health to coordinate nationally and provide some specialist services. The HPA, an independent agency set up by statute, will disappear and its functions will be incorporated into Public Health England, together with the current regional public health units of the NHS, and the public health observatories and cancer registries. The major concern of the public health profession about this change has been the potential loss of independent advocacy and advice, a basic feature of public health success over the last 150 years.[71] There may be renewed opportunities arising from the planned closer integration of health protection services with general public health functions. This will align health protection functions more closely to disease burden (for example,

asthma, allergy, injury)[66] and embrace the ambition of prevention of chronic environmental diseases.[67,72]

Conclusions

Countries still inadequately prepared for the IHR should note that chemical events can cause major loss of life, long-term disability,[5]and, in major ways, disrupt psycho-social health and well-being of large populations [73] as well as the economy.[51] Countries should therefore assess urgently their capabilities for dealing with chemical events against IPCS guidelines.[6]

In the United Kingdom, major incidents exposed weaknesses in handling public concern about longer-term health effects. A paucity of data on health effects of environmental exposures prevented public health authorities from being able to offer robust evidence-based reassurances, thereby exacerbating media and public anxiety. The United Kingdom was slow to recognize the need for national health protection leadership, unlike the United States which created the National Institute for Environmental Health Sciences in 1969,[74] the Centers for Disease Control and Prevention's Center for Environmental Health in 1980,[75] and the Agency for Toxic Substances and Disease Registry in 1983.[76] In contrast, in the United Kingdom, chemical hazards services evolved slowly through a grass-roots movement pressuring an apparently reluctant government. As with infectious disease control arrangements,[31] major incidents helped precipitate policy decisions.

Resources for the adequate management of the public health aspects of chemical events are usually relatively modest, and moreover, chemical events are best addressed within a stable public health infrastructure that can cope with complex situations. The HPA model of multidisciplinary teams at area and regional levels supported by a national expert centre has generally worked well in difficult circumstances (although this model is now being reconfigured), and countries should consider moving away from health protection models based on individual scientific and professional disciplines to models based on a multidisciplinary approach to complex situation management ('white powder' threats and outbreaks of unknown etiology). Nevertheless, the scientific skills required for the public health management of chemical events such as public health toxicology, environmental public health, and environmental epidemiology are in short supply, and governments need to work with

international agencies and professional bodies to ensure sustainability of national capacity.

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