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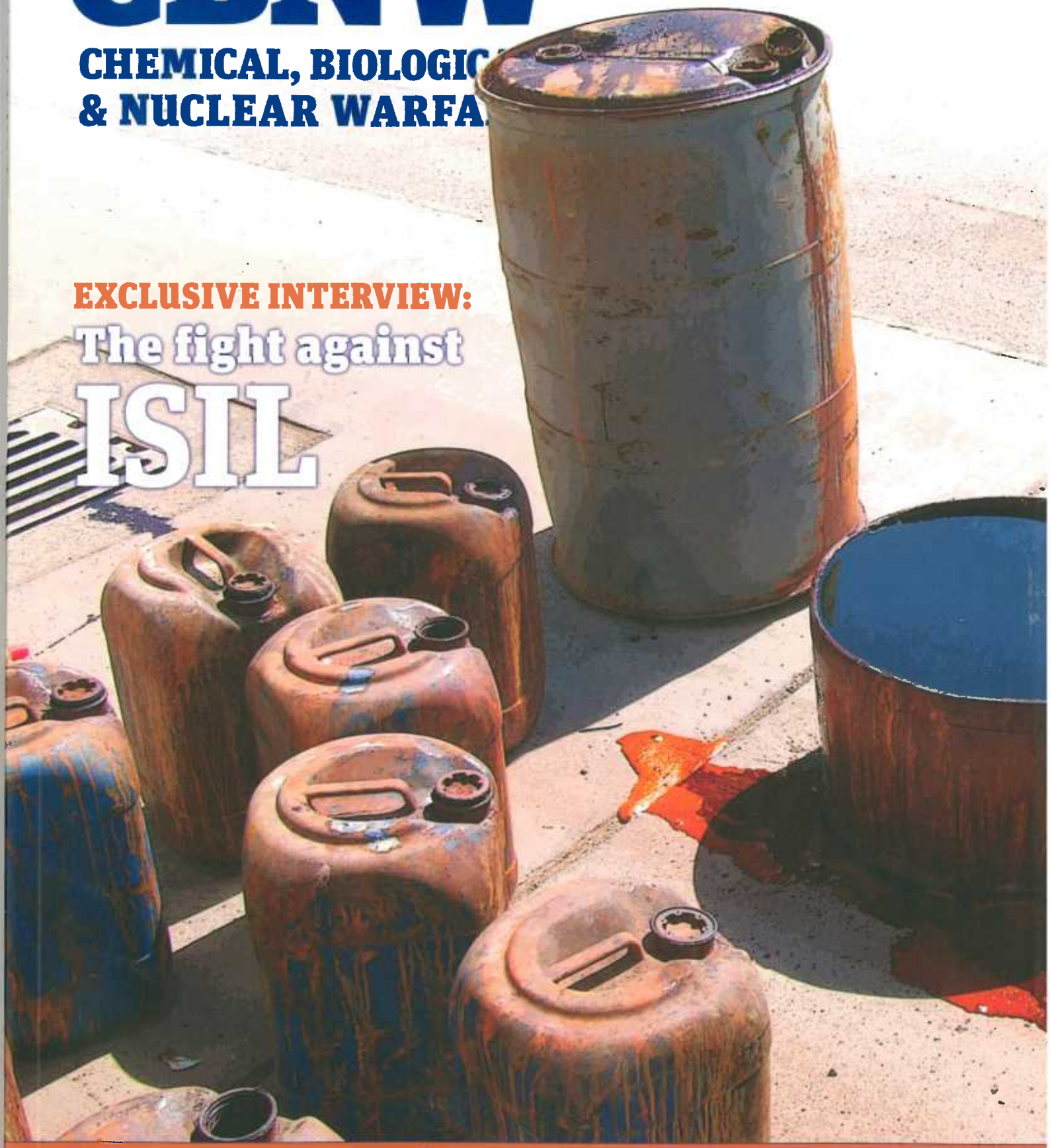

EXCLUSIVE INTERVIEW:
The fight against
ISIL

SPECIAL REPORT: CHEMICAL WEAPONS IN SYRIA

GETTING TO ZERO
Ebola update

CHEMICAL DRAGON
The Tianjin disaster

TESTING TESTING
Going beyond pass/fail

Gary Flory explains how to control outbreaks of highly pathogenic avian influenza through effective animal mortality management

Turkey shoot

Avian influenza outbreaks occur periodically in poultry flocks. But only recently have we considered avian influenza as a significant threat to human health and the global economy

The composting process is started inside a poultry

Constructing compost windrows

The 1997 emergence of H5N1 in Hong Kong first brought our attention to avian influenza's ability to cause disease in humans. More recently, a new avian influenza (H7N9) virus was reported in China that causes severe respiratory illness – resulting in death in about one-third of infected patients.

Human infection with influenza from avian sources is not a new phenomenon. Using lung tissue from 1918 influenza victims, researchers have conducted a genetic analysis of the 1918 virus and have linked the virus to avian origins. The 1918 influenza pandemic, also known as the Spanish flu, infected 25-30% of the world's population and resulted in the death of an estimated 50 million people.

Avian influenza: the impact

The 2015 outbreak of Highly Pathogenic Avian Influenza (HPAI) in the United States illustrates the economic impact of an avian influenza outbreak. Between 19 December 2014 and 17 June 2015, 219 detections of HPAI were reported across the country resulting in the deaths – either directly from the virus or in an effort to prevent the spread of the disease – of nearly 50 million birds. For US consumers this means that turkey prices are at record highs and the price of eggs has more than doubled.

The total cost of the outbreak extends well beyond the cost of destroying and disposing of the birds and includes lost market opportunities from trade restrictions. Eighteen countries have banned US poultry products, including Russia, China, South Korea, and Thailand. Thirty-eight countries have instituted regional restrictions, including Canada, Mexico, Japan, Singapore and the European Union. Recent estimates put the total economic impact of the 2015 outbreak at $3.3 billion dollars.

Given the potential impact of biological threats such as the avian influenza virus, many think that too few resources are allocated to the development of an effective eradication strategy. A new report by the Blue Ribbon Study Panel on Biodefense, *A National Blueprint for Biodefense*, emphasized that the US lacked the centralized leadership for biological threat preparedness.

Learning from outbreaks

Outbreaks of Foot and Mouth Disease (FMD) in the UK in 2001, and in Japan and South Korea in 2010 are clear reminders that carcass disposal plays a critical role in an effective disease response strategy. Dramatic photos of cattle burning on open pyres during the 2001 outbreak in Britain resulted in widespread public opposition to open burning.

In Japan the lack of acceptable burial sites resulted in delays in disease eradication efforts – and required the Japanese government to implement a vaccinate-to-kill strategy. While helpful in limiting the spread of the disease, this strategy required the expenditure of already limited resources. In addition to increasing resource demands, delaying eradication efforts may result in increased case detections and total economic impact.

A recent study of a simulated FMD outbreak in California concluded that delaying the response to detection from 7 days to 22 days increased the mean number of herds under quarantine from 680 to 6,200. The economic impact of this simulated outbreak increased from $2.3 billion to $69 billion when the delay increased from 7 days to 22 days.

In South Korea disease eradication efforts resulted in the destruction of 20% of the county's livestock and the creation of over 4,000 burial sites. This widespread carcass burial resulted in concerns about massive environmental impacts associated with this activity. Although investigations to characterize the actual impacts of this activity are in their early phases, many worry that the environmental impacts, including those to drinking water supplies, will last for decades. One unconfirmed report from rural South Korea described drinking water wells flowing red following the burial of livestock at a nearby burial site.

Despite this history of costly and ineffective carcass disposal efforts, disposal methods have advanced little in the decade since the 2001 FMD outbreak in the UK. A disease outbreak today should not be managed with the same techniques used in previous decades and result in the same economic, health and environmental impacts. Now, more than ever, first responders need better options for disposing of animal carcasses.

Poultry carcasses have been disposed of through a variety of methods including burial, incineration, landfilling and composting.

BURIAL Burial in unlined trenches is the traditional method of carcass disposal which has been used for decades. Though the method is cheap and easy to implement, concerns about groundwater ➤

> "Simply put, the Nation does not afford the biological threat the same level of attention as it does other threats: There is no centralized leader for biodefense. There is no comprehensive national strategic plan for biodefense. There is no all-inclusive dedicated budget for biodefense."
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> A NATIONAL BLUEPRINT FOR BIODEFENSE, OCTOBER 2015

Compost windrows inside a poultry house.


Disposing carcasses into a landfill.

contamination have decreased its use in more urbanized environments and in areas with a shallow groundwater table. New burial designs include enhanced features such as liners, leachate extraction, and monitoring wells.

In addition to environmental concerns, farmers worry about the impact of burial sites on future property values, while researchers continue to try to understand the fate of disease organisms in the burial environment.

INCINERATION Burning cattle carcasses in open pyres drew the public's attention in 2001. In the US, air curtain destructors and incineration units have been more commonly used to destroy carcasses from natural disasters and disease eradication efforts. These types of facilities provide more emission controls, but are often costly and limited in their treatment capacity.

LANDFILLING Disposal at regional landfills allows animal carcasses to be quickly removed from the infected farm. Landfilling, like other off-site disposal options, requires the transportation of potentially infectious material off the farm which poses biosecurity and logistical challenges. While these technical challenges can be addressed through effective planning, perception can often be the greatest obstacle.

Despite the implementation of strict cleaning and disinfection protocols at both the farm and the landfill sites, uninfected farmers are often uneasy about transporting infected carcasses concerned about health and safety implication to their workforce and the liability associated with the carcasses.

COMPOSTING Composting is a biological heating process that results in the natural degradation of organic resources (such as animal carcasses) by microorganisms. Microbial activity within a well-constructed compost pile can generate and maintain temperatures sufficient to inactivate the avian influenza virus. Composting for disease response was first implemented during an avian influenza outbreak in chickens in Delaware in 2004. In autumn of that year researchers in Virginia initiated a demonstration project to evaluate the effectiveness of in-house composting on turkeys.


Air curtain destructor used to dispose of poultry carcasses, Virginia, USA.


Overview of poultry carcass incineration site.


Cleaning and disinfecting a truck to transport carcasses to landfill.

Based on the result of this work, composting was used to control outbreaks of avian influenza in West Virginia and Virginia in 2007. The success of the composting method during these outbreaks resulted in this becoming a example, 108 of the 109 commercial poultry operations successfully composted their flocks.

The success of composting during the 2015 avian influenza outbreak was due to efforts to ensure consistency in implementing the process. The US Department of Agriculture (USDA) employed composting subject matter experts at each infected farm to ensure the composting process was effectively implemented to inactivate the avian influenza virus. During the outbreak, USDA's Composting Technical Team met weekly to gather lessons learned, discuss problem sites, and develop a national composting protocol.

Animal carcass disposal remains a significant weakness in many nations' comprehensive national strategy for biodefence. While incidents of high-consequence foreign animal diseases like African swine fever, avian influenza, and foot-and-mouth disease are increasing, response plans often lack comprehensive carcass disposal considerations. The next outbreak is likely just around the corner. Now is the time to revisit and update foreign animal disease response plans.

Gary Flory is the Agricultural Program Manager for the Virginia Department of Environmental Quality and an independent global consultant, trainer and speaker in emerging infectious diseases, counter-agroterrorism, One-Health.