Chapter 4
Public Health Lessons: Practicing and Teaching Public Health

> Unpredictability is a certainty in public health.
> (Unknown)

4.1 Local Public Health Case: Pediatric Fatality in a Refugee Resettlement Community

Background: Lead is a neurotoxin that can lead to an impairment in cognitive function, including brain damage and even death in young children. Young children are especially vulnerable to the effects of lead due to hand-to-mouth activity, nutritional status, and their developmental stage (ATSDR 2013a). In 2012, the Centers for Disease Control and Prevention (CDC) lowered the action level of concern from 10 micrograms of lead per deciliter of blood to 5 micrograms of lead per deciliter of blood (CDC 2013). A level of exposure for which no adverse health effects have been noted has not been identified (ATSDR 2013b).

Despite the advances in removing lead from paint, gasoline, industrial emissions, and drinking water in the USA, childhood lead poisoning (CLP) is a persistent public health problem for many American children who reside in urban areas. A specific population that experiences a disproportionate risk of the CLP problem consists of African refugee children who are resettled in older housing stock that still contains lead-based paint in these urban communities (Caron et al. 2013). Geltman et al. (2001) found that the prevalence of an elevated blood lead level (EBLL) was more than twice that in recently arrived refugee children compared to American children of the same age. Specifically, Geltman et al. (2001) reported that refugee children from Somalia, a developing country in Africa, were found to have the highest EBLL among refugee children who resettled in Massachusetts. Based on their work, Geltman et al. (2001) proposed that a child's "…refugee status should be considered a risk factor for lead poisoning" (p. 158).

Place: Manchester, New Hampshire (NH), is the state's largest urban area (in a predominantly rural state) and houses approximately 10 % of the state's entire population. About 75 % of the housing units in Manchester were built

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prior to the 1978 federal ban on lead paint and the housing in the center of this city is of very poor quality (MHD 2013a). Manchester is the most racially and ethnically diverse community in the state. The city's designation as a refugee resettlement community contributes to this richness in diversity. Manchester experiences disparity in socioeconomic status and health, similar to other larger urban communities:

> Manchester, New Hampshire represents an urban microcosm of the childhood lead poisoning problem. One-third of all childhood lead poisoning cases occur predominantly in the center of this urban community (MHD 2013a; NHDHHS 2006). In 2006, 2.7% of children in Manchester who had been screened for lead poisoning had EBLLs, as compared to 1.3% of the New Hampshire total (NHDHHS 2006). In 2007, approximately 25% of the lead-poisoned children in the local health department's caseload were refugees or children of refugees. (MHD 2013b)

Sargent et al. (1995) previously examined CLP in urban, suburban, and rural communities in Massachusetts and reported that "…those children living in communities with high rates of poverty, single-parent families, and pre-1950s housing and low rates of home ownership were 7–10 times more likely to have lead poisoning" (p. 531). The center city of Manchester reflects similar demographics and is a community at risk for CLP.

Pediatric Fatality: Although fatalities due to CLP are rare, the first pediatric fatality to occur in over a decade in the USA occurred in this community of Manchester, NH. The fatality occurred in a 2-year-old Sudanese refugee child who had resettled in 2000 to this community with her mother and siblings from a refugee camp in Egypt. The family resided in an apartment in a tenement building that was constructed in the 1920s. Approximately 8 weeks following resettlement, this child acquired an EBLL of 391 micrograms of lead per deciliter of blood. The CDC's action level in 2000 was 10 micrograms per deciliter of blood. Hence, this child's EBLL was 39 times above CDC's action level at that time. An environmental and epidemiological investigation determined that due to the child's exposure to lead paint dust and chips in the apartment she lived in with her family and her underlying conditions of pica (a craving for nonfood substances) and malnutrition resulted in her acquiring an EBLL in a short period of time. The child died as a result of complications triggered by the EBLL (Caron et al. 2001).

Furthermore, despite the existence of federal regulations developed by the Environmental Protection Agency (EPA) that require property owners and managers to provide families with information about lead poisoning and any lead hazards in the home before its sale or lease, the investigation into this case revealed that this information was not communicated in a manner that was understood by the mother of this child (Caron et al. 2001).

Lessons Learned: This tragic event underscored the need for attention to be paid to those public health problems that persist in the environment, i.e., those issues that the community may live with because there is no feasible solution to completely eliminate the risk. Due to the older housing stock in the community that contains

lead paint, the CDC named the community and its surrounding towns as a universal screening site. This means that every child at 1 and 2 years of age must be screened for exposure to lead (Caron and Serrell 2009). This is a form of secondary prevention. The Gold Standard is primary prevention where exposure to lead would not occur in the first place, thus the risk is removed from the environment. To achieve primary prevention of CLP, lead paint would need to be abated from every apartment unit in the city. However, this is a costly process that the municipality or property owners/managers are unable to afford. Yet, there are many families with lead-poisoned children who would argue that the benefits of primary prevention outweigh the costs.

This case also highlights the complexity of persistent public health problems, such as CLP. For instance, this particular family, not unlike other African refugee families, was illiterate in English as well as their own language. In addition, the refugee resettlement process is designed in a declining model of support where the refugees are placed in available housing, which is often of poor quality, and offered health benefits for a limited period of time, and employment is the benchmark of resettlement success not acculturation, good health, or community engagement (Caron and Tshabangu-Soko 2012).

This community was fortunate in that it already had a functional community coalition that was addressing the problem via policy development, distribution of resources, surveillance, and testing of at-risk children. Yet, it is important to consider the multifactorial issues affecting this persistent public health problem in this particular community. Selected issues are included below (Caron and Serrell 2009):

- Non-English speaking, at-risk population.
- Public health system that views the problem as complex due to the continuing influx of refugees and the number of agencies involved in refugee resettlement.
- Multiple stakeholders who view the problem differently and who offer varied, uncoordinated solutions.
- Intersect of socioeconomic factors, housing policies, cultural practices, English proficiency, and native language literacy.
- CLP exemplifies the failure of policy development and implementation in the community.
- Competing demands for food, shelter, clothing, employment for at-risk populations.
- Exposure results in health effects that are not visible until an EBLL is acquired.
- Providing education in a culturally competent manner.
- Distrust of community organizations by the at-risk African refugee population.
- Often, persistent public health problems "…possess no definitive resolutions…" so "…remediation must focus on how to best manage them" (Caron and Serrell 2009, p. 195).

If this tragic event occurred in your community, what questions would you ask? I offer the following questions for you to consider from a practitioner and educator perspective:

1. How could we prevent children from being poisoned by lead in our community considering that practical solutions are difficult to implement due to the high cost of lead-abatement measures?
2. Are there primary and secondary prevention tools we could implement and evaluate in our community? How will we provide lead prevention education for families for whom English is not their first language? There are over 70 different languages spoken in the Manchester, NH, school system (MHD 2013a). It is not feasible to provide translation services for every dialect. How would you educate about a serious public health issue, such as CLP, for which there are no visible signs or symptoms until there is an EBLL?
3. Does the community have a plan to address this public health issue? Has the community, who lives with the issue (i.e., refugees, "working poor"), been invited to participate with public health practitioners? Is there a community coalition formed to work on monitoring the issue and connecting families with testing services? How would you establish such a community group if one does not exist?
4. How would you partner with an academic institution with public health expertise to assist with providing knowledge, expertise, and resources?
5. How would you partner with the local health-care system (i.e., community health centers, hospitals, physician practices) to assure that they are following CDC testing guidelines and to assist with consistent outreach and prevention education efforts?
6. Are there refugee resettlement services developed by resettled refugees who can assist with contacting an often hard-to-reach population to offer peer education? How would you engage this social service agency?
7. What data should you be collecting? How will you access these data? Who is the "keeper" of the data? How will you conduct surveillance of the public health issue?
8. What stakeholders in the public health system should be invited to address the problem? If a stakeholder refuses to come to the "table" to work on the issue because they believe the issue is either not under their purview or is too complex to address, how would you engage this key partner?
9. Policies pertaining to lead paint in housing and occupancy vary from state to state. How would you amend the current (if any) lead housing policies in your community or state? Would public health enforcement laws be necessary (i.e., citations for property owners who do not comply with the developed policy)? Whom would you work with to develop and enact such policies?
10. This case demonstrates a very tragic, albeit rare, event. With so many competing demands on the public health system, and the fact that CLP is a persistent public health problem that the community has lived with for generations, and the costly abatement measures—should CLP be in the "top ten" of issues for communities, similar to Manchester, NH, to be concerned about? Why or why not?
11. If we addressed CLP in the community, what other public health issues could potentially be lessened or mitigated?

12. How does the refugee resettlement process exacerbate CLP? Should the refugee resettlement process be redesigned? If so, how?
13. Should communities with refugee children poisoned by lead request a moratorium for refugee resettlement until the community can provide quality housing that does not pose a health risk? What are the implications of a moratorium for the resettled refugees and the community?
14. How would you engage the refugee resettlement agencies, the social service agencies developed by refugees, and the refugees themselves in a coordinated effort to reduce CLP?
15. How would you know what the newly resettled refugee concerns are and how they compare to their counterparts who have been living in the community for a period of time?

The answers to many of these questions may include more resources, more expertise, and more community support. I agree with this assessment. However, often, the public health principles that guide us are challenging to implement "on the ground." CLP is a very real issue for this community. The number of refugees affected by this public health problem is influenced by the type of refugee who is resettled in the community. For instance, refugee children of parents who speak English and have a secondary and/or postsecondary education tend to not experience an EBLL. This community is not able to request from which country the "newcomers" will arrive. Box 4.1 highlights selected public health tools that should be utilized by a competent public health workforce addressing CLP among a refugee population in their community. These skills are not meant to be exhaustive but are important for public health practitioners and educators of the public health workforce to consider when working on this type of public health problem.

Box 4.1 Public Health Skills to Address CLP in a Refugee Resettlement Community

- *Engage the community* in the public health issue being addressed. Community-based participatory research (CBPR) is one approach to involve the community in addressing the public health issue that they live with on a daily basis.

  CBPR "…in public health focuses on social, structural, and physical environmental inequities through active involvement of community members, organizational representatives, and researchers in all aspects of the research process. Partners contribute their expertise to enhance understanding of a given phenomenon and to integrate the knowledge gained with action to benefit the community involved". (Israel et al. 1998, p. 173)

Serrell et al. (2009) previously identified four core values that were important to progress when building community capacity to address CLP: "…adaptability, consistency, shared authority, and trust as core values for such partnerships" (p. 58).

- *Build academic–community partnerships* based on CBPR principles (see above). These partnerships do not require the presence of a local academic institution but could operate via distance technology so the correct expertise for the specific public health issue is accessed. It is important to note that it can take time to build operational partnerships.
- *Collect data* from screening facilities (e.g., local health department, primary care physicians, community health centers). These data may be centralized in a state CLP and prevention program.
- *Analyze the data* for descriptive purposes to know the demographics of the affected population and the at-risk population.
- *Implement primary prevention* via culturally and linguistically appropriate educational methods.
- Implement secondary prevention via blood screening. Assure screening is being conducted by communicating with screening facilities and engaging in medical record audits.
- *Develop policy* that will be protective of the resident and places the burden of care on the property owner/manager to abate lead from the dwelling.
- *Consider the community's ecology* (i.e., its social, cultural, economic, and political composition) and social context of risk. Caron et al. (2013) proposed the following:

  > …that communities are important determinants in health-related problems for refugee populations. Each community has its own environment and public health system that interacts with each other to influence health risks and risk perceptions of its populations. (p. 660)

- *Partner* with others in the public health system (e.g., housing development, refugee resettlement agencies, property managers, etc.) and learn their barriers to the problem, as well as their perception of the public health issue so a feasible and equitable solution or management strategy may be developed.
- *Evaluate* progress by reviewing the data to determine whether or not there is a decrease in the number of children poisoned by lead. Based on the data, which will tell the story, targeted or tailored approaches for the affected population may be warranted. For example, peer education efforts may be implemented, temporary removal of a family from a home with lead paint until the lead can be removed or covered to meet housing code approval, visual aids for education, nurse case management, environmental inspection of the dwelling, etc.

The type of public health professional required to address this specific public health issue includes, but is not limited to, the following:

- Public health director
- Environmental health specialist
- Nurse case manager

- Epidemiologist
- Community health education specialist
- School nurse
- Peer educator
- Refugee resettlement case worker
- Housing inspector
- Local leadership (e.g., mayor)

4.2 State Public Health Case: Drug Diversion and a Hepatitis C Outbreak

Background: "Hepatitis C is an infection caused by a virus that attacks the liver and may cause liver damage, liver failure, and even cancer" (NHDHHS 2013, p. 8). Specifically, hepatitis C arises as a result of a blood-borne infection. For the majority of those infected, the acute phase of the infection is asymptomatic. In addition, for some infected individuals, their immune system will clear the infection. However, there is a risk that many people infected with the hepatitis C virus (HCV) will develop an active, chronic infection and without therapy some will develop liver cirrhosis, liver disease, liver failure, and/or liver cancer (NHDHHS 2013).

The CDC estimates that there are approximately 4.1 million people who have been infected with HCV and 3.2 million people with active infection in the USA (CDC 2013):

> Risk factors for acquiring hepatitis C include injection drug use, tattoos with contaminated supplies, use of infected blood products or occupational needlestick injury, transmission during pregnancy, and sexual transmission (which is usually very uncommon). The risk of acquiring HCV from a needlestick injury with blood from an HCV-infected patient is approximately 1–2%, but it depends on the level of virus in the blood and the nature of the injury. (CDC 2013)

HCV can be treated with an antiviral drug regimen that is administered for a period of several months and is quite costly (NHDHHS 2013).

> For those who are eligible for therapy and have not been treated in the past, the likelihood of cure is very good in acute infection (80–90%). With newer available agents, the response rate is very good in chronic infection as well (60–80%). (NHDHHS 2013, p. 10)

Specific to the transmission of HCV in health-care settings, risk factors include the following:

> 1. Reuse of syringes for more than one patient or to access medication containers used for more than one patient; 2. Sharing of contaminated equipment, like point of care or podiatry equipment; and/or 3. Drug diversion by an infected healthcare worker (HCW). Transmission can occur when the infected HCW self-administers an injectable narcotic, intended for patient administration, fills the syringe with saline, and places the used syringe back into the circulation for patient administration. (NHDHHS 2013, p. 10)

Reportable diseases are those that "…hospitals, laboratories, healthcare providers, childcare centers, schools, and local boards of health are required to report diagnosis of certain infectious diseases to DPHS" (Division of Public Health Services; NHDHHS 2013, p. 10):

> In New Hampshire, HCV infection is not in and of itself a reportable disease. However, any suspected outbreak, i.e., the occurrence of illness or disease in a community at a rate clearly in excess of what is normally expected, is reportable to DPHS under the mandatory reporting law, Part He-P 301 Communicable Diseases. (NH General Court 2008; NHDHHS 2013, pp. 10–11)

Reported infections are investigated by public health nurses and epidemiologists at the New Hampshire DPHS.

> The purpose of the investigation is to prevent additional illness in the population, which may be accomplished through a variety of methods, depending on the specific disease. Some examples of how public health works to prevent additional illness include identifying close contacts to the infected person and recommending prophylaxis medication to prevent them from becoming ill (antibiotics, antivirals, vaccine, etc.), providing disease prevention recommendations (washing hands, covering cough, etc.), recognizing outbreaks, and identifying and controlling their source (healthcare-associated outbreaks, foodborne outbreaks, etc.). (NHDHHS 2013, pp. 10–11)

Investigation Overview An outbreak of HCV was identified at Exeter Hospital in Exeter, New Hampshire, in 2012. Of the initial four patients diagnosed with HCV, one of the individuals was a traveling medical technician in the cardiac catheterization laboratory of the hospital. Further investigation by the New Hampshire Department of Health and Human Services (NHDHHS) revealed that the cause of the outbreak was drug diversion ("…the stealing of narcotic pain medication intended for patients for self use"; NHDHHS 2013, p. 6) by the infected medical technician.

The testing of potential patients was conducted based on the hospital units to which the medical technician had access, i.e., patients seen in the cardiac catheterization laboratory and those who were patients in the operating room and the intensive care unit. For these areas, 1200 patients who had procedures in the cardiac catheterization laboratory during a time period that overlapped the medical technician's time of employment were tested for HCV:

> Of the 1,074 who were tested, 32 patients were identified with active HCV infection with the NH HCV outbreak strain. 27 additional patients had evidence of past HCV infection (and their virus could not be tested) and 9 of them were categorized as probable cases (n = 4) and suspect cases (n = 5) based on epidemiological information. (NHDHHS 2013, p. 6)

To contact those who were patients in the operating room or intensive care unit during this same time period, NHDHHS partnered with local health departments and clinics to conduct rapid HCV testing on site "…for the first time in an outbreak setting" (NHDHHS 2013, p. 6).

> …2,679 patients were tested and…no additional cases of active HCV infection matching the outbreak strain were identified. Additional investigation of other units in

> EH [Exeter Hospital] did not reveal sufficient evidence to suggest risk from the infected HCW. (health-care worker; NHDHHS 2013, p. 6)

The medical technician worked for a staffing agency that assigned him to 18 different hospitals in seven other states (Arizona, Georgia, Kansas, Maryland, Michigan, New York, and Pennsylvania) over a decade (Seelye 2012). In addition, he had been fired four times over this time span for allegations of drug use and theft (Associated Press 2013). Thus, the potential for exposure of patients in other states existed and resulted in a multistate outbreak investigation that was conducted by the CDC. "As of May 2013, 13 other cases of the NH HCV outbreak strain were identified and confirmed in two other states (Kansas and Maryland)" (NHDHHS 2013, p. 6).

The traveling medical technician pled guilty to "…obtaining controlled substances by fraud…[and] tampering with a consumer product" (FBI 2013):

> …he devised a scheme to divert and steal the controlled substance Fentanyl for personal use and abuse. Fentanyl is a powerful anesthetic intended for patients undergoing medical procedures, among other uses. [He] admitted that he would surreptitiously take syringes of Fentanyl prepared for patients, inject himself with the drug, and refill the syringes with saline, causing the syringes to become tainted with his infected blood. He then replaced the tainted syringes for use on unsuspecting patients. Consequently, instead of receiving the prescribed dose of Fentanyl together with its intended anesthetic effect, patients actually received saline that was tainted with the same strain of Hepatitis C carried by [the medical technician]. (FBI 2013)

At the conclusion of the investigation, the NHDHHS (2013) recommended the following action areas:

- "Increase regulation and improve information sharing regarding allied healthcare workers."
- "Strengthen healthcare systems to promote prevention and early detection of drug diversion."
- "Assure optimal response to healthcare associated outbreaks to protect patient safety." (p. 63)

Lastly, as of September 2013, the NHDHHS had partnered with the National Association of Drug Diversion Investigators (NADDI) in Maryland and HONOReform, Hepatitis Outbreaks National Organization for Reform, a patient advocacy group based in Nebraska to influence national policy regarding the regulation of medical technicians (Associated Press 2013).

Drug Diversion: A Primer

> Any criminal act involving a prescription drug.
> (National Association of Drug Diversion Investigators)

Inciardi et al. (2007) define prescription drug diversion as the following:

> …the unlawful channeling of regulated pharmaceuticals from legal sources to the illicit marketplace, and can occur along all points in the drug delivery process, from the original manufacturing site to the wholesale distributor, the physician's office, the retail pharmacy, or the patient. (p. 171)

In 2012, the CDC declared that the overdose on prescription drugs had reached an epidemic status (CDC 2012a). To further illustrate this point: "In 2007, approximately 27,000 unintentional drug overdose deaths occurred in the United States, one death every 19 minutes" (CDC 2012a, p. 10). Opioid analgesics are responsible for the increase in overdose-related deaths (CDC 2012a).

Regarding the demographics of the abuse of and deaths from opioid analgesic use, it is

> …highest among men, persons aged 20–64 years, non-Hispanic whites, and poor and rural populations. Persons who have mental illness are overrepresented among both those who are prescribed opioids and those who overdose on them. (CDC 2012a, p. 774)

Of those who are prescribed opioid analgesics, the populations of greatest concern are those who seek care from multiple physicians and potentially take advantage of the physician's sensitivity to the patient's pain management (CDC 2012a). It is this population that is estimated to not only comprise approximately 40% of overdose cases on opioid analgesics but also are diverting drugs for self-use or providing them to others (CDC 2012a). Thus, the CDC recommends that prevention efforts should focus on addressing the following target populations: patients who consume opioid analgesics in high doses and those who seek care from multiple physicians and receive high doses of opioid analgesics. This latter group is likely to be involved in drug diversion (CDC 2012a). Inciardi et al. (2009) report that the primary populations involved in drug diversion include "…drug dealers, friends and relatives, smugglers, pain patients, and the elderly, but these vary by the population being targeted" (p. 332).

Due to the complexity of the issue, several comprehensive prevention strategies have been proposed by the CDC and the American Medical Association:

- Restrict the number of reimbursement claims for opioid analgesic prescriptions written by a physician and filled by a pharmacy. This restriction is important for low-income populations on public health insurance, such as Medicaid, since this population presents as high risk for drug abuse (CDC 2012a).
- Monitor that the type and prescribed usage of the opioid medication aligns with the diagnoses (CDC 2012a).
- Develop and enforce legislation that prohibits "doctor shopping" for those physicians who will prescribe opioid analgesics in high doses; elimination of "pill mills" where controlled pain medicine is distributed with little to no medical oversight; and the requirement of a physical examination prior to receiving a prescription for an opioid (CDC 2012a).
- Provide medical education via evidence-based practice for general and specialist physicians regarding opioid use and risks, thus holding them accountable for their prescribing practice (CDC 2012a).
- Fund, at the national level, the National All Schedules Prescription Electronic Reporting Act (NASPER). NASPER provides

> …physicians with up-to-date, patient-specific information at the point of care in order to support appropriate prescribing and to identify those patients who were abusing or diverting prescription drugs. (AMA 2013, p. 1)

NASPER was intended to fund prescription drug monitoring programs at the state level (AMA 2013).

- Develop locations that will take back unused or expired medications (AMA 2013).
- Expand access to addiction treatment and recovery centers (AMA 2013).
- Support NADDI:

> …a non-profit organization that facilitates cooperation between law enforcement, health-care professionals, state regulatory agencies and pharmaceutical manufacturers in the prevention and investigation of prescription drug diversion. (NADDI 2013)

Lessons Learned: If this unfortunate event occurred in your hospital, what questions would you ask? I offer the following questions for you to consider from a practitioner and educator perspective:

- How could a medical technician with a suspect record be passed from hospital to hospital? Why did the staffing agency not disclose the issues with this employee? Did the hospital conduct a thorough background check?
- What are our hiring processes? How can we see "red flags" before the individual of concern is hired? Who should be involved in the hiring process?
- Is there a system in place for employees to report suspicious behavior to senior management and human resources? Should there be incentives to report employees observed in negligent behavior?
- Do we have a policy to prevent drug diversion in the workplace? If so, how can we improve the policy?
- Should we implement mandatory, unannounced drug testing for all hospital employees who engage in patient contact? Should termination of employment be implemented if an employee refuses to cooperate with this policy?
- Is there a reporting system in place so that other hospitals across the country could be notified about the infected individual's reason for termination?
- Should the penalty for engaging in drug diversion be suspension or removal of one's license or certification to practice their skill in a health-care setting?
- What other partners in the public health system should be involved in this issue? How can we partner more effectively with law enforcement and drug rehabilitation centers, for example?
- Should a public registry for those health-care workers found guilty of drug diversion be created at the national level? Should access to such a registry be limited to health-care hiring agencies? Should the public also have access to this registry?
- How can we do a better job in protecting our patients?
- How is drug diversion a public health problem, as well as a health-care problem?

Box 4.2 highlights selected public health tools that should be utilized by a competent public health workforce addressing a HCV outbreak in their community due to drug diversion. These skills are not meant to be exhaustive but are important for public health practitioners and educators of the public health workforce to consider when working on this type of public health problem.

Box 4.2 Public Health Skills to Address a HCV Outbreak Due to Drug Diversion

- *Conduct* an outbreak investigation.
  - Confirm that there are more cases than expected.
  - Consider whether there is ongoing transmission.
  - Define an outbreak-related case.
  - Confirm existing number of outbreak-related cases.
  - Investigate existing number of outbreak-related cases by reviewing all available data (e.g., medical records, laboratory results, interviews).
  - Determine the infectious period for the outbreak.
  - Determine potential sites of contact in a facility and potential family and others who could be exposed.
  - Determine the exposed cohort of people at each site who may have been present during the case's infectious period.
  - Define the screening action plan (including eligibility, implementation, and follow-up).
  - Create a media plan.
  - Develop and implement recommendations to prevent future outbreaks for particular populations or settings.
  - Evaluate the outbreak response including whether implementations were effective in stopping transmission.
  - Identify lessons learned to prevent future outbreaks (CDC 2012b).
- *Communicate* with the affected patients, their families, and the public as soon as the act of negligence is realized.
- *Improve* communication between the public health system and the health-care system professionals.
- *Develop* a policy that would serve as safety measures to protect patient populations from health-care workers engaged in drug diversion. Examples of such policies could include the establishment of a public registry of health-care workers found to be guilty of drug diversion; mandatory, unannounced drug testing of health-care workers whose employment involves patient contact; coordination of care so the number of physicians prescribing pain medications is limited; continued reporting of mandatory conditions.
- *Collaborate* with public health system partners, such as local health departments and law enforcement to assist with drug diversion education initiatives, drug and disease testing, and drug diversion investigations.
- *Support* national initiatives, such as NASPER and HONOReform.
- *Engage* in ongoing surveillance of drug diversion in the health-care setting.
- *Educate* health-care employees on proper reporting of such adverse events.

The type of public health professional required to address this specific public health issue includes, but is not limited to, the following:

- State medical director
- Epidemiologist
- Public health nurses
- Health-care providers
- Laboratory workers
- Public information officer
- Public health administrators
- Hospital administrators
- Law enforcement personnel
- Registrars of state and national databases

4.3 National Public Health Case: Antibiotic Resistance

> Antibiotic resistance is rising for many different pathogens that are threats to health. If we don't act now, our medicine cabinet will be empty and we won't have the antibiotics we need to save lives. (Dr. Thomas Frieden, Director, CDC)

Overview of Public Health Threat Antibiotic use arises from the inappropriate use of antibiotics in humans and animals. For example, with humans, physicians often prescribe an antibiotic when one is not needed and/or the patient does not complete the entire course of antibiotic treatment. Thus, "…up to 50% of all antibiotics prescribed for people are not needed or are not optimally effective as prescribed" (CDC 2013a, p. 11). Antibiotic resistance can occur both within and outside of health-care facilities, yet deaths related to antibiotic resistance are most common in the health-care setting (CDC 2013a). Furthermore,

> Antibiotics are also commonly used in food animals to prevent, control, and treat disease, and to promote the growth of food-producing animals. The use of antibiotics for promoting growth is not necessary, and the practice should be phased out. (CDC 2013a, p. 11)

Antibiotic resistance is not only a public health problem in the USA but it also presents as a major public health problem on a global scale. The statistics that demonstrate the magnitude of this public health issue on a national scale are staggering:

- "Each year in the United States, at least 2 million people acquire serious infections with bacteria that are resistant to one or more of the antibiotics designed to treat those infections."
- "At least 23,000 people die each year as a direct result of these antibiotic-resistant infections."
- "Many more die from other conditions that were complicated by an antibiotic-resistant infection." (CDC 2013a, p. 11)

The CDC states that these figures most likely underestimate the magnitude of the problem since

> …the distinction between an antibiotic-resistant infection leading directly to death, an antibiotic-resistant infection contributing to a death, and an antibiotic- resistant infection related to, but not directly contributing to a death are usually determined subjectively, especially in the preponderance of cases where patients are hospitalized and have complicated clinical presentations. (CDC 2013a, p. 18)

Thus, these statistics could be significantly higher. Moreover, the health-care burden this preventable public health issue creates is multifaceted and can include the following cost-related issues for the health-care system:

> …prolonged and/or costlier treatments, extend hospital stays, necessitate additional doctor visits and healthcare use, and result in greater disability and death compared with infections that are easily treatable with antibiotics. (CDC 2013a, p. 11)

These health-care costs are estimated to be in excess of US$20 billion and societal costs due to a loss of productivity are estimated to be US$35 billion a year (Roberts et al. 2009).

A further complication of antibiotic resistance is seen in those populations who have underlying disease, such as diabetes, asthma, and rheumatoid arthritis. These groups, in addition to those patients who may undergo chemotherapy, organ and bone marrow transplant surgery, joint replacement surgery, or end-stage renal disease are significantly dependent on antibiotic use to fight off infections (CDC 2013a). These subgroups represent a susceptible population to infection especially if antibiotics that are heavily relied upon do not work optimally for these patients.

The CDC readily acknowledges the following significant areas of improvement in the body of knowledge regarding antibiotic resistance:

- "Limited national, state, and federal capacity to detect and respond to urgent and emerging antibiotic resistance threats….we do not have a complete picture of the domestic incidence, prevalence, mortality, and cost of resistance."
- "Currently, there is no systematic international surveillance of antibiotic resistance threats. Today, the international identification of antibiotic resistance threats occurs through domestic importation of novel antibiotic resistance threats or through identification of overseas outbreaks."
- "Data on antibiotic use in human healthcare and in agriculture are not systematically collected. Routine systems of reporting and benchmarking antibiotic use wherever it occurs need to be piloted and scaled nationwide."
- "Programs to improve antibiotic prescribing are not widely used in the United States. These inpatient and outpatient programs hold great promise for reducing antibiotic resistance threats, improving patient outcomes, and saving healthcare dollars."
- "Advancing technologies can identify threats much faster than current practice. Advanced molecular detection (AMD) technologies, which can identify AR [antibiotic resistance] threats much faster than current practice, are not being used as widely as necessary in the United States." (CDC 2013a, p. 27)

Community Example of Antibiotic Resistance

> CDC estimates 80,461 invasive MRSA infections and 11,285 related deaths occurred in 2011. An unknown but much higher number of less severe infections occurred in both the community and in healthcare settings. (CDC 2013a, p. 77)

Approximately 30% of the population has *Staphylococcus aureus* residing in their nose and on their skin with no resultant infection (NIAID 2013). *Staphylococcus aureus* is a bacterium that can become resistant to many antibiotics, including methicillin (methicillin-resistant *Staphylococcus aureus*, MRSA). Among the community, MRSA presents most commonly as a skin infection. In health-care facilities, "MRSA causes life-threatening bloodstream-infections, pneumonia and surgical site infections" (CDC 2013b). Fortunately, according to the CDC, cases of hospital-acquired MRSA (HA-MRSA) infections dropped approximately 54% over a 9-year period between the years of 2005 and 2011 (CDC 2013a). However, "…if MRSA infection rates increase or MRSA strains become more resistant to other antibiotic agents, then MRSA may change from a serious to an urgent threat" (CDC 2013a, p. 20).

Community-acquired MRSA (CA-MRSA) infections can occur

> …when a person is in certain activities or places that involve crowding, skin-to-skin contact, and shared equipment or supplies. This might include athletes, daycare and school students, military personnel in barracks, and people who recently received inpatient medical care. (CDC 2013b)

Chen et al. (2011) propose that rather than identify population groups at risk for CA-MRSA, diagnostic and preventive approaches should focus on addressing risk factors for CA-MRSA, including "…poor personal hygiene, transmission through contaminated environmental services, and care of non-intact skin" (p. 444).

CA-MRSA infections typically occur in otherwise healthy people with no recent stay in a health-care facility. In contrast, hospital-acquired MRSA (HA-MRSA) is contracted by patients in a health-care facility and has been attributed to invasive surgical procedures and poor infection control practices (NIAID 2013). Health-care providers are concerned about those HA-MRSA infections that are potentially brought into the community once the patient is discharged (Johnson 2013).

Prevention Measures The CDC's report titled *Antibiotic Resistance Threats in the United States, 2013*, is an excellent resource on this topic and provides a comprehensive overview of specific, ranked antimicrobial resistance threats, including prevention measures. An abbreviated outline of prevention measures for CA-MRSA and HA-MRSA are presented here. The reader is encouraged to review the CDC's report on this topic for more extensive information.

At the state and community level, it is important to:

- "Know resistance trends in your region."
- "Coordinate local and regional infection tracking and control efforts."
- "Require facilities to alert each other when transferring patients with any infection." (CDC 2013a)

The North Carolina Department of Public Health proposes the following core activities for public health professionals to engage in when managing CA-MRSA as a public health threat:

- "Recognize outbreaks"
  - For example, "An isolated case on a wrestling team; Several cases within the same prison unit in a month; more than one case in a child care classroom in a month" (NCDPH 2013).
- "React to community concerns"
  - "Consider the risk factors for transmission; the 5 Cs"
  - "Contact (skin-to-skin)"
  - "Contaminated items and surfaces (wrestling mats, weight room equipment)"
  - "Comprised skin integrity (cuts and abrasions)"
  - "Crowding (locker rooms)"
  - "Cleanliness (absence)" (NCDPH 2013)
- "Respond with public health control measures"
  - "Active surveillance to determine scope of problem in specific setting"
  - "Assure specific control measures for wound care and containment of drainage"
  - "Stop any sharing of personal items and promote enhanced personal hygiene"
  - "Consider exclusion from contact activities, especially with actively draining or packed wounds"
  - "Achieve and maintain a clean environment" (NCDPH 2013)

Selected examples of actions health-care administrators and providers can take include the following:

- "Require and strictly enforce CDC guidance for infection detection, prevention, tracking, and reporting."
- "Make sure your lab can accurately identify infections and alert clinical and infection prevention staff when these bacteria are present."
- "Prescribe antibiotics wisely."
- "Remove temporary medical devices such as catheters and ventilators as soon as no longer needed." (CDC 2013a)

Patients and their family members should:

- "Ask everyone, including doctors, nurses, other medical staff, and visitors, to wash their hands before touching the patient."
- "Take antibiotics exactly and only as prescribed." (CDC 2013a)

Hospital Example of Antibiotic Resistance

> CRE [Carbapenum-resistant Enterobacteriaceae] are nightmare bacteria…They pose a triple threat. They're resistant to all or nearly all antibiotics, they have high mortality rates and they can spread their resistance to other bacteria. (Dr. Thomas Frieden, Director, CDC ModernHealthcare.com, March 2013)

Carbapenem-resistant *Enterobacteriaceae* (CRE) is a hospital-associated infection that is difficult to treat because the bacteria, normally found in the gut, have become resistant to all antibiotics, including carbapenem, which is often considered a last resort type of antibiotic (CDC 2013c). According to the CDC (2013c),

> …CRE infections most commonly occur among patients who are receiving treatment for other conditions. Patients whose care requires devices like ventilators (breathing machines), urinary (bladder) catheters, or intravenous (vein) catheters, and patients who are taking long courses of certain antibiotics are most at risk for CRE infections.

Additional risk factors for CRE infections include a patient's functional status and a stay in the hospital's intensive care unit (Schwaber et al. 2008). Research conducted by Perez et al. (2010) suggests that acute care health facilities could be significant reservoirs for the transmission of CRE infections. Furthermore, CRE infections "…can contribute to death in up to 50% of patients who become infected" (CDC 2013c).

Approximately 9300 CRE infections occur in health-care facilities in the USA. "Each year, approximately 600 deaths result from infections caused by the two most common types of CRE, carbapenem-resistant *Klebsiella spp*. and carbapenem-resistant *E. coli*" (CDC 2013a). The incidence of CRE infections is on the rise, increasing sevenfold over the past decade (McKinney 2013). The CDC reports that "About 4% of U.S. short-stay hospitals had at least one patient with a serious CRE infection during the first half of 2012. About 18% of long-term acute care hospitals had one" (CDC 2013a).

Prevention Measures The CDC has a comprehensive "Detect and Protect" program for CRE infections. The reader is referred to the following website which provides information about this program (http://www.cdc.gov/hai/pdfs/cre/CDC_ Detect Protect.pdf). An abbreviated outline of prevention measures for CRE infections is presented here:

> State and local health departments are well positioned to lead CRE control efforts because of their expertise in surveillance and prevention and their ability to interact among all the health-care facilities in their jurisdiction. (Jacob et al. 2013, p. 167)

Thus, at the state and community level it is important to:

- "Know CRE trends in your region";
- "Coordinate regional CRE tracking and control efforts in areas with CRE. Areas not yet affected by CRE infections can be proactive in CRE prevention efforts";
- "Require facilities to alert each other when transferring patients with any infection";
- "Consider including CRE infections on your state's Notifiable Diseases list". (CDC 2013a)

Selected examples of actions health-care administrators and providers can take include the following:

- "Require and strictly enforce CDC guidance for CRE detection, prevention, tracking, and reporting";
- "Make sure your lab can accurately identify CRE and alert clinical and infection prevention staff when these bacteria are present";
- "Know if patients with CRE are hospitalized at your facility, and stay aware of CRE infection risks. Ask if your patients have received medical care somewhere else, including another country";
- "Follow infection control recommendations with every patient, using contact precautions for patients with CRE. Whenever possible, dedicate rooms, equipment, and staff to CRE patients";
- "Prescribe antibiotics wisely";
- "Remove temporary medical devices as soon as possible." (CDC 2013a)

Patients should

- "Tell your doctor if you have been hospitalized in another facility or country";
- "Take antibiotics only as prescribed";
- "Insist that everyone wash their hands before touching you." (CDC 2013a).

Public Health Action Plan

> [To address antibiotic resistance] "…will require expanded and coordinated action from clinicians, facility administrators, and public health officials." (Jacob 2013)

Guh et al. (2013) reported that of 11 state health departments surveyed, all perceived emerging infections, such as CRE, as a public health priority for prevention. Yet, the extent to which these states can engage in prevention-oriented activities depends upon available resources and existing partnerships among their agencies, hospital administrators, and others in the public health and health-care systems.

The CDC has developed core actions to help prevent the development of antibiotic resistance:

- "Preventing infections, preventing the spread of resistance";
- "Tracking";
- "Improving antibiotic prescribing/stewardship";
- "Developing new drugs and diagnostic tests." (CDC 2013a, p. 31)

Lessons Learned The main question is how do we, as public health practitioners and educators, work collaboratively with our partners in the health-care system to prevent antibiotic resistance in the health-care setting and the community?

Building upon the public health action plan set forth by the CDC, Box 4.3 highlights selected approaches and tools to prevent infections, broaden our surveillance approach, and improve antibiotic stewardship. These skills are not meant to be exhaustive but are important for public health practitioners and educators of the public health workforce to consider when working on this type of public health problem.

Box 4.3 Public Health Skills to Address Antibiotic Resistance

Preventing Antibiotic Resistance in the Community

- CDC has several surveillance programs to monitor antibiotic resistance trends in the community:
- Active Bacterial Core surveillance (ABCs): Tracks infections caused by *Neisseria meningitides*, *Streptococcus pneumonia*, Groups A and B *Streptococcus* and MRSA (CDC 2013a)
- Gonococcal Isolate Surveillance Project (GISP): Collects isolates from infections of gonorrhea (CDC 2013a)
- National Tuberculosis Surveillance System (NTSS; CDC 2013a)
- Healthcare-Associated Infections–Community Interface (HAIC): Tracks *C. difficile* infections (CDC 2013a)
- FoodNet: Active surveillance network for food-borne diseases (CDC 2013a)
- National Antimicrobial Resistance Monitoring System (NARMS):

  A national public health surveillance system that tracks changes in the susceptibility of foodborne and other enteric bacteria to antibiotics of human and veterinary medical importance. (CDC 2013a, p. 39)

- CDC has activities to reduce the spread of antibiotic-resistant infections in the community (CDC 2013a):
  - Contact tracing
  - Vaccination
  - Treatment guidelines
  - Promotion of safe sex

Preventing Antibiotic Resistance in the Health-Care Setting

> …reducing antibiotic use in a single facility can reduce resistance in that facility. (CDC 2013a, p. 33)

- "CDC's National Healthcare Safety Network (NHSN) is used by healthcare facilities to electronically report infections, antibiotic use, and resistance" (CDC 2013, p. 32). The more hospitals that report to this database will enable CDC to track the level of antibiotic resistance in all bacteria, as well as track antibiotic usage. "This information will allow facilities to target areas of concern, to make needed improvements and to track the success of their efforts" (CDC 2013a).
- "CDC manages the Get Smart program [http://www.cdc.gov/getsmart], a national campaign to improve antibiotic prescribing and use in both outpatient and inpatient settings" (CDC 2013a, p. 33). "One core activity is the development and implementation of the Antibiotic Stewardship Drivers

and Change Package [http://www.cdc.gov/getsmart/healthcare/improve-efforts/driver-diagram/index.html], a tool that provides healthcare facilities with a menu of interventions they can select from to improve antibiotic use" (CDC 2013a, p. 33).
- "Stewardship is a commitment to always use antibiotics only when they are necessary to treat, and in some cases prevent disease; to choose the right antibiotics; and to administer them in the right way in every case. Effective stewardship ensures that every patient gets the maximum benefit from the antibiotics, avoids unnecessary harm from allergic reactions and side effects, and helps preserve the life-saving potential of these drugs for the future." (CDC 2013a, p. 41)

Developing New Antibodies and Diagnostic Tests

- "…new antibiotics will always be needed to keep up with resistant bacteria as well as new diagnostic tests to track the development of resistance". (CDC 2013a, p. 44)

The type of public health professional required to address this specific public health issue includes, but is not limited to, the following:

- State medical director
- Physicians
- Epidemiologist
- Public health nurses
- Laboratory workers
- Infection control specialists
- Public information officer
- Public health administrators
- Hospital administrators
- School system personnel
- Jail and prison system personnel
- Childcare personnel

4.4 International Public Health Case: Middle East Respiratory Syndrome-Coronavirus

MERS-CoV is a "threat to the entire world." (Dr. Margaret Chan, Director, WHO)

Snapshot of an Evolving Outbreak: A new virus emerged in 2012 in Saudi Arabia called the Middle East Respiratory Syndrome (MERS) which is caused by a coronavirus (to which the virus responsible for the common cold belongs) called MERS-CoV. MERS-CoV causes a severe respiratory illness that is acute in nature

and is believed to be spread via direct transmission. The case fatality rate is high in that approximately half of the people with the MERS-CoV infection have died. "However, the virus has not shown to spread in a sustained way in communities. The situation is still evolving" (CDC 2013). To date, clusters of MERS-CoV cases have been documented in the following countries: Saudi Arabia, Qatar, Jordan, United Arab Emirates, Tunisia, UK, France, and Italy. No cases have yet been identified in the USA. A total of 130 cases (58 deaths) have been reported as of September 30, 2013 (CDC 2013).

MERS-CoV versus Severe Acute Respiratory Syndrome: The severe acute respiratory syndrome (SARS) pandemic was short lived but certainly tested the preparedness of our public health and health-care systems for a never-before-seen virus that was transmissible from animals to humans. MERS-CoV possesses some similarities to SARS in that both are believed to be evolved from the bat coronavirus, affect the lower respiratory system, and are transmitted via an airborne route (Breban et al. 2013). However, recent research has also indicated significant differences between these two coronaviruses. For example, Assiri et al. (2013) reported that patients diagnosed with MERS-CoV tended to be older men with underlying chronic medical conditions, including diabetes, heart disease, and renal disease. In addition, these researchers noted that the progression to respiratory failure occurred faster compared to SARS (Zumla 2013). Furthermore, these authors observed,

> In contrast to SARS, which was much more infectious especially in healthcare settings and affected the healthier and the younger age group, MERS appears to be more deadly with 60% of patients with co-existing chronic illnesses dying, compared with the 1% toll of SARS. (Zumla 2013)

Lastly, the authors note that it is possible we are only detecting the most serious of the MERS-CoV cases, and there are milder cases going undetected in the community (Zumla 2013). It is these milder cases that also require a case definition:

> Ultimately the key will be to identify the source of MERS infection, predisposing factors for susceptibility to infection, and the predictive factors for poor outcome. Meanwhile infection control measures within hospitals seem to work. (Zumla 2013)

Public Health Emergency? Although this is a new virus with a high case fatality rate and is of great concern to the public health and health-care communities, the World Health Organization (WHO)'s Emergency Committee of the International Health Regulations

> [unanimously decided in July 2013]…that with the information now available, and using a risk-assessment approach, the conditions for a Public Health Emergency of International Concern (PHEIC) have not at present been met. (WHO 2013)

"While not considering the events currently to constitute a PHEIC, Members of the Committee did offer technical advice for consideration by WHO and Member States on a broad range of issues, including the following:

- Improvements in surveillance, lab capacity, contact tracing and serological investigation
- Infection prevention and control and clinical management

- Travel-related guidance
- Risk communications
- Research studies (epidemiological, clinical and animal)
- Improved data collection and the need to ensure full and timely reporting of all confirmed and probable cases of MERS-CoV to WHO…." (WHO 2013)

Furthermore, there are no current travel bans to countries that have reported MERS-CoV cases. CDC's

> …travel notice is a Watch (Level 1) which advises travelers to countries in or near the Arabian Peninsula to follow standard precautions, such as hand washing and avoiding contact with people who are ill. (CDC 2013)

Similarly, WHO does not currently propose any travel or trade restrictions or special screening activities at points of entry into countries (Hopp 2013).

Public Health Preparedness CDC is actively monitoring the outbreak of MERS-CoV cases and working with international public health partners. To date, CDC has engaged in public health preparedness for this new virus in the following ways:

- "…developed molecular diagnostics that will allow scientists to accurately identify MERS cases."
- "…providing MERS-CoV testing kits to state health departments."
- "…developed interim guidance for preventing MERS-CoV from spreading in homes and communities to help protect people if there is ever a case of MERS in the U.S."
- "…offering recommendations to travelers when needed. CDC is also helping to assess ill travelers returning from affected areas."
- "…provide advice and laboratory diagnostic support to countries in the Arabian Peninsula and surrounding region." (CDC 2013)

Research by Breban et al. (2013) examined the transmissibility of MERS-CoV between humans which allowed them to estimate the potential for MERS-CoV to attain a pandemic status. The authors concluded "…that MERS CoV does not yet have pandemic potential" (Breban et al. 2013, p. 694). The authors recommend the following public health actions: "…enhanced surveillance, active contact tracing, and vigorous searches for the MERS-CoV animal hosts and transmission routes to human beings" (Breban et al. 2013, p. 694).

Knowledge Gaps Since this outbreak is still evolving, there are many gaps in our knowledge about the epidemiology of the infection, its clinical course, best diagnostic tools, patient management, and infection control. Assiri et al. (2013) did an outstanding job in formulating the questions the public health and health-care communities should be addressing. I have highlighted a few of these questions here for discussion purposes. The reader is referred to the descriptive study of MERS-CoV in Saudi Arabia that was conducted by Assiri et al. (2013) for further probing questions.

- "What is the natural reservoir of MERS-CoV?"
- "What is the source of exposure to MERS-CoV outside of the healthcare facility (e.g., animals, water, sewage, food)?"

- "What is the range of clinical presentation in the community (i.e., asymptomatic, mild, severe infection)?"
- "What is the infection rate in the community?"
- "What are the protective immune system mechanisms against MERS-CoV?"
- "What is the excretion pattern of the virus?"
- "What is the best clinical management of MERS-CoV?"
- "Is there a role for antiviral agents?"
- "How stable is MERS-CoV under different environmental conditions (e.g., dry surface, in vomit, sputum or diarrhea)?"
- "How can we efficiently disinfect against MERS-CoV?"
- "Is there a role for herd immunity against MERS-CoV?" (Assiri et al. 2013 p. 758)

Since this outbreak is emerging and the story is unfolding, I recommend the following skills be considered by public health practitioners and educators when addressing novel disease outbreaks. This listing (Box 4.4) is not meant to be exhaustive but is intended to generate a discussion about the interdisciplinary skill sets required to respond to and prevent unchartered public health territory.

Box 4.4 Public Health Skills to Address a Novel Disease Outbreak

- *Collaborate* with public health partners at the local, state, federal, and international levels.
- *Learn* from prior outbreaks. In the case of MERS-CoV, public health and health-care professionals and researchers are reviewing the similarities and differences between SARS and MERS-CoV. Reviewing how similar outbreaks were managed can help steer a similar, yet different outbreak investigation.
- *Participate* in videoconferences and conference calls sponsored by the CDC and WHO regarding the latest information and best practices pertaining to the epidemiology, prevention guidelines, clinical management, and risk communication with the public.
- *Engage* in diligent surveillance activities to help develop prevention methods specific to your local community.
- *Evaluate* these prevention efforts and adapt as necessary.
- *Document* the approaches implemented and their effectiveness as this may inform evidence-based practice for future disease outbreaks.
- *Be prepared,* to the extent possible, with sufficient material and personnel resources to plan, respond, and evaluate prevention efforts.
- *Inform* and *educate* the public about their risk and prevention efforts via media outlets.
- *Develop* and *enforce* appropriate public health policy (e.g., quarantine and isolation policies)
- *Prepare* for change. Outbreaks of novel diseases can be unpredictable as the virus evolves. Be prepared for changes in transmission, the target population, and disease management.

The type of public health professional required to address this specific public health issue includes, but is not limited to, the following:

- State medical director
- Physicians
- Epidemiologist
- Public health nurses
- Infection control specialists
- Laboratory workers and researchers
- Public information officer
- Public health administrators
- Hospital administrators
- Local and state leadership (e.g., mayor, governor)

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