Business as usual? Not a chance! A glimpse into the future of environmental public health in Canada

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Preamble

When Editor Andrew Papadopoulos asked if I would be interested in writing about the future of public health in Canada, I agreed without a second thought. I entered public health in the United Kingdom (1964) as a first-year public health student, and in 50 years the “basics” of protecting public health and safety have remained unchanged: hygienic food, clean water, safe housing, effective waste disposal, pest control, and infection control. . . No, I haven’t forgotten education, research, planning, legislation, and a host of applied sciences; my point is that the basics are applicable at any time and place. Here’s an even more important point: the basics don’t change, but the “contexts” certainly will, and probably far sooner and more drastically than most of us realize.

For the purposes of the discussion to follow, I have deliberately included a broader concept of “inspectors”, “practitioners”, and “environmental health professionals” to include Canadian Food Inspection Agency (CFIA) and federal officers as well as provincial and regional staff. This is to acknowledge a logical continuum of health protection personnel in Canada, recognizing that current legislative and administrative frameworks determine who-does-what.

General observations

More than 30 years have passed since the *Health for all by 2000* declaration (World Health Organization (WHO) 1981). Remarkable discoveries and achievements have been made, and by some measures this is still the safest, healthiest time in history. But in the larger reality, more people live in poverty than before, the gap between rich and poor has increased, 30,000 children still die annually from preventable and treatable diseases, and many health systems are deteriorating or crumbling from financial burdens. This is the first generation with an average life expectancy less than their parents (Hulsegge et al. 2013). If I were writing this article in the year 2000, the general theme would be “Hold the course; we seem to be heading in the right direction”. But 14 years into the millennium, the scenario has taken on a more sinister aspect; changes are coming whether we are ready or not.

“Business-as-usual” is overshadowed by two “elephants in the room”, whose presence will certainly influence any attempt to predict the path of public health in the near and continuing future. They’ve been here all along, but we’ve chosen to ignore them.

Elephant 1

In 1974 a best-selling report, *The Limits to Growth* (Meadows et al. 1972, 1974), predicted a major collapse of social and economic structures early in the 21st century unless substantial changes were made to technological progress and social behaviour, particularly with regard to energy and resources. The simulations demonstrated that without such changes, living conditions would return to the level of the early 20th century. The report was sidelined for 40 years, until September 2014, when a research team at the University of Melbourne’s Sustainable Society Institute (MSSI) found that the original *Limits to Growth* projections were “more” accurate than had been perceived. The MSSI report, *Is Global Collapse Imminent?*, incorporates the data from the intervening 40 years up to 2014 (Turner 2014) and the findings are alarming to say the least: The original *Limits to Growth* projections are confirmed, in many cases to a remarkable degree, and all analyses point to a multiple-system collapse between 2020 and 2030. A report from Massachusetts Institute of Technology’s Forrester Institute has also examined the correlation between global developments and their effect on the Earth, concluding “global economic collapse” in fewer than two decades if humans continue to consume natural resources at today’s rate. These and other reports affirm Charles Hall’s work on the “energy return on investment” and peak oil.

Widespread economic disruption invariably has complex negative effects both directly and indirectly on the health of populations, and the indications are that it may have already begun. We are entering unprecedented arguments over energy use, costs of extraction, transport and processing, as well as the impacts on climate. Individuals, communities, provinces, and stakeholders of all stripes are digging in and preparing for battle. As energy costs increase so do costs of everything else (and Middle-East conflicts will not improve the situation). Major currencies can be expected to become unstable and national debts are already astronomical. Industrial slowdowns in North America and Europe have resulted in layoffs, skyrocketing unemployment, more families below the poverty line, and further rounds of mortgage foreclosures. The United States and some EU states have still not recovered from the global financial collapse a decade ago, and further collapse will be catastrophic. On such a scale, Canada, in relatively calm waters, would quickly be influenced by the U.S. decline.

Elephant 2

Other than to the petrochemical industry, members of the Fraser Institute, the Flat-Earth Society, and other denialist groups, the evidence of accumulating anthropogenic damage to the atmosphere is now overwhelming and beyond question. (I am writing these words on 21 September 2014, and the People's Climate March is happening in New York and other cities around the world.)

The World Meteorological Association's data for 2013 shows the global average level of atmospheric carbon to be just under 400 parts per million¹, about 40% higher than in pre-industrial times "and higher than in any other period in at least 800,000 years" (World Meteorological Association 2013). Don't think for a moment that our work in public health is somehow separate from this scenario. The resulting increase in average atmospheric and sea-water temperatures, sea-water acidification, collapse of fisheries, instability and extremes in local and regional weather phenomena, melting of polar ice sheets and glaciers, and subsequent increase in sea levels, will severely stress society on a global scale and limit the provision of "basic" public health needs. Such impacts will include loss of arable land, more frequent crop failures, lack of ground and surface water for irrigation and for drinking, increased range and types of insect pests and vectors bringing diseases to food crops and to people, vast populations of displaced persons due to floods, droughts, wild fires, warfare, and other conflicts. In short, even in Canada, we can now virtually guarantee problems with food security, water supply, displaced populations, and disease incidence; in the longer term, the extended loss of food growing regions will reduce available food supplies even further.

The Intergovernmental Panel on Climate Change (IPCC) has determined that even if greenhouse gas emissions were curbed today, the current trends in weather and climate will continue for decades, if not centuries. We have passed the point where our only focus is on preventing climate change; we must also plan for and adapt to the consequences of climate changes that are already becoming evident in our daily news (TRCA and ESSA 2012).

If they arrive, simultaneously, these ponderous pachyderms of "social collapse" and "climate change" conjure up an ugly scenario, a downward spiral from which any recovery will be a lengthy process. Canada, long recognized as the "bread-basket" to the world, has experienced rare periods of droughts producing dust-bowl conditions and also loss of crops due to floods. But "extreme" weather is already occurring more frequently around the globe. The vast rice growing regions of Pakistan, Viet Nam, and Thailand have suffered recent crop losses from extreme floods, just as Canadian grain harvests have been severely reduced several times in recent years. And, if reduced crop yields were not bad enough, subscribers to ProMED and the Food and Agriculture Organization documents will already have become familiar with new and devastating crop diseases. Cassava, rice, banana, coffee, potato,

sorghum, mango, and citrus are all under assault in increasing geographical ranges by bacterial and fungal diseases, which in many cases are spread by insect vectors. Farmers are reporting a 70%–80% loss in many affected areas, and in some cases there is no effective treatment.

The following discussions are unavoidably overshadowed by the foregoing.

Communicable diseases

In 1982, colleagues from the "Population Health" movement and "*Health for all 2000*" questioned why communicable diseases were still in the Ryerson University School of Occupational and Public Health curriculum. "That's so nineteenth century!" they commented, "public health today is chronic diseases, cardiovascular, and cancer!"

That same year, *Escherichia coli* O157H7 was isolated for the first time in ground beef following an outbreak, and a few months before, a strange new syndrome, first observed in Haitians, haemophiliacs, and homosexuals, was destined to become acquired immune deficiency syndrome (AIDS). Less than three years later, a puzzled vet in Surrey, United Kingdom, ordered lab tests for an unfamiliar neuropathology in cattle, thus beginning the bovine spongiform encephalopathy (BSE) saga and its human form, variant Creutzfeldt–Jakob Disease (vCJD)—a totally new domain of infectious agent. In the last few decades we have been visited by severe acute respiratory syndrome (SARS); middle east respiratory syndrome (MERS); the hanta, Hendra, and Nippah viruses; several varieties of equine encephalitis; and West Nile virus.

Tuberculosis (TB) used to have a case fatality rate of 67%. Nonpulmonary TB was halted by pasteurization and pulmonary TB by drugs such as Isoniazid. In recent years, however, TB has re-emerged, this time in a multiple drug-resistant form, while at the same time nonpulmonary TB threatens to reappear because of misguided "anti-pasteurization" crusaders.

The A/H5N1 influenza virus, first seen in 1997 and still lurking in bird populations, has a human case fatality rate between 30 and 50 times greater than in 1918 (Li et al. 2008). Should that avian influenza mutate sufficiently to sustain person-to-person spread, the world would dramatically change in a few months. The public health movement began with epidemics, but after 150 years, the list of new and re-emerging diseases is not diminishing. (As I write this, the Centers for Disease Control is reporting a doubling of the cases of Ebola each 20 days (Meltzer et al. 2014)). A future without infectious diseases? I think not.

Climate change projections add a depressing new twist. For example, in 1955, only three countries reported cases of dengue fever. Today, according to the WHO's second report on neglected tropical diseases, dengue fever is found in over 125 countries, with nearly half the world's population at risk of infection. Following closely behind and with the same vector, chikungunya fever has this year infected people in 14 Caribbean territories (Khan et al. 2014); it has appeared in Africa, Asia, Southern Europe, and may be making inroads into North America. A few months ago a colleague in Nepal reported the *Aedes* mosquito vector at elevations never before seen, while today, the day of the People's Climate March,

¹ In April 2014, the climate observatory at Mauna Loa recorded 402 ppm CO₂ for the first time. It is also worth noting that 25% of the increased CO₂ from 1800 has occurred since the year 2000.

Ae. albopictus, was reported in the United Kingdom for the first time. And it's not just vector-borne diseases that are on the increase due to climate change. Fungal diseases that affect food crops, mammals, reptiles, and humans, are expected to increase their range (Garcia-Solache and Casadevall 2010).

In Canada

A tropical fungus, *Cryptococcus*, is now established on temperate Vancouver Island. Parasitic and protozoan infections are predicted to increase due to climate-related changes in ecosystems, increases in atmospheric temperature, flooding, and other environmental conditions (Fletcher et al. 2012). Tropical disease experts are unsure if dengue and chikungunya will ever become established in Canada, but already tourists are returning with the virus. If Native Canadian *Aedes* species were to become adapted, anything is possible. We cannot forget that malaria ("ague") was endemic during the 19th century in Upper Canada from the Rideau Canal to Hamilton (Watson 2007). But the most spectacular example of northward spread into Canada has been Lyme disease; perhaps it is the harbinger of pathologies to follow (US EPA 2014).

Drinking water

Water-borne epidemics brought modern public health into existence, and provision of safe water remains of central importance. Eighty-five percent of humanity already live in the driest half of the planet (UNDESA 2014), and a safe drinking-water supply simply does not exist for nearly 20% of the World's population. Extreme water shortages struck many regions in Asia, Africa, Australia, and North America in the past few years, and it is not just drinking water; simple hygiene, such as hand washing is essential for preventing and controlling outbreaks of enteric diseases, but if water must be carried long distances, usually by women, hand washing has low priority.

In North America, the vast ancient aquifers such as the Ogallala, underlying parts of eight states, has diminished so much that it cannot be restored through natural rainfall in less than 6,000 years. Salt-water intrusion in coastal areas from New Jersey to Florida has reached a crisis level as ground water is removed (USGS 2003).

In Canada

Some regions are fortunately adjacent to vast reserves of lake water. Current (2014) water levels in the Great Lakes are high due to the precipitation in the previous winter, but this can change dramatically in drier years, especially if Lake Michigan is allowed to flow south to replenish water in the Missouri–Mississippi system, as has been proposed. Climate warming is likely to increase water demand while decreasing the supply.

Conservation of water is being encouraged far more outside of Canada than at home. Technological developments are replacing the health officer's most beloved of sanitary devices, the flush toilet. Composting units and toilets that do not require the wasting of large quantities of drinking water are already to be found in home and bathroom stores and catalogues in Europe and Asia. When they arrive here, adjustment will be required to the accepted specifications for

adequate toilet facilities in restaurants and institutions, as well as the design, approval, and operation of disposal facilities for the contents of such units. Appropriate legislative and building code adjustments will be required in due course, and the expertise of environmental public health practitioners (EPHP) will doubtless be called upon.

Heated debates are likely to continue between proponents of municipal versus bottled water and exacerbated every time unwanted contaminants are found in either supply. Health personnel should be prepared to discuss and interpret the quantitative risks of both.

Food

All factors are aligning for a "perfect storm" on a global scale: an exponentially increased demand, yet a loss of arable land, collapsed fisheries, and increased crop and harvest failures due to disease, pests, drought or flood.

In Canada

Even at normal times, unscrupulous food retailers will repackage and relabel expired products. But the sustained high prices and shortages will doubtless increase pressure on retailers and wholesalers to cut corners, substitute with inferior or unsafe products, and generally compromise quality. There may be increased incidence of people choosing to eat sub-standard or risky foods, expired foods harvested from grocery dumpsters, or cans of pet foods.

During the winter months, Canadians may need to forego imported tropical fruits and vegetables, due to crop failures and demand from elsewhere or costs of transportation. Where people have access to a garden or farmer's markets, we can expect a return to home canning, but copying Granny's faded recipe will not necessarily be safe: modern tomatoes need extra acid for lower pH, whereas beans and garlic need pressure treatment at 121°C. New types of foods unfamiliar to North Americans' refined tastes but traditionally part of the European and Asian cuisines will appear. The EPHP will need to become familiar with preserved and fermented vegetables, new types of organ and glandular meats and offals, as well as cheaper seafood from further down the food chain and the products processed from them.

Labelling (content and language) of imported foods, which was previously a responsibility of the Health Protection Branch and more recently Industry Canada (but not strictly enforced by any agency), may fall initially within the scope of the local, regional, or provincial health officer, at least where there are health and safety issues.

Increasing numbers of immigrants into Canadian urban centres raises several food safety issues both for newcomers and the Canadian public. Certain toxic plant materials in the food store will need clear warnings for a cosmopolitan public about safe preparation. This applies to rhubarb leaves (containing oxalic acid) as much as to cassava or manioc tubers (containing cyanide which must be leached out).

Input may be required from field-experienced personnel and public health laboratories as part of the process of revising and adjusting food-related legislation and regulations.

We learn that 30% of all food is wasted, trimmed, lost, contaminated, or infested. If we are to feed the burgeoning billions we must put aside unreasonable fears of new technologies. Irradiation of raw meats will protect consumers from *E. coli*, *Salmonella*, *Campylobacter*, and prevent the dumping of thousands of tonnes of meat every time *E. coli* is discovered.² In stored foods, irradiation will also prevent insect damage, moulds, and premature sprouting of stored vegetables, in the same way that spices have been safely irradiated for decades. Other technologies include adopting far more genetically modified foods, which resist insect pests, dry conditions, or excessive UV radiation. Organic foods require greater land area than conventionally grown crops (Tuomisto et al. 2012) with no demonstrated health benefit, but their production without industrially derived potash, phosphorus, and nitrogen may be an advantage. Other changes include the decreasing production and consumption of red meat due to the exorbitant land use, water use, feed, and energy requirements compared with other protein foods.

The health practitioner will need to be able to discuss and advise the health and safety risks of novel foods as society shifts to alternative food sources. Health agencies may find themselves in the middle of numerous debates, and it would be an important objective to have the real facts and empirical evidence and the experience to lead or moderate public discussions. I believe that the local health agency will continue monitoring food (its transportation, sale, preparation, and service, and outbreaks arising from its consumption) despite attempts in recent decades by provincial agriculture ministries to take over all food “from farm to fork”.

Low credibility, low public trust, and skepticism

Frewer et al. (1996) found a downward shift in public trust toward traditional authorities and sources of information; in the United Kingdom central government departments were trusted barely more than supermarket tabloids. Covello and Sandman (2001) demonstrated similar findings in the United States as did Speller et al. (1994) in Canada.

People clearly prefer now to make up their own minds (or delegate that function to ill-informed starlets or TV talk-show celebrities), yet they view all “official” information with increasing scepticism. The Internet offers unlimited information, but much of it is misleading; the EPHP of the future must become a resource and a guide for helping the public find the accurate information. The extent of misinformation, myth, and malicious garbage is alarming, as recent “anti-vaccination” and “anti-pasteurization” campaigns have demonstrated.³

² Even without irradiation, meat contaminated with *E. coli* can easily be processed into pies, sauces, etc. and safely consumed. All *E. coli* strains are destroyed at far less than 100°C.

³ The anti-pasteurization movement has lost its memory. Some 70–80 years have passed since children developed nonpulmonary TB mainly from raw milk products. However, TB-positive reactors still exist in national dairy herds.

There is some rationale for the public lack of trust: “experts” have trouble ensuring that information is clear and understandable, that their process is transparent, and that a true dialogue has been opened instead of one-way messages. The public has learned that waste disposal companies are trusted to take their own environmental monitoring samples and that town water utilities monitor their own chlorine readings. They have discovered that all foods are not inspected or scrutinized for safety, wholesomeness, or hygiene. Meat inspection has been slowly transformed into an industry-based activity instead of a government-based screening.⁴ Only carcasses showing signs of abnormality are diverted by (company) line workers for close examination by the official meat inspector. Imported foods on grocery shelves are supposed to be subject to strict labelling and language requirements, but a glance at any ethnic supermarket shelf confirms this is not enforced. Imported produce is subject to a probabilistic multistage sampling system that might detect a contaminated batch, but just as easily it might not.⁵ Even the CFIA was spawned from the Agriculture ministry that is also entrusted with protecting markets, foreign trade, and producers.

The local official health agency still retains more credibility than other public sector agencies, but that credibility needs constant nurturing. There is no “instant credibility”, no way to increase public trust, other than by demonstrating that you are worthy of that trust gradually through accountability, transparency, sincerity, reliability, and a willingness to engage in dialogue. The EPHP of the future (starting tomorrow) should be effective in facilitation, public dialogue, and risk communication—that means training in these essential skills.

Local emergencies

Health officers have always been involved in power outages, flooding, ice storms, wind storms, tornados, and any situation threatening loss of shelter, loss of water, contamination, etc. Such events have already increased, and can be expected to occur more frequently as climate instability progresses.

Modern “just-in-time” retail operations retain very little inventory, so that when a disaster or extreme weather event interrupts delivery, we may be little more than three days away from hunger. Such interruptions may be expected more often, and citizens need to be advised how to chlorinate and filter emergency water supplies and how to build and safely maintain their own reserves of food, water, power, and other equipment. Refrigeration will fail when power is lost, canned foods can corrode and leak in storage, dry foods develop mould and infestations, and all food can become contaminated by rising

⁴ Truth to tell, with a few important exceptions, most meat inspection in the slaughterhouse is not set up to detect the most widespread causes of meat-borne human illness (e.g., *Salmonella* or *Campylobacter*), and it focuses instead on bruises, tumors, abscesses, etc., that are quality or grading issues and not of any pathogenic importance to the consumer.

⁵ Note that routine sampling exercises for produce are set up to detect *E. coli*, but not specifically for Enterohemolytic *E. coli* such as O157H7.

floodwater. This has always been squarely within the responsibility of local health staff, but it is very possible that this role may be called upon more frequently.

Extended periods with excessive heat cause more deaths in an average year in the United States than hurricanes, tornados, lightning, and floods combined (US National Oceanographic and Atmospheric Administration 2011), and in the words of the IPCC are expected to occur more frequently as a “virtual certainty”.

Following hurricane Katrina (2005), hurricane Sandy (2012), typhoon Haiyan (2013), and the U.K. flooding (2014) questions were raised about the wisdom of rebuilding on land that will probably be inundated more frequently. Local health staff will clearly be involved in such assessments and relocation of entire communities.

Some final considerations

Terrorism

Deliberate attempts at spreading diseases, death, and destruction warrant vigilance and preparation. In cases of sabotage or terrorism, many of the possible chemical and biological agents may already be familiar to local health staff, who could assume a lead role in surveillance, containment, monitoring, and communications.

Reorganization

Canada still follows an older model where the chief executive officer (CEO) of the local official health agency (LOHA) is a physician. In the U.K. model, the CEO may be drawn from a wider range of disciplines, including environmental public health, the predominant qualification being proficiency in administration of a public health agency. When the structural reorganization of the LOHA is complete, the impressive administrative, academic, and professional career accomplishments of some EPH personnel over the last 30 years should result in eligibility for CEO positions.

I predict that our grandchildren may refer to this present time as “enviable”, when electricity was always available at the touch of a switch, or when food was abundant in every store. On the other hand, they may have difficulty believing that drinking water was used to wash cars, to water lawns, and to flush 4–6 litres of it into the sewers for each 100 mL of urine. The “good old days?” Enjoy them while you can; they may not last too much longer.

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