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Storage and stockpiling as techniques of preparedness: Managing the bottlenecks of flu pandemics

2016-06-15 05:00:20

By Frédéric Keck

In the last twenty years, influenza has been considered by global health experts as a model for the emergence of new pathogens from animal reservoirs. In the logic of zoonoses, human disease is the tip of the iceberg constituted by a wide circulation of viruses – often asymptomatic – in animals; it is often described as an “evolutionary dead-end”. As the influenza virus is composed of a single-stranded segmented RNA, it mutates and reassorts between birds and pigs before spreading to humans and causing pandemics. The regularity of flu pandemics – 1918, 1957, 1968, 2009 – is explained by that the fact that the seasonal flu is replaced regularly by new flu viruses to which humans have no immunity. Consequently, to prepare for the emergence of new flu viruses, events whose probability cannot be calculated but whose consequences are catastrophic, samples have been stored and vaccines have been stockpiled, as if the iceberg of the animal reservoir could be visualized and controlled in the fridges where humans conserve live and attenuated viruses. Storage allows public health authorities to identify a new virus as it emerges by comparison with circulating viruses, and then to raise alarm from this early warning signal. Stockpiling provides a quick immunization of the population considered as having priority in the exposure to the new virus.

I am interested in storage and stockpiling as techniques to plan and visualize the mutations of flu viruses in the ordinary work of global health, in contrast with the extraordinary management of health crises. While stamping out the animal reservoir and vaccinating the human population are techniques used during the emergence of new flu viruses, storing samples and stockpiling vaccines is practiced before and after the emergence, as part of ordinary surveillance work. I want to describe these techniques of preparedness as modalities of accumulation of life – or biovalue – but also as modes of relations between humans and animals. To do this, I argue, we must be attentive to the representation of scarcity as bottlenecks: the emergence of a new virus is a rare event that presents new threats but also creates new possibilities for action. How do storage and stockpiling help global health experts to visualize and manage

bottlenecks in the mutations of flu viruses? And what kinds of relations does it produce between humans and animals besides the model of eradication?

This question, unexpectedly, comes from the world of museums, in which I have worked for the last two years after several years observing avian influenza experts. I want to suggest that in the case of influenza, epidemics play the same role for global health institutions as exhibitions for museums: they are periods of time during which relations between humans and non-humans are exposed to the public before returning to the ordinary work through which they are stored. Before and after the outbreaks, microbiologists continue sampling and storing influenza strains, in the same way as curators in a museum continue acquiring and storing artefacts when there is no exhibition.

In 1948, the World Health Organization created a centre for the storage of influenza strains collected by national laboratories. It declared: “The desiccated viruses received by the Centre, will, as far as possible, be tested to determine their activity and, where appropriate, passaged to form a larger stock of desiccated material. It will thus constitute a sort of “museum” of desiccated strains of influenza. All laboratories that conduct research on the antigenic relations between strains may request the Centre to be kept informed of available strains and obtain the sending of a particular strain. We will periodically submit the museum strains – or at least those of them which seem to be important and representative – to passages in eggs or others to maintain stocks and avoid losses”. The goal of the WHO in 1948 was to centralize and standardize viral information independently from the occurrence of epidemics, and to produce the most adequate vaccine for the next seasonal and pandemic influenza viruses. Just as a museum does with exhibitions, the WHO would anticipate the next epidemic as an opportunity to display the knowledge it acquired on its collection of viruses.

One of the questions in the history of influenza research is what has changed since this dream of a total archive of flu strains was expressed by WHO. I argue that the shift from storage to stockpiling in labs and museums is one of the ways to capture this change. It is not only a shift in the numbers of actors of surveillance – as pharmaceutical industries entered the field of influenza research in the 1980’s due to a shortcut in the WHU budget – but also in the modes of visibility of pathogens circulating between animals and humans.

Two main events produced this shift, one concerning storage and the second stockpiling. At the end of the 1960’s, Graeme Laver and Robert Webster were walking along a beach in Canberra, where they were doing their PhD on influenza antibodies, when they saw dead seabirds on the

shore. After joking that they had died from flu, they launched a massive program of trapping and sampling seabirds in the Great Barrier Reef to survey the patterns of Influenza A in birds. Martin Kaplan, a veterinarian who was the head of the WHO zoonoses program in Geneva, gave them funding for this research, which opposed the skepticism of Australian authorities. Webster and Laver imposed this bizarre idea that aquatic birds, despite their beautiful appearance, could be the reservoir of influenza, meaning that they carry the virus without being sick and shed it massively via fecal drops. Webster spent the rest of his career building a massive virus bank in the private hospital of St Jude in Memphis (Tennessee), where he could follow the mutations of flu strains in a large spectrum of species. Webster's innovation was not only in the use of private and international funding to bypass national boundaries, but also in the modes of visualization of flu strains, from hemaglutination in eggs – the technique designed by his mentor Franck Macfarlane Burnet – to mutations in wild bird reservoirs.

Webster thus turned a black hole of surveillance into an abundance of information. In the 1970's, China didn't collaborate with the WHO in sending flu strains, despite the fact that it was considered as a starting point for the pandemics of 1957 and 1968. The founder of the department of microbiology at Hong Kong University, Kennedy Shortridge, in partnership with Robert Webster, showed that birds and pigs in south China were positive to influenza. He raised a global alert in 1997 when a new flu virus called H5N1 was found in chickens and humans in Hong Kong and later in mainland China. Microbiologists trained by Shortridge and Webster used this proximity between Hong Kong and mainland China to build a virus bank as a sentinel device where emerging viruses could immediately be traced to phylogenic ancestors.

A team of virologists I worked with had thus shown that the Fujian strain of H5N1 circulating in birds and humans could be traced to the massive vaccination of chickens by the Chinese government in 2005. According to them, this vaccination had created an evolutionary bottleneck in which new strains could develop and spread to humans. They were consequently refused by the Chinese government the access to Shantou on the Fujian coast, where they used to go to collect samples, but they argued that they could still produce new knowledge with the information in the sequences they had purified from collected samples. "All the information that we've had in the past ten years is because of this massive surveillance that's been going on in this region. And when the H5N1 virus spreads, we could say: this is the genotype that is spreading, WHO could be preparing, we could send vaccines to these countries where the virus is endemic. But since 2006 when Shantou was closed we don't know much about this region, so you suppose these nucleotides are spreading outside. Hong Kong is the perfect example of how transparent it

can be. Surveillance in poultry, swine, wild birds, as soon as it's done, it's made public. And that doesn't mean Hong Kong is a bad place, it means that everything that is done is reported. We're sitting on a bunch of information. Viruses are there, still unknown. Even if we don't do surveillance, we have enough information to work for five years."

Here we see that preparedness as a technique of anticipation is also a technique of collection. Raising alarm on a new virus is possible from an accumulation of material and virtual information, samples collected in poultry farms or wild bird reserves and sequences stored on data banks. The phylogenic classification of flu strains doesn't inquire about the end of the disease but about its beginning, and traces it back to points in evolution described as evolutionary bottlenecks. In the logic of storage, there is never too much information to trace a zoonotic event back to its animal reservoir. In a sense, the epidemic never stops beginning, as a phylogenic ancestor can always be found in a collection of samples that was previously unknown or not analysed.

By contrast, with stockpiling, bottlenecks appear at the end of the disease, in the populations targeted by vaccination. The term was probably introduced in the management of infectious diseases from the world of nuclear weapons by Edwin Kilbourne, who was the head of the US Strategic National Stockpile. He was the advisor to President Gerald Ford to whom he recommended in 1976 the administration of 200 million doses of vaccine against flu after a soldier died from a swine flu virus close to the 1918 pandemic virus. Among the first 43 million who received the vaccine, 535 came down with the Guillé-Barrain Syndrome, and the program was interrupted. Kilbourne maintained, however, that the production and stockpiling of vaccines targeting several flu strains (what he called a "barricade vaccine") was necessary to mitigate the first cases before an adequate vaccine (or rampart vaccine) was produced.

One of the key issues for stockpiling is to identify bottlenecks in the distribution of medical equipment. The unequal access to vaccination is a vulnerability of the infrastructure for which public health agents must be prepared. Stockpiling is equipped with a list of professions that have priority access to vaccination (such as physicians or nurses) and with exercises of triage to detect patients who need emergency care. In the logic of stockpiling, epidemics never end, as there is always a population that has been left out of vaccination, and for which doses of vaccine should me made available. While storage traces bottlenecks in the past, as sites where intervention would have been possible to eradicate the epidemic before it started, stockpiling projects it in the future, as a space for mitigation of the epidemic.

Stockpiling is difficult to investigate ethnographically, as it follows a logic of

military secret. The only interview I obtained on stockpiling was at the Animal Health Research Institute of Taiwan. The same institute stored viruses from birds at -80°C and stockpiled vaccines for chickens at +4°C, because the adjuvants in vaccines needed to be preserved. Taiwan started stockpiling vaccines against avian influenza after the SARS crisis in 2003, which had confirmed the scenario of a zoonotic virus coming from China, and the Institute preserved 10 million doses for H5 and 5 million for H7. There had never been H5N1 in Taiwan but a human case of H7N9 was declared in 2013 – a man traveling from Shanghai to Taipei – and a similar H7N9 was found in the viruses stored from wild birds. While China and Vietnam had been criticized for vaccinating their domestic poultry massively with vaccines produced locally, creating evolutionary bottlenecks in the selection of new strains, Taiwan chose to stockpile vaccines and only use them in case of an outbreak. But this created bottlenecks at the level of vaccine management.

The problem raised by stockpiling is: what to do with the excess vaccines produced for strains that are not circulating any more? After 18 months, any non-used vaccines are incinerated, and updated vaccines are bought. Members of the Taiwanese Parliament complained about the quantity of vaccines destroyed, which led the Taiwanese government to decrease the number of vaccines stockpiled and to contract with private companies capable of producing 3 million doses of vaccine within a week. A Taiwanese private pharmaceutical company, Adimmune, announced that it could produce between 5 and 10 million doses of vaccines for H7N9 in six to eight weeks, and was consequently awarded the right to develop the vaccine. While Taiwan cannot sell its vaccines to mainland China, it can give its supplementary vaccines to countries who recognize its legitimacy as part of a global health diplomacy. A similar logic was applied in France in 2009 with the 90 million doses of vaccines that had been ordered by the State and not used by the citizens: many of these doses were proposed to former French colonies such as Cambodia or Algeria.

Managing the stockpile of vaccines thus oscillates between two types of bottlenecks: the scarcity of vaccines for populations considered as priority, and the waste of vaccines that populations don’t need or refuse to take. In the first case, the epidemic never ends, while in the second case it ends too quickly. This is why public health authorities have to prepare for the epidemic without calculation of its duration, as if it was already there. Hence the connection between stockpiling and storage. Because the same viral strains coming from animal reservoirs are conserved in storage and stockpiling, with a few natural or artificial mutations, the epidemic for which stockpiling prepares is latently inscribed in the collections that are stored. The intentionality of the expression “after the end of disease” takes place in a wider set of relations between structure – the classification of viral strains – and events – the emergence of an epidemic. The pastoral

logic of curing a population against a pathogen is anchored in a logic of collecting viruses common to animals and humans. There is no end to collecting: the list of entities that compose the world is indefinite.

Frédéric Keck *is a researcher at the Laboratoire d'anthropologie sociale (Paris) and the head of the research department of the musée du quai Branly. Besides his own publications on the history of social anthropology and the biopolitics of zoonoses, he has co-edited several collective volumes : (with N . Vialles) Des hommes malades des animaux, L' Herne, 2012 ; (with A. Lakoff) Sentinel devices, Limn, 2013 ; (with F. Bretelle-Establet) Penser les épidémies depuis la Chine, le Japon et la Corée, Extrême-Orient Extrême-Occident, 37, 2014 ; (with N. Auray) Virus, Terrain, 64, 2015.*