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Lessons for surveillance in the 21st century: a historical perspective from the past five millennia

Summary

This paper reviews some major epidemics in the past 5000 years in human history and derives 12 lessons in the context of epidemiologic surveillance. The corresponding 12 challenges proposed in this paper could be used to guide us in building a better and more comprehensive surveillance system in the 21st century. This will be achieved by: continuing the evolvement and improvement of surveillance; maintaining on an ongoing basis; being systematic; being population-based; including risk and intervention indicators in the data base; more efficient data analysis; stimulating etiologic research; improving forecasting capability; linking to development of intervention; evaluating the intervention; better ways of information dissemination; and dissemination without prejudice.

Key-Words: Historical review – Surveillance system – Epidemiologic methods – Conceptual framework – Data interpretation – Statistical.

It is unfortunate that the human race has encountered large scale epidemics from time to time. Countless people have suffered unnecessarily or died prematurely. This is history written in blood, sweat, and tears. It is, therefore, desirable at this start of a new century, and of a new millennium, to review some major epidemics in human history, to see if there are a few lessons that we can learn from our past. It is hoped that things will improve in the new century as we build a better and more comprehensive surveillance system[1].

This paper is intended to be interesting and unusual – interesting by taking a very broad multi-millennial look at surveillance, and unusual by taking a historical approach which is rather rare in epidemiology. It is intended, not to provide a detailed historical account of past epidemics, but to provide, with its historical references, a broad base on which we derive 12 lessons for present day surveillance. The lessons, while regarded by many to be valid, noteworthy and unimpeachable, may not be so regarded by others. It is hoped that this paper will stimulate further discussion on how surveillance can best be conducted in the 21st century.

In this paper, a surveillance system is defined, following the conceptual framework proposed by Choi[1], as a systematic, ongoing and population-based system for the collection, analysis, and interpretation of data on health outcomes, risk factors, and intervention strategies, for the monitoring and early warning of health events, and for the development and evaluation of public health interventions and programmes, closely integrated with the timely dissemination of the information to those who need to know.

Review of major epidemics in the past five millennia

The first recorded epidemic in human history was "a great pestilence" that occurred in Egypt during the reign of Pharaoh Mempses in the First Dynasty, 3180 BC (Tab. 1). Manetho, Egyptian priest and historian, in listing the pharaohs, stated, "Mempses, for eighteen years. In his reign many portents and a great pestilence occurred"[2, p. 3]. The causes, nature, and consequence of the epidemic were unknown.

Plague, any of various forms of a virulent and highly contagious disease, tormented the human populations from the Ancient Times (Ancient Egypt, beginning around 4500 BC) to Classical Times (Ancient Greece and Rome) and the Middle Ages (the fall of the Roman Empire in AD 476 to the mid-15th Century) (Tab. 1). Although plague killed many people in the past, its nature was not recognised until

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Time	Place*	Epidemic	Number of deaths	Possible cause
3180 BC	Egypt	"A great pestilence"[2, p. 3]	Unknown	Unknown
1495 BC	Egypt	"The Plague of Pharaoh", during the month of Adar (mid-February to March)[3, p. 1]	Unknown	Drought, causing death of wildlife, crop failure, and epidemic diseases[2, p. 4]
1471 BC	Kadesh	"A plague"	14700	"Moses called for the earth to open up and swallow the rebel army of Korah", possibly an earthquake[2, p. 6]
1190 BC	Greece	"A loimos" (Greek, meaning a plague or pestilence) lasting nine days[2, p. 7]. Now believed to be a bubonic plague[4]	Unknown	"King Agamemnon refused to free the captured daughter of the Trojan priest Chryses" (*Iliad* of Homer)[5], real cause possibly the Trojan War (1194 BC-1184 BC)
1017 BC	Israel	"A pestilence" lasting three days	70 000	"And Satan stood up against Israel" (*Chronicles*)[2, p. 11], real cause unknown
431 BC-427 BC	Aethiopia, then spread to Egypt, the Persian empire, and Athens	"The Plague of Thucydides". It was a mixed epidemic, now believed to be typhus and measles[2, p. 19]	Unknown	The Peloponnesian War (432 BC-411 BC).
AD 166	Rome	Possibly smallpox[6]	Unknown	Spread by soldiers returning from the Parthian War (AD 161-166)
541–591	Constantinople, then spread to Egypt and the whole populated world	"The Plague of Justinian". The first of the three most devastating epidemics to hit the human race[2, p. 44]	Unknown	Unknown
664–689	Britain	"The Yellow Plague", a disease marked by yellowness of the skin. Now believed to be relapsing fever with jaundice[2, p. 65]	"A great multitude of men"[2]	Unknown
1348–1351	Central Asia, then spread east to China, south to India, west to Portugal, north to England (1349), Norway (1350) and Russia (1351)	"The Black Death". Now believed to be bubonic plague. The second of the three most devastating epidemics to hit the human race[2, p. 72]	"Thousand died everyday"[2]	Contaminated ships that visited the various sea ports, following the trade routes
1374–17th century	Germany (1374), then spread to France (1518), Italy (17th century)	"Dancing Mania". People formed groups of three and danced. While dancing they fell to the ground and allowed others to trample on their bodies to cure their disease[2, p. 93]	Unknown	Possibly both psychic and somatic in origin. The nervous affection characterised by an uncontrollable impulse to dance could be caused by the bite of a spider, *tarantula*[2]
1665	London	"Great Plague of London"[2, p. 139]	43 (week of June 8), 112 (week of June 15), 1089 (week of July 20), 6102 (week of August 31), 333 (week of November 30)	Poor sanitary conditions, dense population, and overcrowded housing. With the coming of the November frosts the epidemic subsided. In 1666, the "Great Fire of London" cleansed the streets, destroying narrow alleys and the epidemic was over[2]
1817–1875	Calcutta (1817), all of India (1821), China (1820), Japan (1822), Russia (1823), England (1831, 1849, 1854, 1866), Canada and USA (1832), Africa (1837), Central America (1863), South America (1875)	Four pandemics of cholera: 1817–1823, 1826–1837, 1846–1863, 1863–1875[2, p. 193]	2140000	Cholera was spread across countries through steamboats and mass migration during the Industrial Revolution. In 1849, John Snow mapped the incidence of cholera in London and found that many of the people who died had drunk contaminated water from the Broad Street Pump. Snow removed the pump handle and the epidemic waned[7]
1918	France (April), England (June), China (July), USA (August)	"Spanish Influenza"[8]. The third of the three most devastating epidemics to hit the human race[2, p. 271]	22000000	A filterable virus, first isolated in 1933. Its vaccine was not developed until 1972[2]
1940–now	Worldwide	Lung cancer. Before 1940, lung cancer was a medical curiosity. After World War II (1939–1945), number of cases increased[9]	In the decade 1990–1999, 1800000 in the US, 1800000 in Europe, 1500000 in Russia, 900000 in Eastern Europe, 600000 elsewhere; a total of 6600000[10,11]	Cigarette smoking[12,13]. Despite tobacco consumption intervention strategies, the lung cancer epidemic continued to worsen. In 1975, 63% of lung cancer deaths in Canada were attributable to cigarettes[14, p. 170]. In 1989, the attributable fraction in the US was 87%[10]

* Year refers to the time when an epidemic was first reported in a place. The epidemic could recur in a place subsequent to the year cited.

Table 1 Some of the major epidemics in the human history

late 19th century[4]. Plague is an infectious disease of wild rodents. The plague bacillus, *Pasteurella pestis*, is transmitted from rodent to rodent by a flea that inhabits the hair of rodents and whose favourite food is the blood of rodents. The fleas attack humans as the rodents drop dead. The major type of plague is bubonic plague, characterised by swellings in the groin (buboes) (2, p. 7).

The "loimos" in Greece (1190BC) and "The Black Death" (1348–1351) are now believed to be bubonic plagues (Tab. 1). "The Plague of Thucydides" (431BC-427BC) has been suggested to be typhus and measles. "The Yellow Plague" (AD 664-689) is likely relapsing fever with jaundice. Various possible causes have also been proposed for these epidemics (Tab. 1).

According to Marks and Beatty[2], the three most devastating epidemics to hit the human race were: "The Plague of Justinian" (AD 541-591) which lasted 50 years, "The Black Death" (1348–1351) which lasted four years, and "Spanish Influenza" (1918) which lasted five months. "The Black Death" engulfed more of the populated world and resulted in more deaths in four years than "The Plague of Justinian" did in fifty. The "Spanish Influenza" killed 22 million people in five months in 1918[8], about twice as many as the 10 million deaths caused by World War I (1914–1918)[15].

What do we learn from history?

There are 12 lessons that we learn from the historical review of major epidemics in the past five millennia:

First, there is a need to continue the evolvement of public health surveillance. Early surveillance systems were first instituted in some towns in Italy in the 15th century. Around 1519, the town council of London, England, started to keep a count of the number of persons dying from the plague and began a weekly tally (Bills of Mortality). John Graunt described in 1662 how the early system worked: "when any one dies, then, either by tolling, or ringing of a Bell, or by bespeaking of a Grave of the Sexton, the same is known to the Searchers, corresponding with the said Sexton. The Searchers hereupon repair to the place, where the dead Corps lies, and by view of the same, and by other enquiries, they examine by what Disease, or Casualty the Corps died"[16]. Over more than 300 years, the early systems gradually evolved into the present day surveillance systems.

Second, history indicates a need to collect surveillance data on an ongoing basis. Needless to say, it would have been extremely useful to have had good continuous surveillance data dating back to 3180 BC. Besides, from history, we learn that epidemics are becoming more widespread in less time, due to the rapid advancement of technology. "The Black Death", cradled in Central Asia, took four years to reach Russia, following the trade routes used by ships and on land (Tab. 1). At present, inter-continental travel by aeroplanes takes less than 24 hours. Therefore there is a need for a quick response time, which can be effectively achieved by having an ongoing surveillance system.

Third, history indicates a need to collect systematic and consistent surveillance data. An example of inconsistency in historical records is the time unit "day". The "days" in biblical texts were somewhat metaphorical, as one thinks of the Creation narrative. The "9 days" for the "loimos" in Greece (1190BC), or the "3 days" for the pestilence in Israel (1017BC) could have been based on a different time scale than today's. It is inconceivable that with the small population in those days, the "pestilence" in Israel could have killed 70000 people in three days (Tab. 1). Such inconsistent variable definitions could lead to problems in time trend analysis. Another example of inconsistent definitions involves the words "pestilence" and "plague" which have historically been used interchangeably to describe devastating epidemic diseases and also such disasters as an onslaught of locusts. As a result, original sources have often left scholars doubtful of what precisely was involved in any given event.

Fourth, history indicates a need to collect population-based data. At the peak of the "Great Plague of London" (1665) (Tab. 1), the diarist Samuel Pepys commented on the fact that his recorded number of deaths might not be representative. "In the City died this week 7496, and of them 6102 of the plague. But it is feared that the true number of the dead this week is near 10 000; partly from the poor that cannot be taken notice of, through the greatness of their number, and partly from the Quakers and others that will not have any bell ring for them."[2, p. 144] For various reasons, the lower social class had been ignored for enumeration.

Fifth, history indicates a need to collect data on risk factors and interventions. In the past, epidemics have been related to different natural and human causes (Tab. 1). Risk factors have included natural environmental factors, such as drought ("The Plague of Pharaoh"), earthquake (the plague in Kadesh), and contaminated water (cholera); wars[17]; biological agents, such as bacteria *Pasteurella pestis* (plague), bacteria *Vibrio cholerae* (cholera), and the spider *tarantula* ("Dancing Mania"); psychological factors, such as the mass psychogenic phenomenon in the "Dancing Mania"; socio-economic factors, such as poor sanitary conditions, dense population and overcrowded housing ("Great Plague of London"); and behavioural factors, such as infrequent hand washing (cholera) and cigarette smoking (lung cancer). Inclusion of risk factors in a surveillance system would greatly improve its capability as an accurate early warning system.

History also indicates that intervention strategies (or the lack thereof) are important predictors for health outcomes. For example, an epidemic, possibly smallpox, decimated the Roman army toward the end of the Parthian War (AD 161-166) (Tab. 1). Following the war, the epidemic was spread throughout the empire by soldiers returning from the east due to lack of intervention, e.g., quarantine[6].

Sixth, there is a need to improve data analysis methods. John Graunt was the first one to realise the potential benefits of the Bills of Mortality and suggested a protocol for data analysis. He wrote in 1662, "Now having engaged my thoughts upon the Bills of Mortality, and so far succeeded therein, as to have reduced several great confused Volumes into a few perspicuous Tables, and abridged such Observations as naturally flowed from them, into a few succinct Paragraphs, without any long series of multiloquious Deductions, ... I hoped it might not be ungrateful to your Lordship, to see unto how much profit that one Talent might be improved, beside the many curiosities concerning the waxing and waning of Diseases."[16] Graunt's data analysis method was simple but efficient: reduce volumes of data to a few tables, then interpret them and prepare a few paragraphs so as to gain profit from analysing the data.

Seventh, surveillance should stimulate etiologic research. During the third pandemic of cholera (1846–1863) (Tab. 1), using data on cholera deaths by street and house number (contemporary surveillance system), John Snow proved the theory that cholera was waterborne and taken into the body by mouth, and not caused by "miasmic vapors" or supernatural causes (the "miasma theory")[18, p. 25].

Eighth, surveillance system should serve an early warning function. There were four cholera pandemics (Tab. 1). The first pandemic started in Calcutta (1817) and ended in Russia (1823). The second pandemic started in northeast India (1826) and ended in Africa (1837). The third pandemic started in India (1846) and ended in North and Central America (1863). The fourth pandemic started in the lower basin of the Ganges (1863) and ended in South America (1875)[2, p. 193]. It is obvious that there was a common origin (India) and that the pandemic area became larger with each new pandemic. European contemporaries by this time had a fairly good idea of the routes traced by cholera, and a warning system which used the customs service and diplomatic corps to get reports of where infected ships might be coming (a quarantine surveillance system).

Ninth, surveillance data should lead to intervention. The "Spanish Influenza" in 1918 killed 22 million people (Tab. 1). It was only as late as 1972, 54 years after the epidemic had hit, that the vaccine for influenza was developed[2, p. 277].

Tenth, surveillance data should be used to evaluate programme and intervention strategies. During the "Great Plague of London" in 1665 (Tab. 1), Samuel Pepys kept detailed diary and made almost daily reference to the epidemic, "15th [June] ... The town grows very sickly, and people to be afraid of it: there dying this last week of the plague 112, from 43 the week before. ... 20th [July] ...Walked to Redriffe, where I hear the sickness is, and indeed it is scattered almost every where, there dying 1089 of the plague this week. ... 31st [August] ... In the City died this week 7496, and of them 6102 of the plague. ... 30th [November] ... Great joy we have this week in the weekly Bill, it being come to 544 in all, and but 333 of the plague; so that we are encouraged to get to London soon as we can[2, p. 144]." These numbers recorded by Pepys from the beginning of June to the end of November indicate the effectiveness of the natural intervention, i.e., the coming of the November frosts and the winter.

Eleventh, there is a need for more effective ways of information dissemination. In the past, without good information dissemination, there was only one reaction: panic. For example, in New York City in 1832 when there had been 1050 cholera cases with 460 deaths, of a population of 200 000, 70000 fled the city[19], carrying cholera into the interior and other unaffected areas, hence further spreading the epidemic. "The roads, in all directions, were lined with well-filled stage coaches, livery coaches, private vehicles and equestrians, all panic struck, fleeing from the city."[20]

Twelfth, dissemination of surveillance information should be equitable and fair. During the "Great Plague of London", only the privileged class was able to receive privileged information and to act on the basis of the information. In fact, "London looked like a desert. The King and Queen had gone with the whole court to the West, to uninfected places in the country; the High Councils and the High Court of Justice had been transferred. Parliament, which had just been opened, had moved to Oxford. All rich people with very few exceptions had left the town".[2, p. 141] The poor were in no position to flee but they were the hardest hit during the plague, as "the plague in the big cities like London, Bristol and Coventry was always worst in the 'stinking lanes' inhabited by the poor. Little was ever done to improve these poor areas where the plague was endemic, and when the plague periodically became epidemic and spread to the rest of the city the only solution was for the rich and their physicians to flee, leaving the poor to suffer"[21].

Discussion

From the historical review of epidemics in the past 5000 years, there are 12 challenges for surveillance in the 21st century.

1. There is a need to continue the evolvement and improvement of surveillance into a more comprehensive system

Surveillance of epidemics started in the 15th century and evolved into the present day system. Death registries are now available in many parts of the world. In Canada, the collection of death certificates started in 1869 and this practice is still ongoing. Besides, data on cancer incidence, hospital discharge records, physician visits, etc., are also available. There are initiatives to expand data on risk factors and interventions.

The challenge for the 21st century is to expand the current surveillance system to include, besides deaths, new cases for all diseases (in particular non-cancer chronic diseases such as cardiovascular diseases, respiratory diseases, and diabetes), and to collect data on risk factors and intervention and prevention strategies.

2. The surveillance system should be ongoing

"Ongoing" means that the surveillance system should operate on a continuous basis over a long-term. Ongoing (routine) collection of data is the key to reduce the response time (from data collection to appearance of intervention) to meet present day and future needs.

The challenge for the 21st century is to develop long-term plans for surveillance systems and to avoid ad hoc systems, such as those created and disbanded with the change of governments or managers of the systems.

3. The surveillance system should be systematic

"Systematic" means several things[1]. First, there should be a standard set of core, or indicator, variables to be collected in the database. Second, the set of variables should be determined through a systematic process, such as expert consensus workshops, and not by the people who head or fund the surveillance system. Third, there should be ground rules concerning when and how to add or delete variables in the database. Fourth, there should be clear and consistent definition of the variables, and these definitions should not be changed from year to year. Fifth, there should be ground rules concerning when and how to change the definition of the variables, for example, when dictated by new scientific evidence. Sixth, there should be a standard set of core statistics to be estimated from the database. Seventh, the set of statistics should be estimated through some systematic process that is not hypothesis driven, such as through an automated data analysis system. Eighth, the surveillance system should be linked directly to public health practice. Ninth, the surveillance system should be linked directly to an efficient information dissemination system.

As an example of being systematic, the definition of a smoker should not be changed from year to year, and even if changed, based on new knowledge, the old definition must continue to be used side by side in the surveillance database for a number of years, so as to provide a smooth transition[1]. Other examples include problems in Human Immunodeficiency Virus (HIV) case definition, and changes in International Classification of Disease (ICD) codes for heart diseases.

The challenge for the 21st century is to develop ground rules on when and how to add or delete variables under surveillance, and when and how to change the definitions of the variables when new scientific evidence arises.

4. The surveillance system should be population-based

Because of the expense of conducting large-scale surveillance of whole populations (universal surveillance), some programmes target sentinel sites for special surveillance (sentinel surveillance)[22]. Such sentinel systems, while generally inexpensive, may give biased information, depending on how representative the sites are of the general population[23]. Active surveillance actively solicits data from reporting sources, while passive surveillance relies on reporting sources to provide data on their own initiative[22]. Active surveillance, while more expensive, allows a more complete enumeration of cases, than passive surveillance.

The challenge for the 21st century is to develop large scale and widespread data collection systems which are population-based[24]. This will be in favour of universal, rather than sentinel, and active, rather than passive, systems.

5. The surveillance system should be comprehensive, i.e., contain data on health outcomes, as well as risk factors and intervention strategies

A comprehensive surveillance system collects data not only on health outcomes, but also on risk factors and intervention strategies[1]. Determinants of health is the collective label given to factors and conditions that are thought to have an influence on health. These include a variety of things such as income and social status, social support networks, education, employment and working conditions, social and physical environments, personal health practices, and coping skills. To be able to forecast health trends in an accurate and timely manner, the changes in the patterns of risk factors and intervention strategies must be considered.

The challenge for the 21st century is to expand the current surveillance system based mainly on health outcomes, e.g., disease registries, to include risk factors and intervention indicators. Data on risk factors and intervention would improve the capability of the surveillance system to forecast health outcomes and to evaluate the effectiveness of interventions[1].

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6. The surveillance system should be linked with an efficient data analysis system

A surveillance system must have a purpose. The attitude that "we collect data for a purpose, and the purpose is to collect more data" is not helpful. A major purpose of the surveillance system is to collect data for data analysis, in order to make decisions for early warning and for programme development and evaluation. To this end, novel techniques and new statistical tools must be developed. Odds ratios, regression coefficients, p-values, and confidence intervals may not be enough to get us through the 21st century.

The challenge for the 21st century is to develop novel analysis tools and new statistics, and to make sure that data in a surveillance system are appropriately and adequately analysed for developing disease prevention and control strategies. In this regard, an automated data analysis system that can produce early warning signals for health and risk factor trends will be extremely helpful and needs to be developed[1].

7. The surveillance system should stimulate etiologic research so that the causes of epidemics can be found

Elucidation of etiologic factors would improve the capacity of the surveillance system to forecast events based on the trends of risk factors and to develop intervention strategies for the prevention, elimination, or reduction of risk factors.

The challenge for the 21st century is to develop surveillance systems that are closely integrated with etiologic research to pinpoint the causes of diseases.

8. The surveillance system should provide information for early warning of emerging health risks

Risk is a measure of the harm to human health that results from being exposed to a hazardous agent, together with the likelihood that the harm will occur. The science of risk assessment, including risk forecasting, is now well established and can be applied to surveillance data[25].

The challenge for the 21st century is to develop better and more accurate methods for forecasting based on surveillance data. Forecasting can be based on the trends of the disease itself, as in time-series analysis[26], or theoretical models, as in computer simulations[27]. But better still, forecasting should be based on the actual trends of risk factor exposures and intervention strategies using multiple regression techniques[28].

9. The surveillance system should provide information for the development of programmes and intervention strategies

With the globalisation of the economy, global travel and other globalisation practices, new epidemics could become more widespread in less time. This dictates a good, efficient, evidence-based intervention system.

The challenge for the 21st century is to develop, for the surveillance systems, a direct and effective mechanism to feed information into the public health decision making process, in order to develop programmes and intervention strategies.

10. The surveillance system should provide information for the evaluation of programmes and intervention strategies

Programmes and interventions need to be evaluated. Inefficient programmes and interventions should be discontinued to make room for and reallocate resources to new programmes and interventions. In addition, the surveillance system itself needs to be evaluated as well. In other words, we need to build another surveillance system on the surveillance system. This additional surveillance system should be able to evaluate the accuracy of data, cost-effectiveness, etc., as described in the surveillance systems evaluation guidelines of Centers for Disease Control and Prevention (CDC)[29].

The challenge for the 21st century is to develop better evaluation protocols for public health programmes and intervention, using routine surveillance data.

11. There is a need for more effective ways of information dissemination

Effective information dissemination involves determining the types of information that interested and affected parties need and want, and presenting this information to them in a useful and meaningful way. Information dissemination includes risk communication, i.e., to inform individuals about the existence, nature, form, severity or acceptability of health or environmental risks[30]. Informed individuals are in a better position to make decisions.

The challenge for the 21st century is to develop better ways of dissemination of information from a surveillance system to all those who need to know.

12. The surveillance system should provide equal opportunity for participation and for receipt of information

The surveillance system should aim for achieving health for all, regardless of age, race, socioeconomic status, etc. As proclaimed in the Universal Declaration of Human Rights (1948, Article 1), "All human beings are born free and equal in dignity and rights." The guidance principle for information dissemination should be that "All parties who are affected by, or express an interest in, the outcome, can contribute to a decision-making process, and should have an equal opportunity to influence decisions and receive equal access to information to the extent possible"[31].

The challenge for the 21st century is to ensure that the surveillance system would achieve health for all, on an equal basis and without prejudice.

In summary, history is a mirror for us to look into the future. The 12 lessons that we learn from the past 5000 years of the history of epidemics should be able to guide us in building a better and more comprehensive epidemiologic surveillance system in the 21st century. We encourage further discussion on this vision of an evolving, ongoing, systematic, population-based, comprehensive surveillance system, which is linked with a comprehensive and possibly automated data analysis system, to stimulate etiologic research, and to disseminate information for early warning of health risks, and for development and evaluation of intervention strategies, on an efficient and fair basis.

Zusammenfassung

Lektionen für die Surveillancesysteme im 21. Jahrhundert: eine historische Perspektive der letzten 5000 Jahre

Dieser Artikel betrachtet einige wichtige Epidemien der letzten 5000 Jahre in der Geschichte der Menschheit und zieht daraus 12 Folgerungen in Zusammenhang mit epidemiologischen Beobachtungen (Surveillance). Die entsprechenden 12 Herausforderungen könnten dazu dienen, im 21. Jahrhundert ein besseres und umfassenderes Beobachtungs- oder Surveillancesystem aufzubauen. Dies kann erreicht werden, indem wir: die Entwicklung und Verbesserung der Beobachtungspraxis fortsetzen, eine fortlaufende Grundlagenerhebung aufrechterhalten, systematisch und bevölkerungsbezogen vorgehen, Risiko- und Interventionsindikatoren in den Datenbanken berücksichtigen, effizientere Datenanalysen betreiben, Ursachenforschung anregen, die Prognosefähigkeiten verbessern, eine direkte Verbindung zu Interventionen herstellen, die Interventionen evaluieren, Massnahmen zur Informationsstreuung verbessern und unbefangen Informationen verbreiten.

Résumé

Leçons concernant la surveillance épidémiologique au XXIe siècle: Une perspective historique des cinq derniers millénaires

On trouve, dans ce document, une revue de quelques unes des grandes épidémies survenues au cours de 5000 dernières années de l'histoire de l'Homme. Douze leçons en sont tirées dans le contexte de la surveillance épidémiologique. Les douze impératifs correspondants proposés dans ce document pourraient servir d'orientation pour établir un système de surveillance plus adéquat et mieux intégré au XXIe siècle. Cela pourra se faire en: poursuivant le développement et l'amélioration de la surveillance; son maintien de façon permanente; sa systématisation; sa représentativité; l'inclusion d'indicateurs de risques et d'interventions dans la base de données; une analyse plus efficace des données; la promotion de la recherche étiologique; l'amélioration de la capacité de prévision; l'établissement de liens avec le développement de moyens d'intervention; l'évaluation des interventions; l'établissement de meilleurs outils d'information; la diffusion sans crainte de préjudice.

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