ANNEX 1
Software free and in the public domain

1. EPI INFO

Epi Info is a series of microcomputer programs for word processing, data management and epidemiological analysis, designed for public health professionals. Epi Info is easy to use, and also offers programming languages for both data input and analysis so that permanent health information systems can be developed.

EPI INFO software contains:

- **Epi Info**: allows rapid set-up of new entry forms and data files, easily customized data entry, and many data management and analysis techniques.

- **Epi Map**: displays counts or rates on geographic maps supplied or drawn on the screen. Colours, shading dots, or noncontiguous cartograms can be used to show any type of numeric data related to map.

- **DoEpi**: a series of educational studies and computer exercises designed to teach both epidemiology and the use of Epi Info. An instructor’s module is included.

- **SSS1**: provides functions for Box Jenkins Time Series analysis, “Fig. 1” MMWR graphs, robust trend analysis, and comparison of surveillance data from two sources.

WEBSITES: You can download the programs from the following Websites

**CDC Epidemiologic Software** (English)
URL (USA): [http://www.cdc.gov/epo/epi/software.htm](http://www.cdc.gov/epo/epi/software.htm)

**WHO Homepage WHOSIS** (English)
URL (Switzerland): [http://www.who.int/whosis](http://www.who.int/whosis)

**Epi Info Manuals from Brixton Books** UK (English)
URL (UK) [http://mkn.co.uk/help/extra/people/Brixton_Books](http://mkn.co.uk/help/extra/people/Brixton_Books)

**EpiConcept** (French)
URL (France): [http://www.epiconcept.fr/epiinfo.html](http://www.epiconcept.fr/epiinfo.html)

**USD, Inc.** (English)

**Epi Info Spanish Homepage** (Spanish)
URL (Spain): [http://www.cica.es/aliens/sveacsca/epiinfo.htm](http://www.cica.es/aliens/sveacsca/epiinfo.htm)

**Epi Info Brazilian Homepage** (Portuguese)
URL (Brazil): [http://www.lampada.uerj.br/epiinfo.htm](http://www.lampada.uerj.br/epiinfo.htm)

**Epi Info Swedish Homepage** (Swedish)
URL (Sweden): [http://www.umu.se/socialmedicin/epi](http://www.umu.se/socialmedicin/epi)

**Epi Info Norwegian Homepage** (Norwegian)
URL (Norway): [http://www.gruk.no/epi-info/download.htm](http://www.gruk.no/epi-info/download.htm)

**Epi Info German Homepage** (German)
URL (Germany): [http://www.shuttle.de/lga](http://www.shuttle.de/lga)

**Epi Info Usergroup BeNeLux** (Dutch)
URL (The Netherlands): [http://web.inter.nl.net/hcc/Koomen.Em/epinl.html](http://web.inter.nl.net/hcc/Koomen.Em/epinl.html)

CONTACT Epi Info hotline
Tel: (00) 1 404 639-0840 Fax: (00) 1 404 639-0841 e-mail: epiinfo@cdc.gov
2. **PROPHET**

   Prophet offers advanced, easy-to-use software tools for data management and visualization, and statistical analysis, from simple descriptive statistics to multi-factor ANOVA, logistic regression, and non-linear modelling.
   
   [http://www-prophet.bbn.com](http://www-prophet.bbn.com)

3. **CLUSTER VERSION 3.1**

   This software is designed to help the researcher determine if there is a statistically significant probability that a disease cluster occurred other than by chance.
   

   Performs the major tasks in survey and census data processing: data entry, data editing, tabulation, data dissemination, statistical analysis and data capture control, all of which can be used as a complete processing system or as stand-alone modules.
   

4. **WHONET**

   Local and national uses of antimicrobial resistance data can be greatly enhanced by the use of specialized software (WHONET), available free of charge from:
   
   WHO Headquarters: 20, Avenue Appia, CH-1211 Geneva 27 Switzerland
   Communicable Diseases Surveillance and Response (CSR)
   E-mail address: williamsr@who.ch / Surveillancekit@who.ch
   Tel: (41) 22 791 2679   Fax: (41) 22 791 4878
   [http://www.who.int/emc/amr.html](http://www.who.int/emc/amr.html)

5. **SDRBT2**

   WHO has developed a simple software programme (SDRTB-2) based on EPI Info for entering and analysing data from surveys. It can produce summary tables with the prevalence of drug resistance for each drug, analysed from different perspectives. The software is available free of charge from:
   
   WHO Headquarters: 20, Avenue Appia, CH-1211 Geneva 27 Switzerland
   Communicable Disease Surveillance and Response (CSR)
   E-mail address: Surveillancekit@who.ch
   Tel: (41) 22 791 2708   Fax: (41) 22 791 4878
ANNEX 2

Proposed surveillance definitions

ACTIVE CASE FINDING The process of seeking out cases* or health event* under surveillance* (e.g. house visits by community workers to identify cases of tuberculosis, active searching of medical records to identify cases of acute haemorrhagic fever).

ATTACK RATE The cumulative incidence* of infection in a group observed over a period during an epidemic*. This “rate” can be determined empirically by identifying clinical cases and/or by means of seroepidemiology. Because its time dimension is uncertain or arbitrarily decided, it should probably not be described as a rate. (Last JM, ed. A Dictionary of Epidemiology, 1997).

CASE A person who has the particular disease, health disorder, or condition which meets the case definition* for surveillance* and outbreak* investigation purposes. The definition of a case for surveillance* and outbreak* investigation purpose is not necessarily the same as the ordinary clinical definition.

CASE CLASSIFICATION Gradations in the likelihood of being a case* (e.g., suspected / probable / confirmed). This is particularly useful where early reporting of cases is important (e.g., ebola haemorrhagic fever) and where there are difficulties in making definite diagnoses (e.g., specialized laboratory tests required).

CASE DEFINITION A set of diagnostic criteria that must be fulfilled for an individual to be regarded as a case* of a particular disease for surveillance* and outbreak* investigation purposes. Case definitions can be based on clinical criteria, laboratory criteria or a combination of the two with the elements of time, place and person.

CASE-FATALITY RATE The proportion of cases* of a specified condition which are fatal within a specified time. (Adapted from Last JM, ed. A Dictionary of Epidemiology, 1997).

\[
\text{Case-fatality rate} = \frac{\text{Deaths from a given disease in a given period}}{\text{Diagnosed cases of that disease (in the same period)}} \times 100
\]

CLUSTER Aggregation of relatively uncommon events or diseases in space and/or time in amounts that are believed or perceived to be greater than could be expected by chance*.

COMMUNICABLE DISEASE (Synonym: infectious disease) An illness due to a specific infectious agent or its toxic products that arises through transmission of that agent or its products from an infected person, animal, or reservoir to a susceptible host, either directly or indirectly through an intermediate plant or animal host, vector, or the inanimate environment. (Last JM, ed. A Dictionary of Epidemiology, 1997).

CONTACT (OF AN INFECTION) A person or animal that has been in such association with an infected person or animal or a contaminated environment as to have had opportunity to acquire the infection. (Last JM, A Dictionary of Epidemiology, 1997).

ENDEMIC The constant presence of a disease or infectious agent within a given geographic area or population group; may also refer to the usual prevalence of a given disease within such area or group. The expression “endemic disease” has a similar meaning. (Adapted from Last JM, A Dictionary of Epidemiology, 1997).

EPIDEMIC [from the Greek επί, upon), δέκα (people)]. The occurrence in a community or region of cases* of an illness, specific health-related behaviour, or other health-related events* clearly in excess of normal expectancy. The community or region and the period in which the cases occur are specified precisely. The number of cases* indicating the presence of an epidemic* varies according to the agent, size, and type of population exposed; previous experience or lack of exposure to the disease; and time and place of occurrence. (Adapted from Last JM, ed. A Dictionary of Epidemiology, 1997).
EXCEPTION FLAGGING (REPORTING) SYSTEM A manual or automated system of data analysis which calculates thresholds for epidemic* detection (e.g. the signal given when incidence of meningococcal meningitis in African belt area is 15/100 000/week over 2 consecutive weeks).

EXPOSURE Proximity and/or contact* with a source of an agent in such a manner that effective transmission of the agent, harmful or protective effects of the agent may OCCUR. (Adapted from Last JM, ed. A Dictionary of Epidemiology, 1997).

FEEDBACK The regular process of sending analyses and reports about the surveillance* data back through all levels of the surveillance* system so that all participants can be informed of trends and performance.

HEALTH EVENT Any event relating to the health of an individual (e.g., the occurrence of a case* of a specific disease or syndrome, the administration of a vaccine or an admission to hospital).

INCIDENCE The number of instances of illness commencing, or of persons falling ill, during a given period in a specified population. Incidence is usually expressed as a rate, the denominator being the average number of persons in the specified population during the defined period or the estimated number of persons at the mid-point of that period (Prevalence and Incidence. WHO Bulletin, 1966; 35: 783-784).

INFECTIOUS DISEASE See COMMUNICABLE DISEASE.

NOTIFIABLE DISEASE A disease that, by legal requirements, must be reported to the public health or other authority in the pertinent jurisdiction when the diagnosis is made. (Adapted from Last JM, ed. A Dictionary of Epidemiology, 1997)

NOTIFICATION The processes by which cases* or outbreaks* are brought to the knowledge of the health authorities. In the context of the International Health Regulations, notification is the official communication of a disease/health event* to the World Health Organization by the health administration of the Member State affected by the disease/health event.

OUTBREAK An epidemic* limited to localized increase in the incidence* of a disease, e.g., in a village, town, or closed institution. (Adapted from Last JM, ed. A Dictionary of Epidemiology, 1997)

PERFORMANCE INDICATORS Specific agreed measurements of how participants are functioning within the surveillance* or reporting system*. These indicators may measure both the process of reporting (e.g., completeness*, timeliness*) and the action taken in response to surveillance* information (e.g., the percentage of cases* investigated or surveyed) and the impact of surveillance and control measures on the disease or syndrome in question (e.g., the percentage of outbreaks* detected by the system, the drop in the number of cases over a specified time period).

PERIODICITY The presence of a repeating pattern of excess cases*. The repeating pattern can be in years, months or weeks.

PREVALENCE The number of instances of illness or of persons ill, or of any other event* such as accidents, in a specified population, without any distinction between new and old cases*. Prevalence may be recorded at a stated moment (point prevalence) or during a given period of time (period prevalence). (Prevalence and Incidence. WHO Bulletin, 1966; 35:783-784).

REPORTING COMPLETENESS Proportion of all expected reports that were actually received. It is usually stated as “% completeness as of a certain date” (e.g. if of 30 administrative units in a reporting system* 15 submit reports, the reporting completeness is 50%; if of 50 cases* of diarrhoea 40 are reported, the reporting completeness is 80%).

REPORTING SYSTEM The specific process by which diseases or health events* are reported. This will depend on the importance of the disease and the type of surveillance*.
REPORTING TIMELINESS Proportion of all expected reports in a reporting system* received by a given due date.

SEASONAL VARIATION Change in occurrence of a disease or health event* that conforms to a regular seasonal pattern. (Last JM, ed. A Dictionary of Epidemiology, 1997).

SECULAR TREND (Synonym: temporal trend) Changes over a long period of time, generally years or decades. (Adapted from Last JM, ed. A Dictionary of Epidemiology, 1997).

SEROSURVEILLANCE The surveillance* of an infectious disease* through immunological markers of the disease in a population or sub-population (e.g. measuring the presence of HIV antibodies in pregnant women coming for antenatal care).

SENSITIVITY The ability of a surveillance* or reporting system* to detect true health events* i.e. the ratio of the total number of health events detected by the system over the total number of true health events as determined by an independent and more complete means of ascertainment.

SPECIFICITY A measure of how infrequently a system detects false positive health events* i.e. the number of individuals identified by the system as not being diseased or not having a risk factor, divided by the total number of all persons who do not have the disease or risk factor of interest.

SURVEILLANCE The process of systematic collection, orderly consolidation and evaluation of pertinent data with prompt dissemination of the results to those who need to know, particularly those who are in a position to take action (Adapted from Report of the Technical Discussions at the twenty-first World Health Assembly on National and Global Surveillance of Communicable Diseases, 18 May 1968 – A21/Technical Discussion/5).

SURVEILLANCE, ACTIVE Surveillance* where public health officers seek reports from participants in the surveillance system on a regular basis, rather than waiting for the reports (e.g. telephoning each participant monthly).

SURVEILLANCE, CASE-BASED Surveillance* of a disease by collecting specific data on each case* (e.g. collecting details on each case of acute flaccid paralysis (AFP) in poliomyelitis surveillance).

SURVEILLANCE, COMMUNITY Surveillance* where the starting point for the notification* is from community level, normally reported by a community worker. It can be active (looking for cases*) or passive (reporting cases). This may be particularly useful during an outbreak* and where syndromic* case definitions* can be used (the active identification of community cases* of Ebola virus infection in Kikwit was an example of active community surveillance).

SURVEILLANCE, ENHANCED The collection of additional data about cases* reported under routine surveillance*. Routine surveillance is a starting point for more specific data collection on a given health event*. This information may be sought from the reporter, the case, the laboratory or from another surveillance data set.

SURVEILLANCE, HOSPITAL-BASED (Synonym: Hospital surveillance) Surveillance* where the starting point for notification* is the identification by a hospital of a patient with a particular disease or syndrome.

SURVEILLANCE, INTENSIFIED The upgrading from a passive to an active surveillance* system for a specified reason and for a limited period (usually because of an outbreak*). It must be noted that the system then becomes more sensitive; secular trends* may therefore need to be interpreted carefully.

SURVEILLANCE, LABORATORY Surveillance* where the starting point is the identification or isolation of a particular organism in a laboratory (e.g. surveillance of salmonellosis).
SURVEILLANCE, PASSIVE Surveillance* where reports are awaited and no attempt are made to seek reports actively from the participants in the system.

SURVEILLANCE, ROUTINE The regular systematic collection of specified data in order to monitor a disease or health event*.

SURVEILLANCE, SENTINEL Sentinel surveillance is surveillance* based on the collection of data from a sample (random or non-random) of collecting sites as indicator data for the rest of the population, in order to identify cases* of a disease early or to obtain indicative data about trends of a disease or health event*. Examples are the use of a few hospitals to monitor the composition of influenza virus and check that the vaccine includes the right components, or the use of a network of general practitioners to monitor diseases or health events (e.g. attempted suicide, requests for HIV testing ). One instance of sentinel surveillance is the use of a particular population group (e.g., monitoring the serology of syphilis among pregnant women as an indicator of syphilis trends in the general population). Sentinel surveillance is inappropriate for those situations where every case requires public health action, e.g., poliomyelitis.

SURVEILLANCE REPORT A regular publication with specific information on the disease under surveillance*. It should contain updates of standard tables and graphs as well as information on outbreaks* etc. In addition it may contain information on the performance of participants using agreed performance indicators*.

SURVEY An investigation in which information is systematically collected. Usually carried out in a sample of a defined population group, within a defined time period. Unlike surveillance* it is not ongoing ; however, if repeated regularly, surveys can form the basis of a surveillance system.

SYNDROME A symptom complex in which the symptoms and/or signs coexist more frequently than would be expected by chance on the assumption of independence. (Last JM, ed. A Dictionary of Epidemiology, 1997).

SYNDROMIC REPORT The notification* of a health event* under surveillance* for which the case definition* is based on a syndrome* not on a specified disease (e.g. acute haemorrhagic fever syndrome, acute respiratory syndrome).

ZERO REPORTING The reporting of “zero case” when no cases* have been detected by the reporting unit. This allows the next level of the reporting system* to be sure that the participant has not sent data that have been lost, or that the participant has not forgotten to report.

Annex 3

Role and use of Geographic Information Systems (GIS) and mapping for epidemiological surveillance

Spatial analysis and mapping in epidemiology have a long history but until recently, their use in public health has been limited. Maps were either created manually, or in research institutes using capital-intensive GIS hardware and software.

However, recent advances in geographical information and mapping technologies and increased awareness have created new opportunities for public health administrators to enhance their planning, analysis and monitoring capabilities. The late 1990s have seen a significant expansion in information and mapping technology, including the development of desktop mapping software, new programming tools for customization of mapping products and increasing connectivity to information highways such as the World Wide Web.

There are many definitions of GIS. GIS are often described as an organized collection of computer hardware, software, geographical data and personnel designed to efficiently capture, store, update, manipulate, analyse and display all forms of geographically referenced information. While accurate, comprehensive and quite widely accepted, this definition may not help the public health newcomer to GIS. They are first and foremost an information system with a geographical variable which enable users to easily process, visualize and analyse their data or information spatially. Each piece of information is related in the system through specific geographical coordinates (e.g. latitude and longitude) to a geographical context. This can be a health facility, a laboratory, a village, a district, a region, a country or a group of countries. The information can be displayed in the form of graphs, charts and maps, although GIS are mainly used to display results in the form of maps.

Use of GIS in epidemiological surveillance

Geographical information systems and maps are valuable in strengthening the whole process of epidemiological surveillance information management and analyses.

In data collection
- A GIS provides an excellent means of collecting, updating and managing epidemiological surveillance and related information. A GIS can store, handle and geographically integrate large amounts of information from different sources, programmes and sectors.

In data management
- A GIS serves as a common platform for convergence of multidisease surveillance activities. Standardized georeferencing of epidemiological data facilitates standardized approaches to data management. As such, a GIS can serve as an entry point for integrating disease surveillance activities where appropriate.
- A GIS facilitates the convergence of multisectoral data, including epidemiological surveillance information, population information, environmental information and health and other resources into a common platform for analyses (Figure 1).
Figure 1: This figure illustrates how Guinea worm eradication programmes use GIS for standardized data entry and updating of epidemiological and programmatic data. National Coordinators can track all villages under surveillance, quickly identify newly infected and reinfected villages and monitor progress of eradication of the disease. The system contains all historical information to support the required procedures for eventual certification of eradication of the disease.

In data analysis
- A GIS provides an excellent means of visualizing and analysing epidemiological data, thus revealing trends, dependencies and interrelationships that would be more difficult to discover in other formats (Map 1).

Questions a GIS can answer
- Condition: What is...?
- Location: Where is it?
- Trends: What has changed since...?
- Patterns: What spatial patterns exist?
- Modelling: What if...?
Functions of a GIS

A GIS can help answer specific questions and perform the following functions:

- generate “thematic” maps (ranged colour maps or proportional symbol maps to denote the intensity of a mapped variable);
- allow for overlaying of different pieces of information;
- create buffer areas around selected features (for example a radius of 10 km around a health centre to denote a catchment area or 1 km around a water point or school);
- carry out specific calculations (the proportion of the population falling within a certain radius of a health facility, school, dam etc.);
- calculate distances (e.g. the distance of a community to a health facility) (Map 2);
- permit a dynamic link between databases and maps so that data updates are automatically reflected on the maps;
- permit interactive queries of information contained within the map, table or graph;
- process images such as aerial or satellite images to allow information such as temperature, rainfall, soil types and land use to be easily integrated, and spatial correlations between potential risk factors and the occurrence of diseases to be determined;
- provide a range of extrapolation techniques (for example, extrapolating sentinel site surveillance to unsampled areas).

Map 1: A GIS can easily combine information from different countries to support cross-border monitoring of transmission of diseases. Here, some foci for African trypanosomiasis are clearly identified.
Map 2: As this example from Mali shows, GIS and mapping can be used to assess the adequacy of health services to respond to disease notification.

**Location of Guinea worm endemic villages and distance to health facilities**

86% of Guinea worm cases & 75% of endemic villages are more than 5km from a health facility

Source: Ministère de la Santé/Min. de l’Hydraulique, Mali

**Use of GIS in public health**

GIS and mapping technologies are being used by a wide variety of public health administrators, including policy makers, national programme managers, statisticians, epidemiologists, regional and district medical officers.

**Sample GIS applications in public health**

- Determining geographical distribution and variation of diseases (prevalence, incidence)
- Analysing spatial and longitudinal trends
- Mapping populations at risk
- Stratifying risk factors
- Assessing resource allocation (health services, schools, water points)
- Planning and targeting interventions
- Forecasting epidemics
- Monitoring diseases and interventions over time

**First steps in using GIS**

In order to establish an operational GIS for epidemiological surveillance, the following steps should be followed.

*Determine the objectives of the GIS.* Why do you want to use a GIS? What is the problem to be solved? What kinds of analysis are to be carried out? What are the final products expected of the GIS? Who is to access the GIS?

*Access digitized basemaps,* e.g., maps of administrative boundaries, rivers, roads, etc. that contain xy coordinates and are available as computerized files.
Georeference epidemiological surveillance datasets. Assigning a unique and standardized code or nomenclature to the geographical area in which you want to work (e.g. region, district, village, health centre). The georeference of a district must correspond to the digitized base map. The georeference of a village or health facility must be the exact geographical coordinates (latitude and longitude). When these do not already exist in the country, global positioning systems (GPS) can be used. A GPS can be used to obtain the geographical coordinates of a point on a map, such as a village, health facility or dam. A GPS is a hand-held receiver used to find a location in the field through radio transmission to satellites.

Choose the appropriate GIS software packages. There are many different commercial and non-commercial GIS software packages. The choice of software should be guided by specific GIS requirements, as each software offers different functions.

Acquire suitable computer hardware. The minimum requirement to run any GIS software is a suitable environment to operate a microprocessor with 32 MB Ram minimum, 30 MB of available space on hard disk, Windows 95/NT or 98.

The WHO/UNICEF Joint Programme on Health Mapping (HealthMap) has developed a database management and mapping system called the HealthMapper that has been customized for public health applications at country, regional and global levels. The system contains a standardized georeferenced database of country, regional, district and subdistrict boundary maps, rivers, roads, villages, and health and social infrastructures. The system also comprises a user-friendly mapping interface and a database management interface. It is currently being used in West Africa and will be extended for use in all of Africa, South-East Asia and the Eastern Mediterranean regions of WHO.

For more information on how to get started using GIS for epidemiological surveillance and for accessing digitized basemaps, standardized geocoding methods, and the HealthMapper, please contact:

WHO/UNICEF Joint Programme on Data Management and Mapping – HealthMap
Communicable Disease Surveillance and Response (CSR)
World Health Organization, 20 Avenue Appia, 1211 Geneva 27, Switzerland
E-mail: meertj@who.ch / Surveillancekit@who.ch
Tel: (41 22) 791 3881 / 3836 Fax: (41 22) 791 4198
Internet: http://www.who.int/emc/healthmap/healthmap.html