Chapter 4.9
Real-time Syndromic Surveillance

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Learning objectives

Understand the key factors underpinning real-time syndromic surveillance systems and the use of syndromic surveillance data in research, including:

- The definition of syndromic surveillance.
- Data sources for syndromic surveillance.
- Governance issues.
- Data analysis and statistics.
- The application of syndromic surveillance in research.

What is syndromic surveillance?

Definition

"the near real-time collection, analysis, interpretation and dissemination of health-related data in order to enable the early identification of the impact (or absence of impact) of potential health threats that may require public health action"

Why do we undertake syndromic surveillance?

Early warning; operate in near-real-time allowing the timely identification of, and response to incidents.
Situational awareness; enable further description of healthcare seeking behaviour during an incident.
Reassurance; provide reassurance that there have been no widespread acute public health problems.
Flexibility; respond to a variety of public health demands ranging from infectious disease outbreaks to environmental incidents ('multi-hazard approach').

Examples of syndromic surveillance syndromes

Table 4.9.1 Examples of syndromic surveillance syndromes that are flexible in responding to a range of public health threats

Syndrome monitored	Related public health threats
Asthma	Respiratory pathogens, air pollution, chemical incidents, wild or industrial fires, severe thunderstorms
Fever	Influenza, respiratory pathogens, heatwave (infants)
Difficulty breathing	Air pollution, respiratory pathogens, chemical incidents, wild or industrial fires
Diarrhoea and vomiting	Gastrointestinal pathogens, flooding
Conjunctivitis	Respiratory pathogens, chemical incidents, wild or industrial fires, allergic rhinitis
Cough	Influenza, respiratory syncytial virus (children aged <5 years), respiratory pathogens, chemical incidents, wild or industrial fires

Table 4.9.1

Syndromic data sources: primary care / general practitioner / physician

Primary care / general practitioner / physician

- Primary care surveillance is often considered a gold standard for assessing community morbidity.
- Syndromes are usually constructed using clinical diagnoses as recorded by the treating physician at the time of the consultation.

Syndromic data sources: emergency department

Emergency department (ED)

- EDs are frequently used for syndromic surveillance, particularly in countries where primary care data may not be readily accessible.
- ED surveillance provides a metric for more severe presentation of disease or conditions.
- Syndromes may be constructed from chief or presenting complaints, or clinical diagnoses, depending on the timescale at which the information is available.

Syndromic data sources: telehealth services

Telehealth services

- Telehealth surveillance can provide access to populations not captured through emergency department or primary care surveillance.
- These sources are traditionally considered to provide early warning over other systems.
- Syndromes used are based on patient reported symptoms and may have the lowest specificity.

Syndromic data sources: ambulance services

Ambulance services

- Monitoring ambulance dispatch calls can provide an additional measure of acute, potentially more severe presentation of diseases or conditions in public health surveillance.
- Usually based upon the capture of chief complaint codes during the initial dispatch call (rather than clinical data collected by paramedic/clinician 'at site').

Syndromic data sources: non-healthcare syndromic data examples

Non-healthcare syndromic data examples

- School absenteeism
- Employee absenteeism
- Over the counter pharmacy sales
- Web searches (such as using Google)
- Social media activity (such as on Twitter)
- Online health services

Governance of syndromic surveillance (1)

- Often overlooked in the published syndromic surveillance literature.
- Adherence to good governance and data security practices is important.
- Establishing a syndromic surveillance system requires multiple phases undertaken by a multi-disciplinary group.
- One key area that will determine the sustainability of a system is establishing appropriate governance arrangements with data providers to assure the correct use and secure storage of data, as well as the competence of trained specialist staff accessing, analysing and interpreting data.

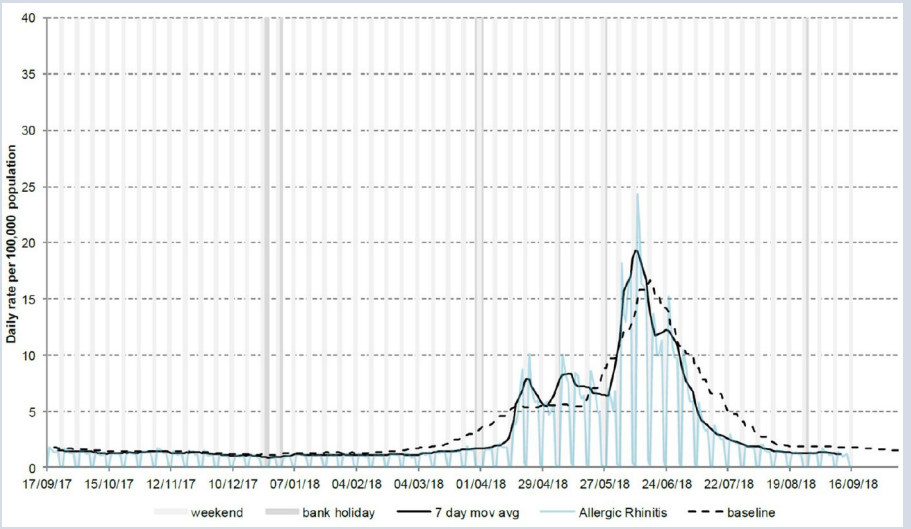
Governance of syndromic surveillance (2)

- Alongside governance, appropriate management and oversight of syndromic surveillance systems is important for their success.
- This requires collaboration between data providers and public health intelligence teams to steer the development and management of the systems.

Analysis of syndromic data: time

Time

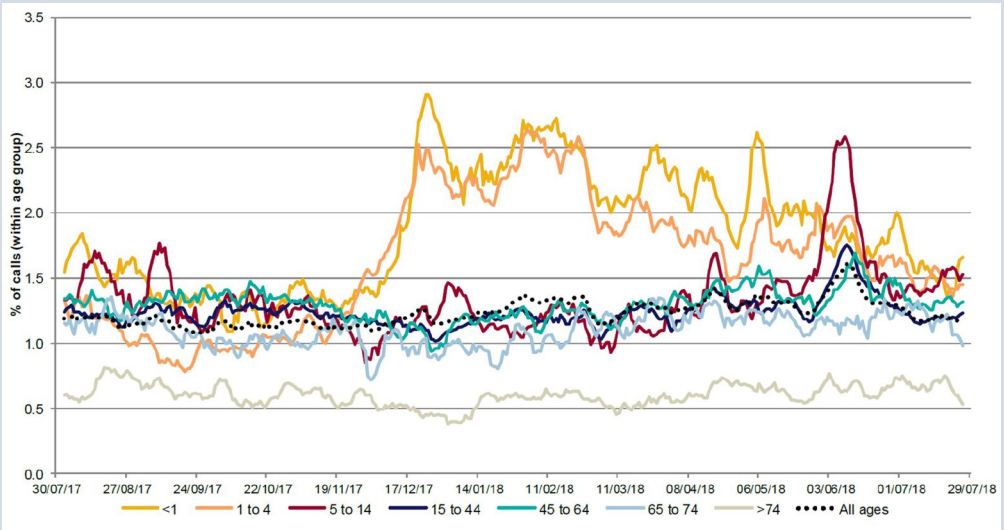
Syndromic surveillance data are analysed over time to identify short term increases in syndromes (suggesting outbreaks of disease, for example), environmental impacts (air pollution, for example) and long-term changes in trend (suggesting changes in disease burden).



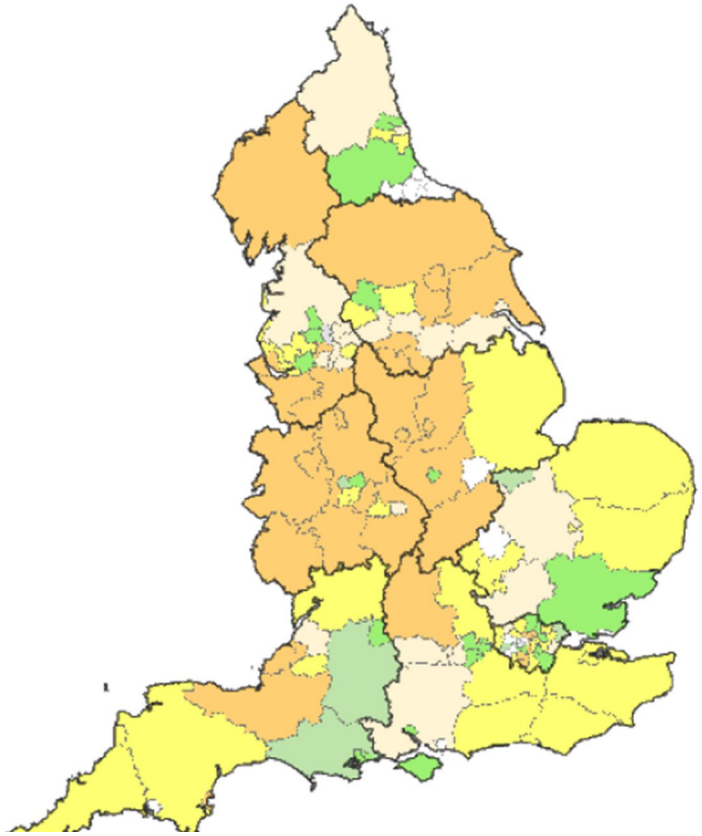
Analysis of syndromic data: person

Person

Data can be broken down by person demographics (such as age or gender) to identify changes in burden, which may be indicative of public health threats.



Analysis of syndromic data: place



Place

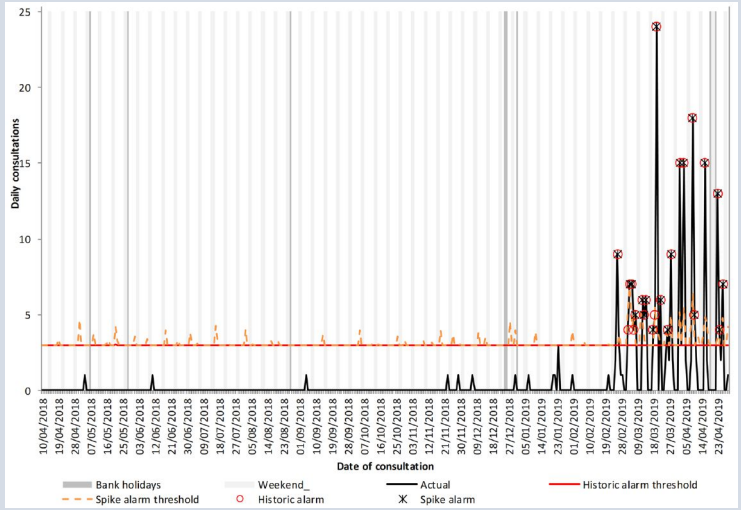
Where possible, links to the location of the patient (either area of residence or place of healthcare consultation) can be used to identify clusters or map the spread of activity.

Analysis of syndromic data: anomaly detection

Anomaly detection

Statistical tests can also be used for anomaly detection or to aid interpretation of syndromic data.

Statistical algorithms can also be applied to the development of historical baselines, which can supplement the interpretation of syndromic data by comparing the observed values to historically expected levels.



Research using syndromic surveillance

Syndromic surveillance data can provide a rich resource for Health EDRM researchers to address important public health questions.

- A wide range of research methods outlined elsewhere in the *WHO Guidance on Research Methods for Health EDRM* can be used alongside syndromic surveillance data.
- It is important to understand several key limitations of syndromic surveillance data, which might limit their application in certain research projects.

Limitations of syndromic surveillance for research (1)

Table 4.9.1

Limitation	Detail
Anonymized records	Syndromic data tend to be anonymised and therefore patient-level data cannot be linked to other records or databases and cannot be used to trace patients or undertake further studies (e.g., selecting controls for case-control type analysis)
Population level	Syndromic data tend to be aggregated to population level and often cannot be used for secondary analyses on an individual level
System coverage	Some syndromic systems do not have full or representative coverages geographically (country or region), or person level (such as different age groups: paediatric or adult EDs) or other limitations on access to healthcare
Coding	Clinical coding used to define syndromes can be limited or very generic or, if free text is provided this might require additional analytical skills

Limitations of syndromic surveillance for research (2)

Table 4.9.1

Limitation	Detail
Symptom based	Syndromic data are not based on confirmed laboratory reports and, therefore, are not directly attributable to specific pathogens
Data quality	Syndromic data are not 'cleaned' before being used for surveillance. Consequently, compared to other health data sources used by researchers, there is a greater risk of data errors (for example, duplications, miss-entry of age data, incorrect coding or incomplete data fields)
Incomplete data	Syndromic data only uses data available in real-time, taking a 'snapshot' of daily activity. Therefore, some data will be excluded due to transfer issues or time taken to confirm diagnoses (e.g., most GP pneumonia diagnoses occur after laboratory confirmation and are not available in a next-day extract)

Case study 1: *Assessing potential health impacts of mass gatherings and sporting events (1)*

Mass gatherings can impact on the health of the public. Surveillance during mass gatherings is needed to identify and quantify any impact (or reassure that there is an absence of impact) in a timely manner.

- The 2016 European Football Championship was hosted in France, involving 24 nations with 51 matches during a four-week period.
- ED syndromic data from England, France, Northern Ireland and Wales were analysed retrospectively to identify any relevant impacts of matches played.

Case study 1: *Assessing potential health impacts of mass gatherings and sporting events (2)*

- In the four hours before matches were played by the national team, ED attendances were significantly lower than would be expected in all countries.
- In the four hours after the final match, involving France, the number of ED attendances in France increased significantly.

Overall, these results indicated relatively small impacts of major sporting events on ED attendances.

Case study 2: *Assessing the impact of air pollution on health using syndromic surveillance*

Globally, air pollution is the biggest environmental risk to health.

- Syndromic surveillance systems present an opportunity to assess the acute impact of air pollution on the health of the population by monitoring healthcare seeking behaviour during periods of poor air quality.
- More complex research approaches may incorporate the inclusion of further variables and confounders, which might influence the outcome of the relationship between healthcare seeking behaviour and air quality.

The results of this research can be used to assure prospective surveillance during air pollution incidents by providing baselines for future interventions and adding to the knowledge base.

Case study 3: *Determining the likely impact of a new vaccine programme using syndromic surveillance*

Syndromic surveillance can contribute a rapid assessment of the impact of the introduction of new vaccines on the health of the population. An anticipated outcome of the introduction of a new vaccine might be reduced disease incidence and thus fewer healthcare visits.

- Interrupted time series and 'before-after' study methods (Chapter 4.1) can be used to assess the impact of a new vaccine using syndromic surveillance.
- Syndromic data collected before the introduction of the intervention are compared to equivalent data collected after the event.

Rotavirus vaccine was introduced in the UK in 2013 - syndromic surveillance revealed a 30% decrease in gastroenteritis, coinciding with the introduction of the new rotavirus vaccine programme in England.

Key messages (1)

- Syndromic surveillance systems can augment existing public health surveillance programmes, providing early warning and introducing real-time intelligence and reassurance at a national, regional and local level.
- Compared to traditional surveillance systems, syndromic surveillance can provide a more flexible approach to surveillance, enabling multi-purpose surveillance including emerging threats.
- Adherence to good governance and data security practices around the collection, storage, processing and use of syndromic surveillance data is essential for the long-term success of systems.

Key messages (2)

- Syndromic surveillance data are a valuable resource for public health research, including in Health EDRM, but specific limitations of syndromic surveillance for research need to be considered.
- Syndromic surveillance systems gain value in research data sources when operated consistently over time enabling comparison to historical data.

Further reading (1)

Conway M, et al. Using chief complaints for syndromic surveillance: a review of chief complaint based classifiers in North America. Journal of Biomedical Informatics 2013:46:734-43.
Review of 15 North American syndromic surveillance systems that use chief complaints coding systems

Josseran L, et al. Assessment of a syndromic surveillance system based on morbidity data: results from the Oscour network during a heat wave. PLoS One 2010:5:e11984.
Description of the application of a national syndromic surveillance system during a heatwave

Smith GE, et al. Novel public health risk assessment process developed to support syndromic surveillance for the 2012 Olympic and Paralympic Games. Journal of Public Health2017:39:e111-7.
Outlines the development of a novel risk assessment that systematically allows the translation of syndromic surveillance data and statistics into public health action

Further reading (2)

Triple-S: Syndromic Surveillance Systems in Europe. Guidelines for designing and implementing a syndromic surveillance system. 2013. https://webgate.ec.europa.eu/ chafea_pdb/assets/ files/pdb/20091112/20091112_d08_giss_en_ps.pdf
These guidelines provide a practical description of how to set up a syndromic surveillance system, which data sources to use, how to analyse the data, report the findings and evaluate the system's usefulness.

Yoon PW, et al. Syndromic surveillance: the value of real-time data for public health action. Public Health Reports; 2017: 132: 1S-126S.
This supplemental issue of Public Health Reports contains 18 articles that describe the use of syndromic surveillance for event identification, situational awareness, and enhanced response to diseases, conditions, and activities that affect population health.

References

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Syndromic surveillance definition: https://webgate.ec.europa.eu/chafea_pdb/assets/files/pdb/20091112/20091112_do8_giss_en_ps.pdf.
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Case study 'assessing impacts of mass gatherings and sporting events': Journal of Public Health; 2017: 39: e111-e7.
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