UK Health Security Agency

Communicable Disease & Epidemiological methods

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Session Learning Objectives

- Understand the basic principles, concepts and practice of communicable disease surveillance
- Understanding of the uses of surveillance information in effective public health practice
- Recognise the components of a surveillance system

What is surveillance?

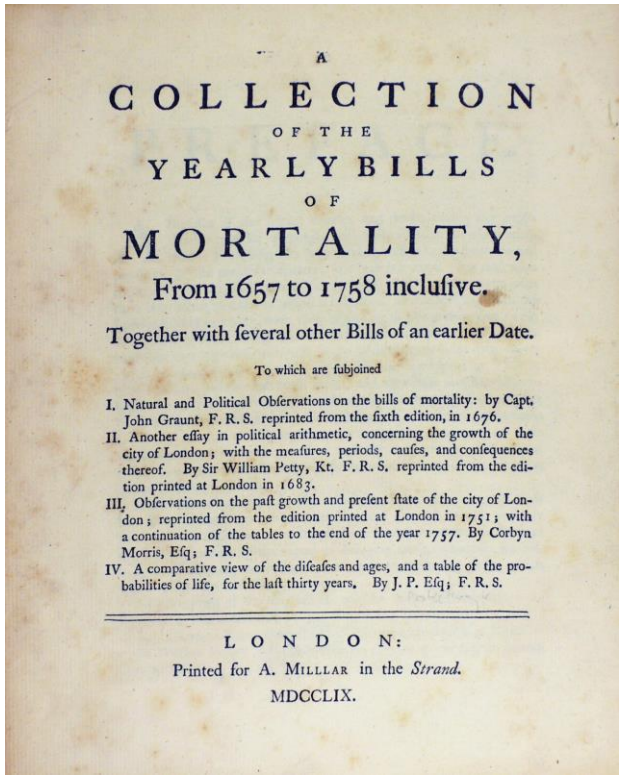
“close observation, especially of a suspected spy or criminal”

What is public health surveillance?

"Systematic ongoing collection, analysis, and interpretation of data and timely dissemination to those who need to know so that action can be taken"

"Information for action"

London Bills of Mortality



A

COLLECTION

OF THE

YEARLY BILLS

OF

MORTALITY,

From 1657 to 1758 inclusive.

Together with several other Bills of an earlier Date.

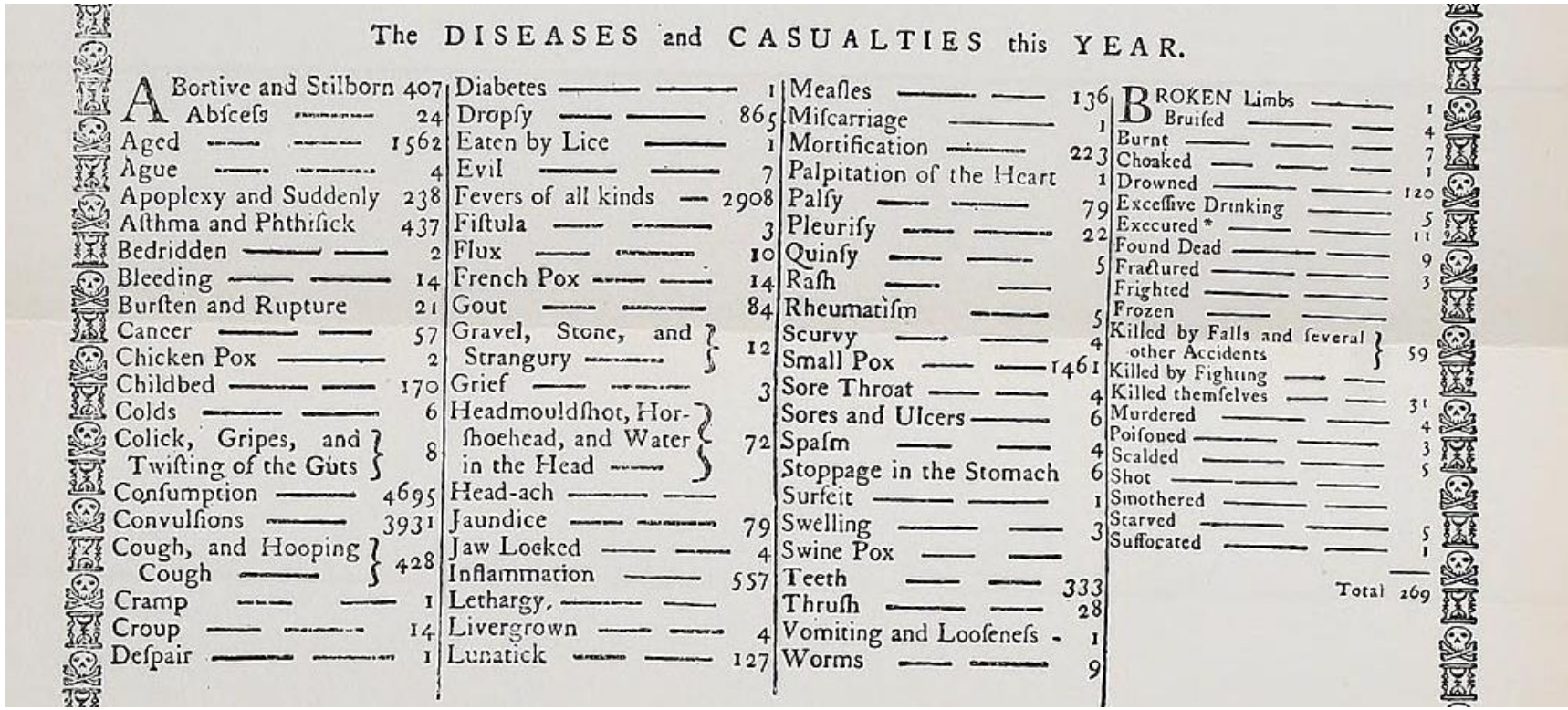
To which are subjoined

I. Natural and Political Observations on the bills of mortality: by Capt. John Graunt, F. R. S. reprinted from the sixth edition, in 1676.
II. Another essay in political arithmetic, concerning the growth of the city of London; with the measures, periods, causes, and consequences thereof. By Sir William Petty, Kt. F. R. S. reprinted from the edition printed at London in 1683.
III. Observations on the past growth and present state of the city of London; reprinted from the edition printed at London in 1751; with a continuation of the tables to the end of the year 1757. By Corbyn Morris, Esq; F. R. S.
IV. A comparative view of the diseases and ages, and a table of the probabilities of life, for the last thirty years. By J. P. Esq; F. R. S.

LONDON:

Printed for A. MILLAR in the *Strand*.

MDCCLIX.



The DISEASES and CASUALTIES this YEAR.

Abortive and Stilborn	407	Diabetes	1	Measles	136	Broken Limbs	1
Abscess	24	Dropsy	865	Miscarriage	1	Bruised	4
Aged	1562	Eaten by Lice	1	Mortification	223	Burnt	7
Ague	4	Evil	7	Palpitation of the Heart	1	Choaked	1
Apoplexy and Suddenly	238	Fevers of all kinds	2908	Palsy	79	Drowned	120
Asthma and Phthisick	437	Fistula	3	Pleurisy	22	Excessive Drinking	5
Bedridden	2	Flux	10	Quinsy	5	Executed *	11
Bleeding	14	French Pox	14	Rash		Found Dead	9
Burften and Rupture	21	Gout	84	Rheumatism	5	Fractured	3
Cancer	57	Gravel, Stone, and Strangury	12	Scurvy	4	Frighted	
Chicken Pox	2	Grief	3	Small Pox	1461	Frozen	
Childbed	170	Headmouldshot, Horshoehead, and Water in the Head	72	Sore Throat	4	Killed by Falls and several other Accidents	59
Colds	6	Head-ach		Sores and Ulcers	6	Killed by Fighting	
Colick, Gripes, and Twisting of the Guts	8	Jaundice	79	Spasm	4	Killed themselves	31
Consumption	4695	Jaw Locked	4	Stoppage in the Stomach	6	Murdered	4
Convulsions	3931	Inflammation	557	Surfeit	1	Poisoned	3
Cough, and Hooping Cough	428	Lethargy.		Swelling	3	Scalded	5
Cramp	1	Livergrown	4	Swine Pox		Shot	
Croup	14	Lunatick	127	Teeth	333	Smothered	
Despair	1			Thrush	28	Starved	
				Vomiting and Looseness	1	Suffocated	5
				Worms	9		1
						Total	269

What is public health surveillance?

Ongoing: routine over some period, perhaps indefinite

Systematic:

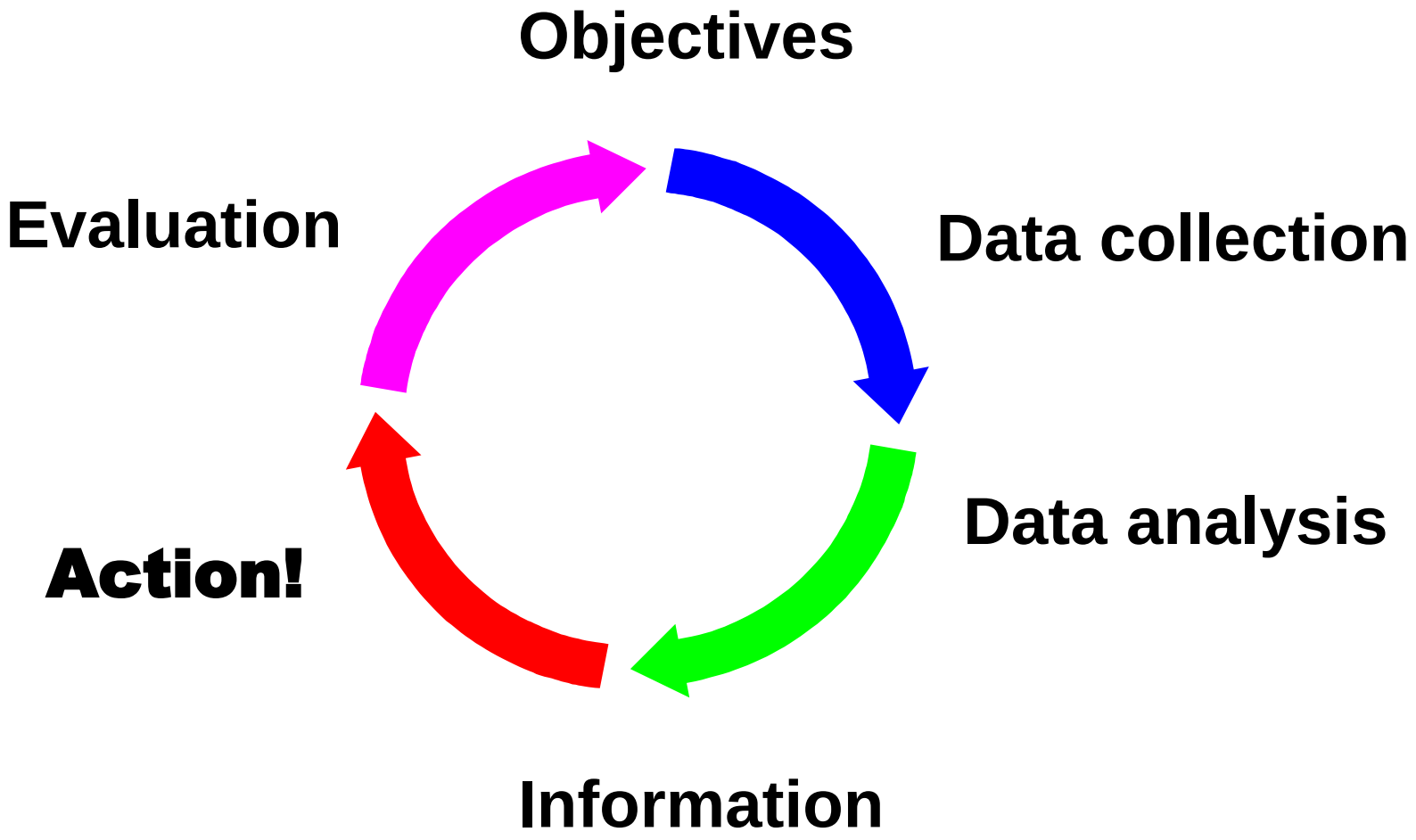
- All necessary information, same definitions, same format

Collation: from multiple sample points

Analysis and interpretation: based on understanding of object of surveillance

Dissemination: information to those who need to know

The surveillance loop



Why Surveillance is Required

- Underpins our reactive public health response
- Monitoring trends and estimate magnitude of health problem (Burden of disease on populations)
- To detect sudden changes in disease occurrence or patterns (Outbreak detection and alert function)
- To monitor trends in disease and risk factors (time / person / place)
- To increase understanding of disease epidemiology

Why surveillance is Required (2)

- Estimate future disease impact (e.g. Emergency planning, epidemic preparedness)
- Guide public health policy/ (e.g. Hepatitis C strategy)
- Evaluate interventions (e.g. Effectiveness of vaccination policy)
- Support Research

- Goal: reduce morbidity and mortality through control and prevention of disease

Surveillance is NOT research

Surveillance

- Applies **existing knowledge** to guide health authorities in the use of known control measures
- Directly relevant to monitoring and control needs
- **Generate** hypotheses e.g. regarding disease causation

Research

- Pursues **new knowledge** from which better control measures will result
- **Test** hypotheses

Categories of Surveillance I

Indicator vs Event Based	Hospital LIMS vs media reports (e.g PROMED)
Passive vs Active	Laboratory report of measles vs. actively phoning doctors' surgeries to look for measles cases
Sentinel (sample) vs Universal (comprehensive)	Flu swabs at major airport vs lab reported measles in UK

Categories of Surveillance II

Syndromic vs Traditional	Syndromes vs Diseases
Participatory	Mobile phones, apps…

Surveillance data sources

Infectious disease reporting:

- Physician diagnoses (notifiable diseases & informal, primary and secondary care)
- Laboratories

Syndromic surveillance

- Other Health Care Activity e.g.
  - GP consultations
  - Hospital episode statistics
  - Calls to 111
- Many others e.g. medicines sales, web searches, school absences
- Vital statistics (birth/death registrations/population estimates)

Characteristics of infectious disease data

- Large amount of PII
- Requires constant review to detect changes that might signal need to intervene
- Turnaround time
- Informed interpretation required
- Exposure and outcome data routinely collected
- Local / National / International dimension
  - E.g. COVID, Food poisoning

Infectious vs non-infectious disease epidemiology

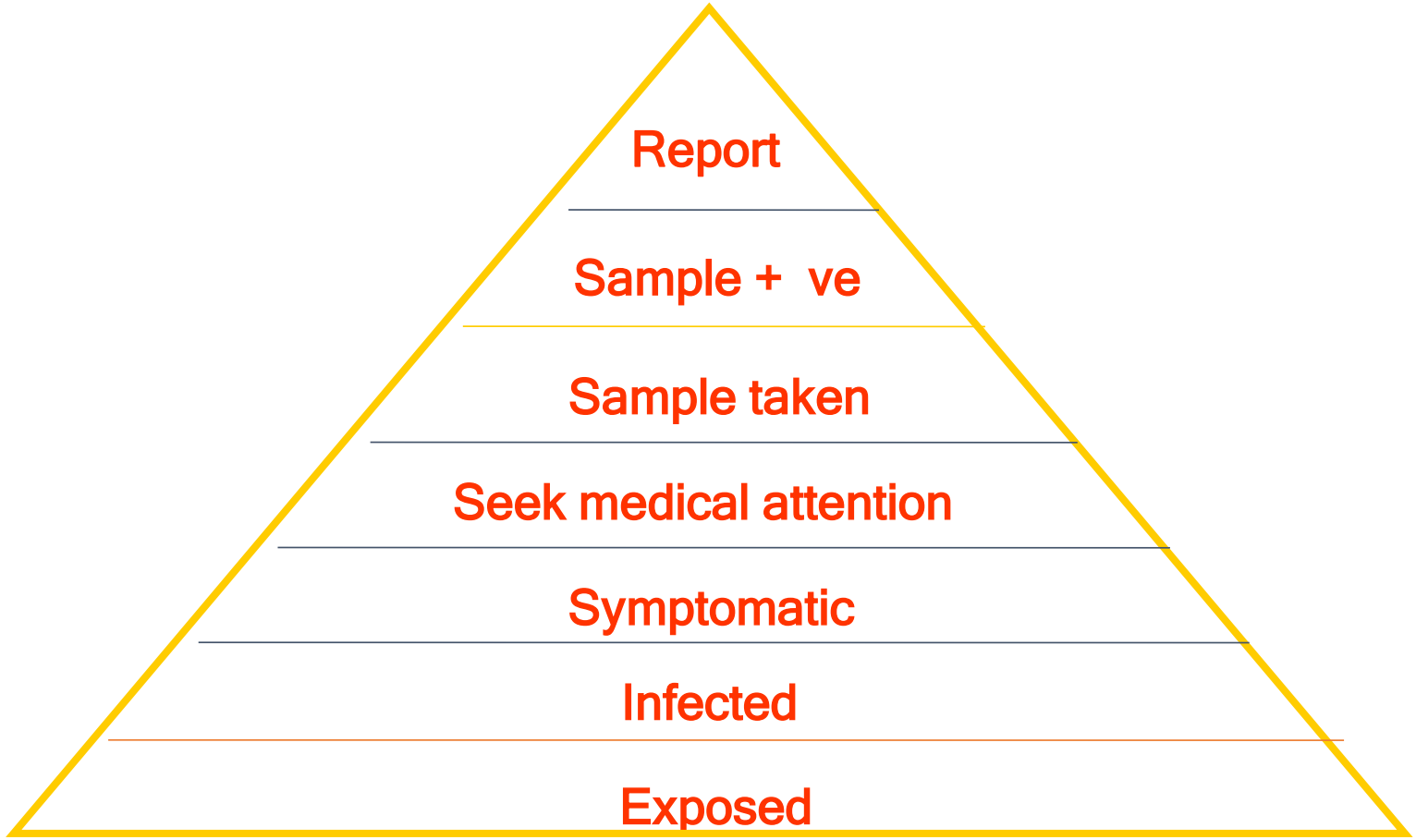
Same

- General rationale
- Terminology
- Ways of collecting data (blood samples, questionnaires, registries)
- Analysis (statistics)

But some special features

- A case may also be a risk factor
- People may be immune
- A case may be a source without being recognised as such
- There is sometimes a need for urgency
- Complexity of data sources

The surveillance pyramid

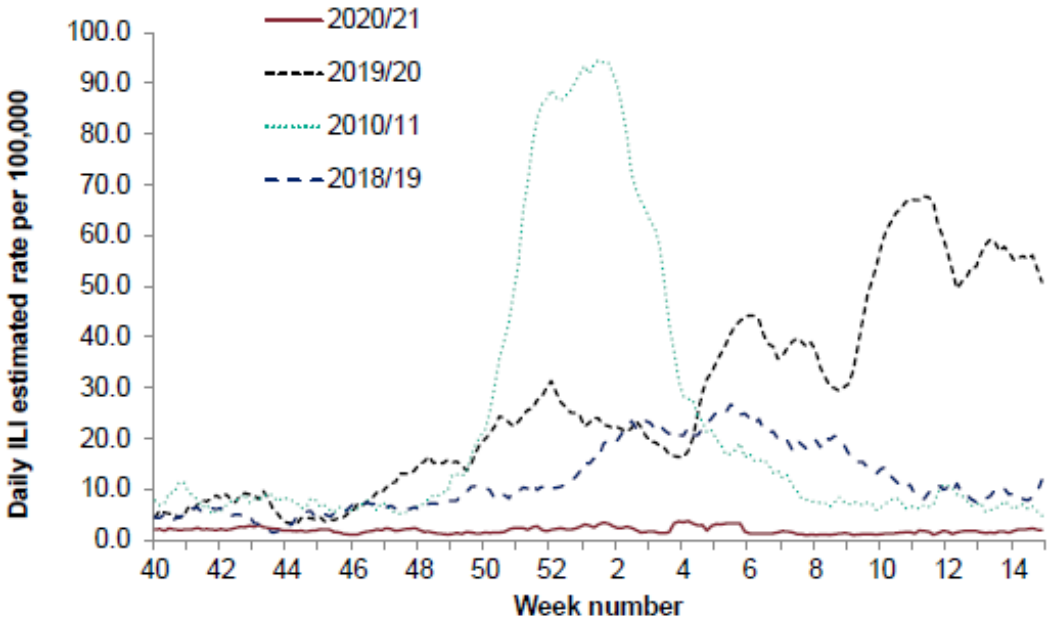


Surveillance data sources

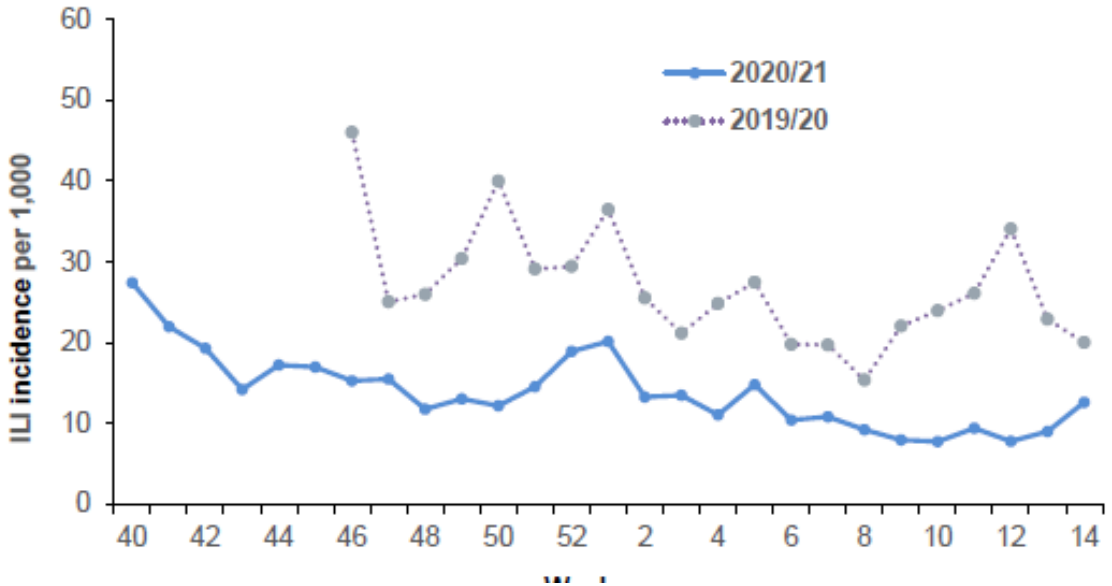
Q: Which data sources can we capture surveillance data to monitor influenza activity?

Community survaillance

Daily Google search query rates

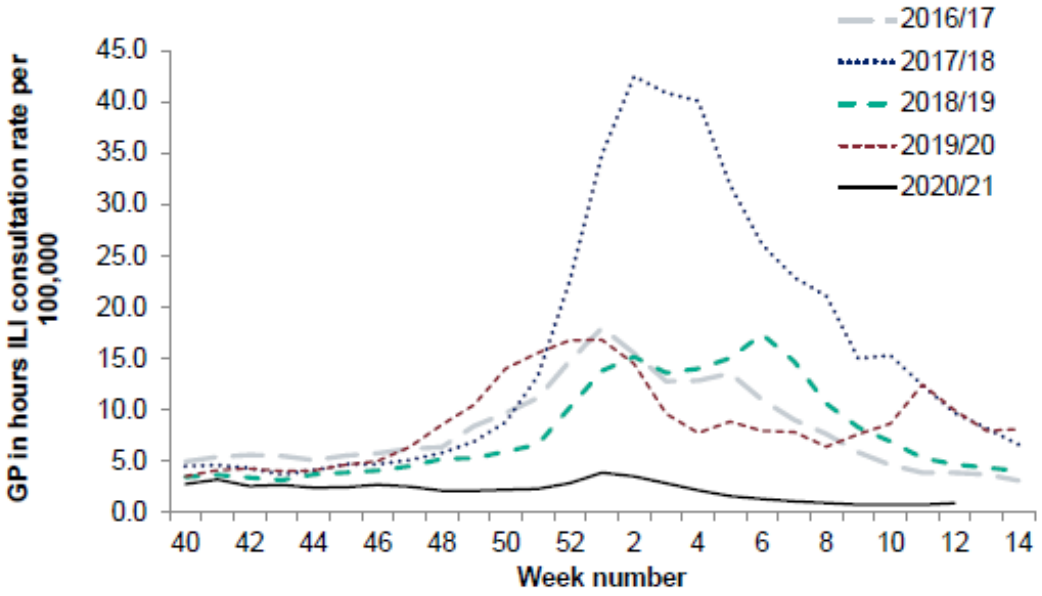


Weekly ILI reported in FluSurvey

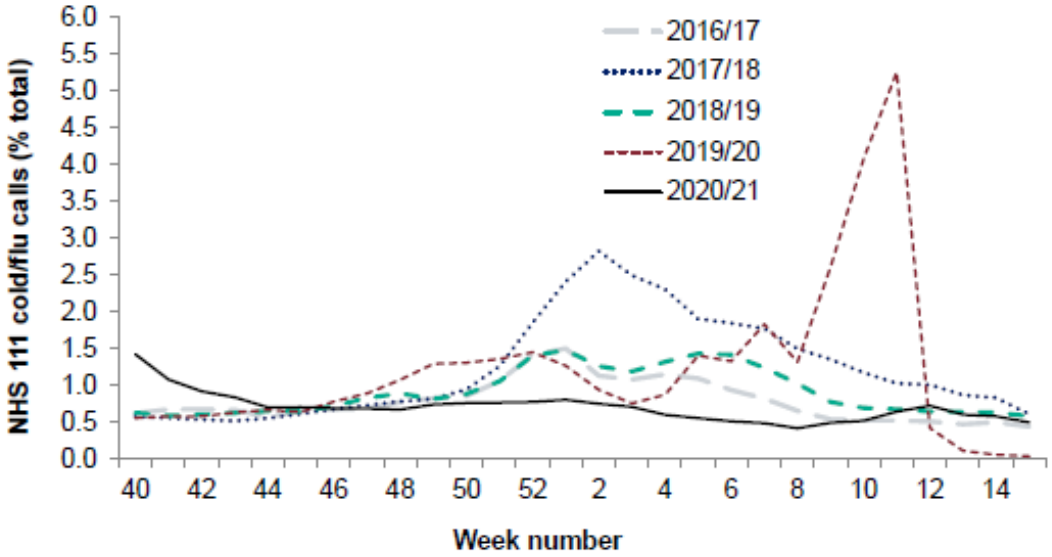


Syndromic Surveillance

NHS 111 cold/flu calls

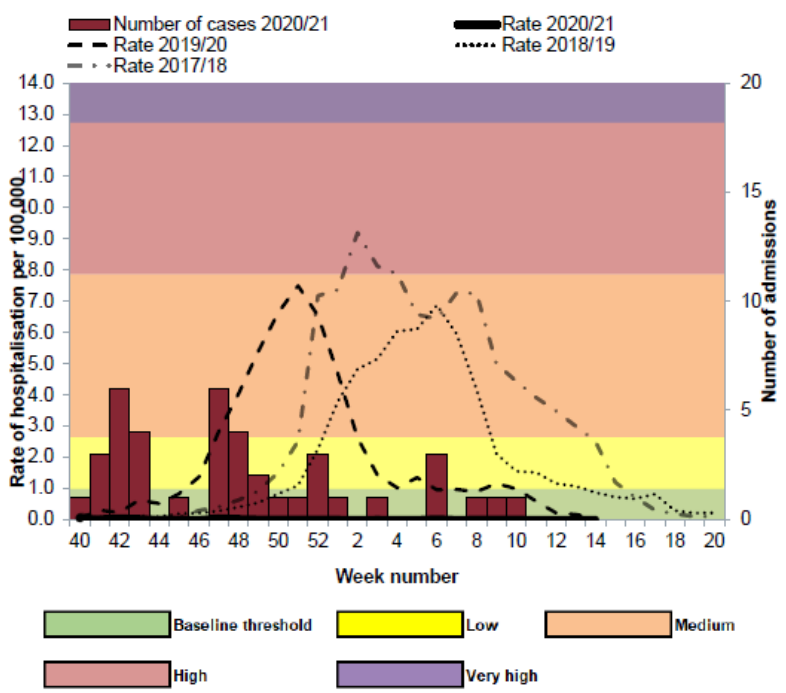


GP consultations (influenza-like illness)

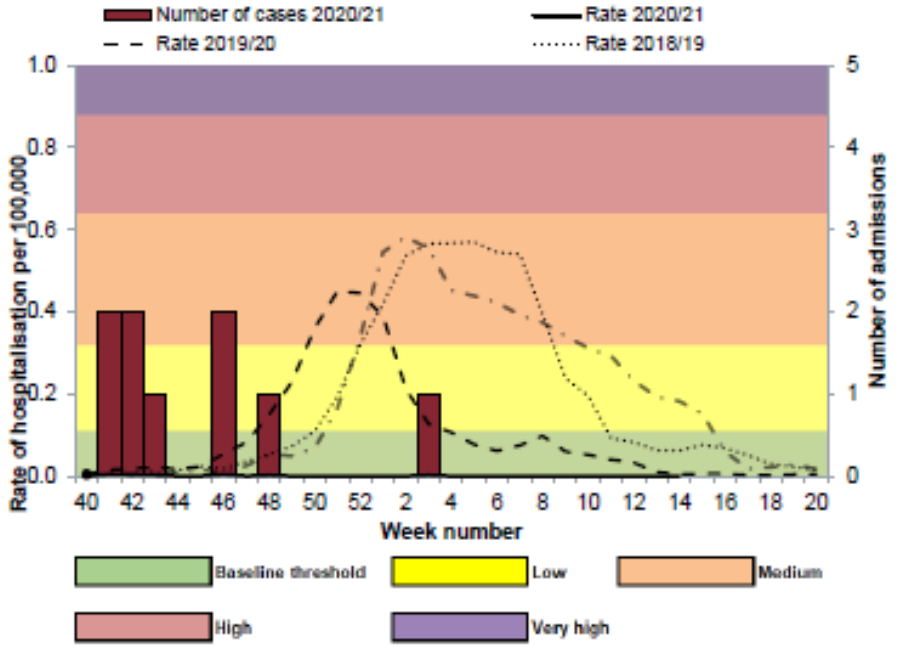


Hospital Admissions

Influenza hospital admissions

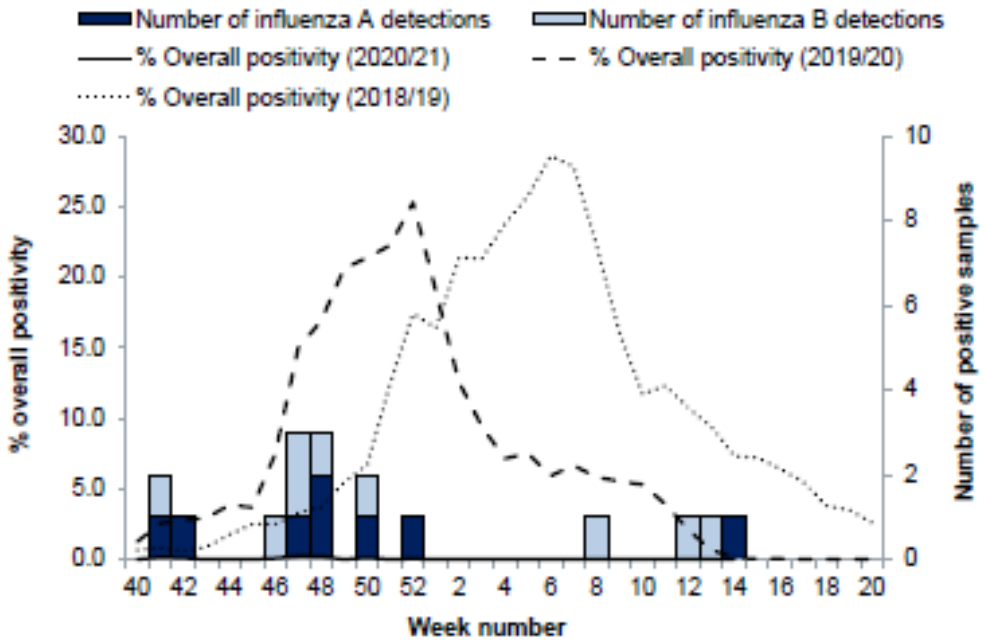


ICU/HDU influenza admissions

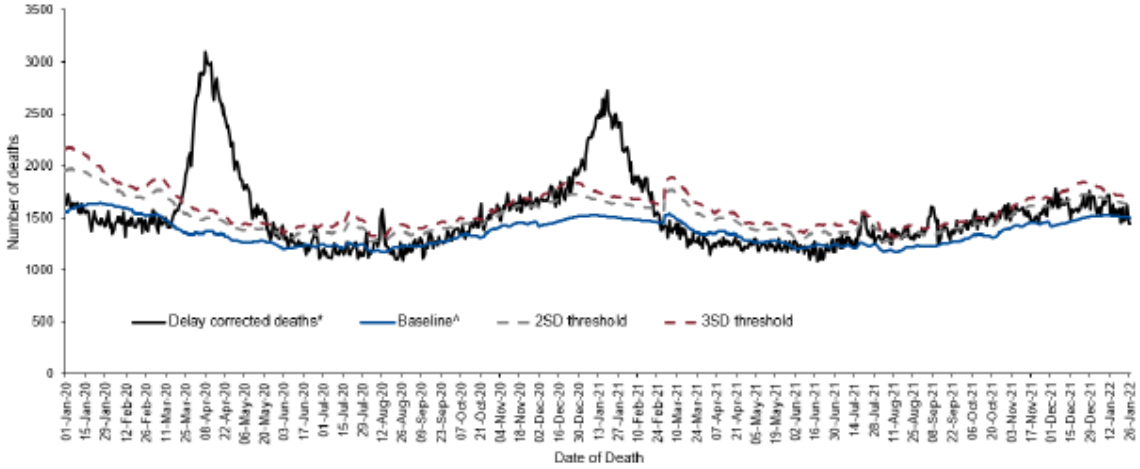


Laboratory Reports & Death Registrations

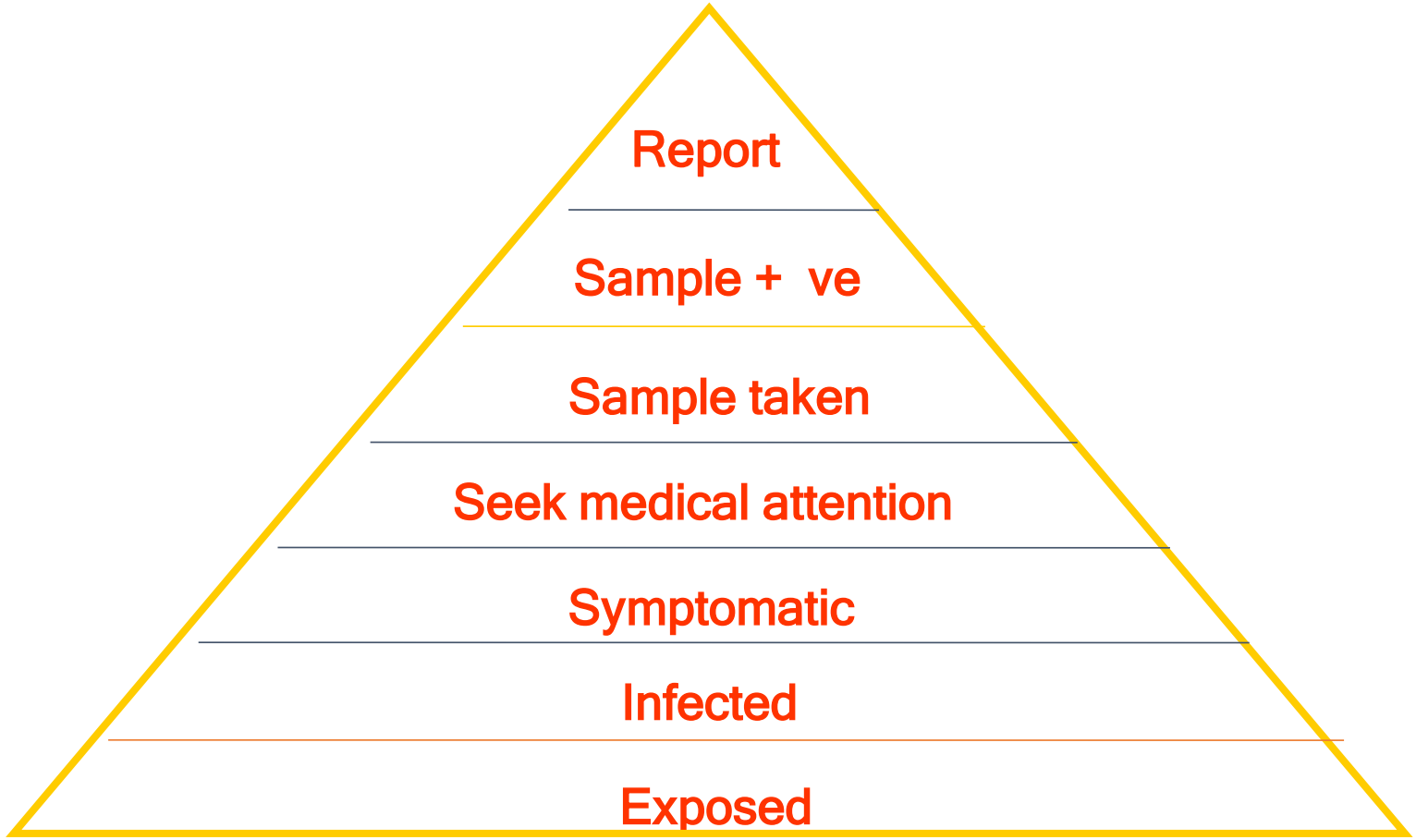
Laboratory reports



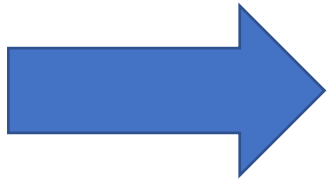
All cause deaths

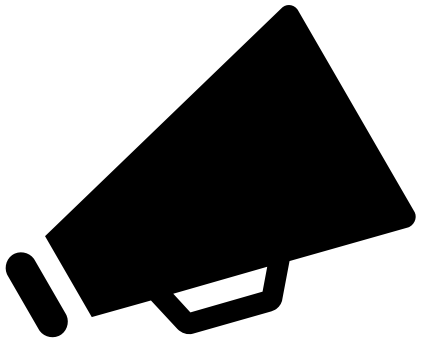


The surveillance pyramid



Analysis and interpretation





SGSS Key information provided

- Patient ID numbers (hospital or NHS)
- Laboratory specimen number and date
- Organism (Antibiotic Resistance)
- Patient age, gender
- Patient location (i.e. patient or GP postcode)
- Specimen types
- Test methods

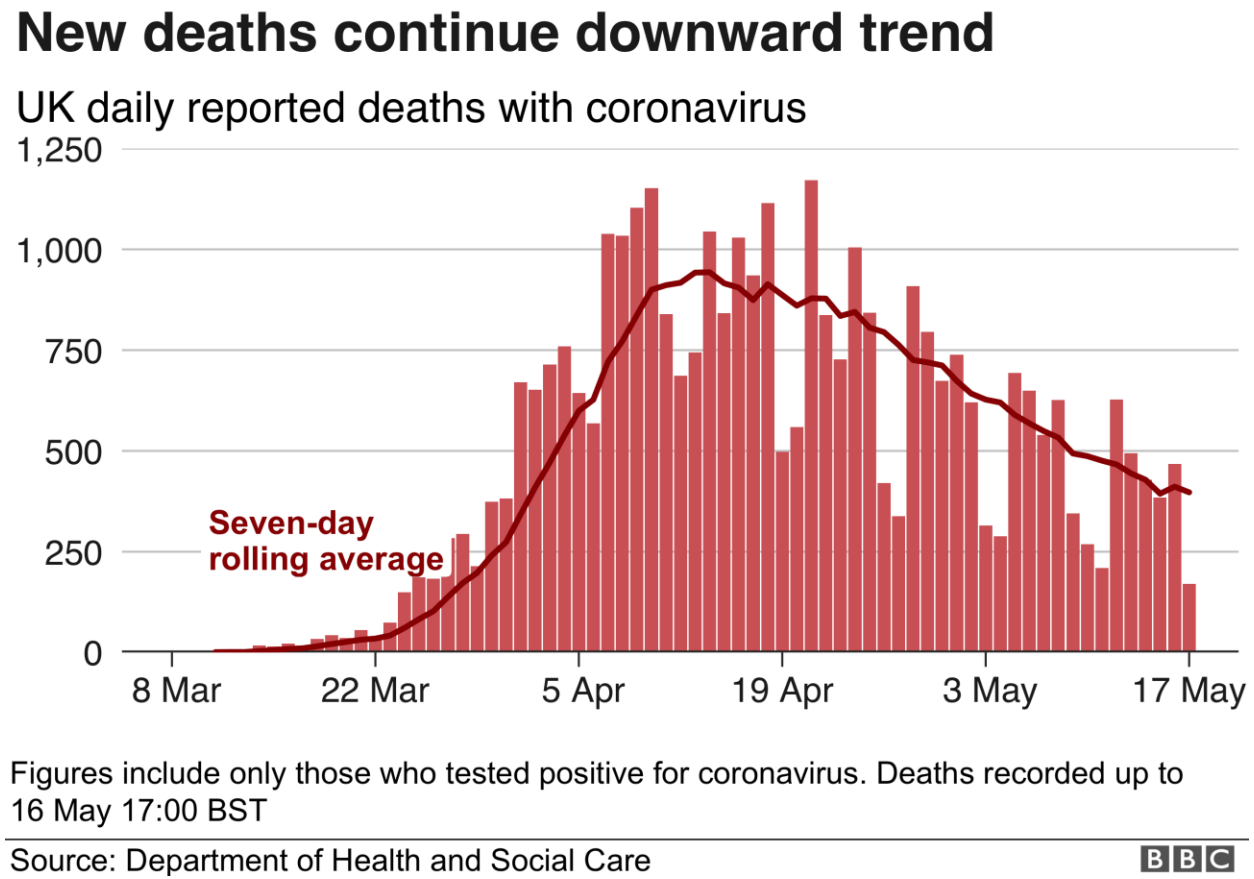
Aim of analysis

- Process raw data into information that can be used for decision-making e.g. should we investigate an increase in cases
- Generation of **hypotheses** e.g. possible common exposures
- Detection of **outbreaks** or unexpected increases / decreases in disease occurrence
- Assurance of **lack of impact** during incidents

Requires

- Regular analysis using a standard approach
- Customized approaches may be required under specific circumstances
- Human interpretation in order to determine whether any additional action is necessary (e.g. familiarity with people and disease patterns in a particular community and the reporting system in use)

Issues with interpreting surveillance data

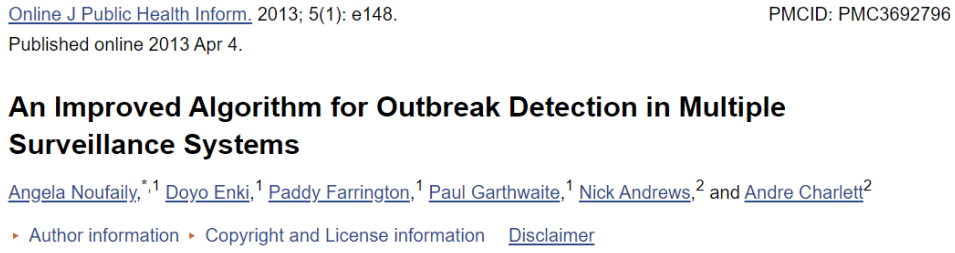


BBC News, https://www.bbc.co.uk/news/uk-52699483

Exceedances

Statistical algorithm;

- Generates a ‘baseline’ number of reports (or ‘cases’)
- Generates a predicted ‘threshold’ or upper limit
- An ‘exceedance’ happens when the number of reports is above the predicted upper limit
- In England, exceedance algorithms run weekly
- Available at https://connect.phe.gov.uk/sites/how-to/story/3592/laboratory-reporting-surveillance



Online J Public Health Inform. 2013; 5(1): e148. PMCID: PMC3692796
Published online 2013 Apr 4.

An Improved Algorithm for Outbreak Detection in Multiple Surveillance Systems

Angela Noufaily,[*,1] Doyo Enki,[1] Paddy Farrington,[1] Paul Garthwaite,[1] Nick Andrews,[2] and Andre Charlett[2]

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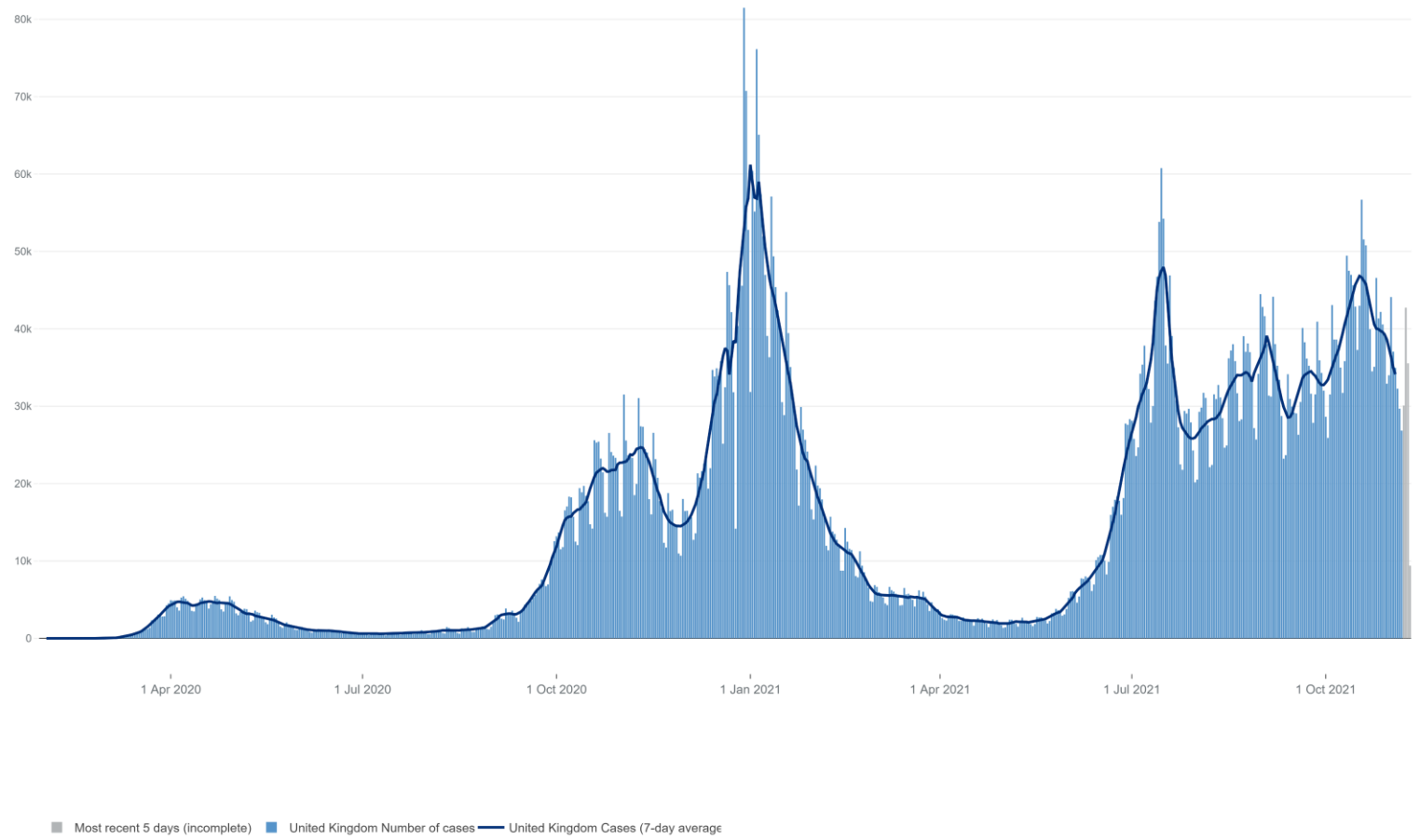
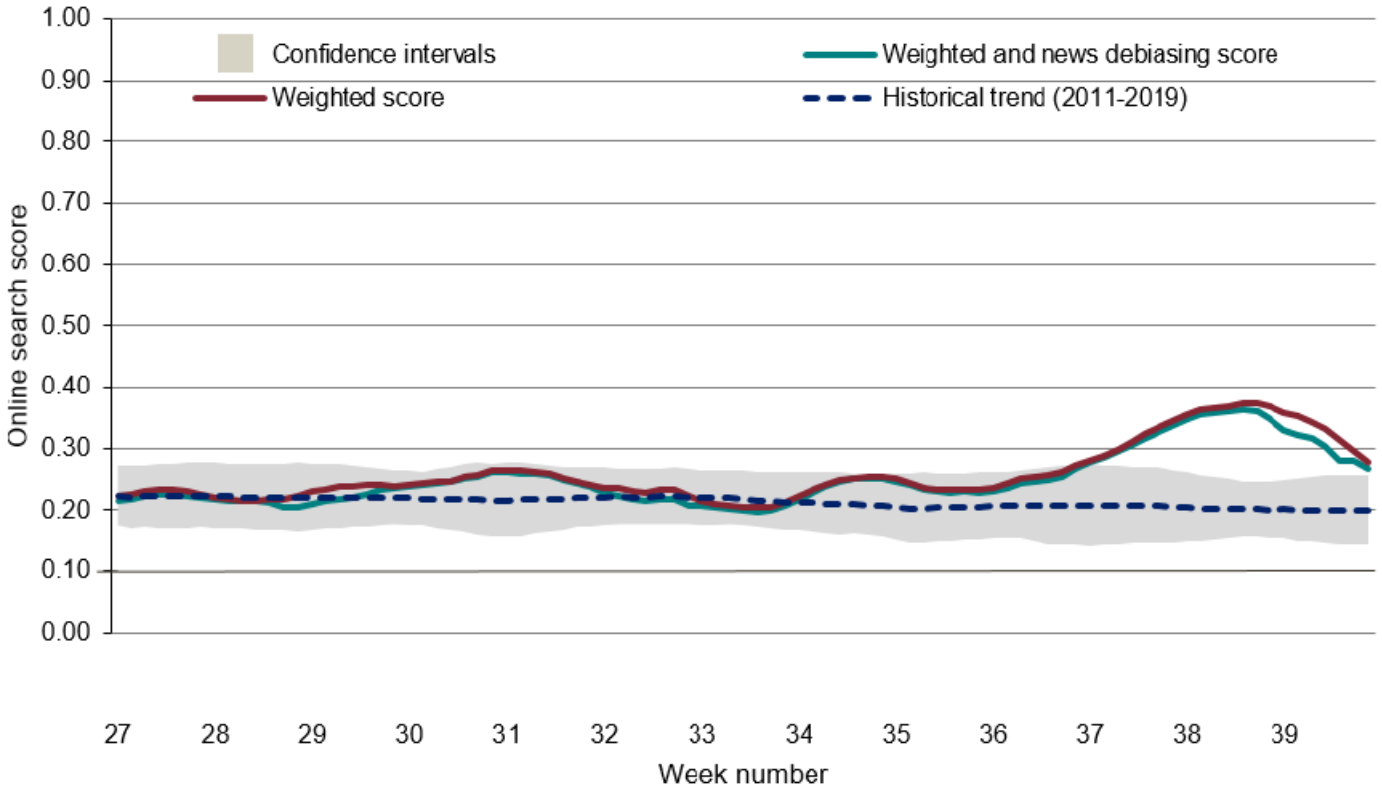
Spot the exceedance...



COVID cases by specimen date, https://coronavirus.data.gov.uk/details/cases

Google searches

Figure 26: Normalised Google search score for COVID-19 symptoms, with weighted score for media-debiasing and historical trend, England

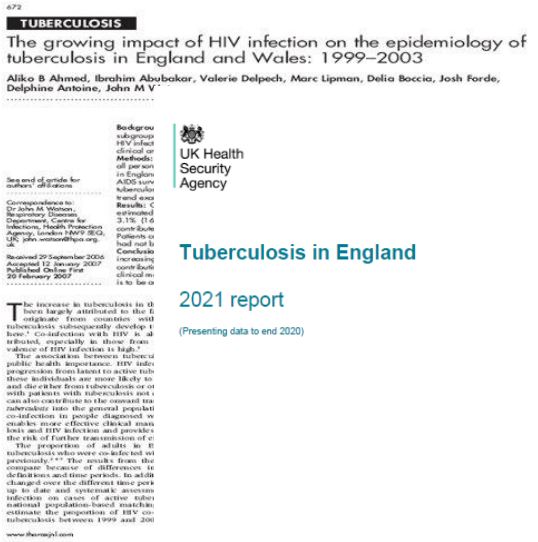


https://www.gov.uk/government/publications/national-covid-19-surveillance-reports

Dissemination of surveillance data

Ad-hoc and Routine Reports

- Routine (weekly, monthly or quarterly) epidemiological summaries (bulletins, dashboards)
- Web Based Datasets / Summaries
- Special Reports, guidelines, briefings and queries
- Media (in collaboration with partners)
- Research Articles



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TUBERCULOSIS

The growing impact of HIV infection on the epidemiology of tuberculosis in England and Wales: 1999–2003

Aliko B Ahmed, Ibrahim Abubakar, Valerie Delpech, Marc Lipman, Delia Boccia, Josh Forde, Delphine Antoine, John M V

UK Health Security Agency

Tuberculosis in England

2021 report

(Presenting data to end 2020)

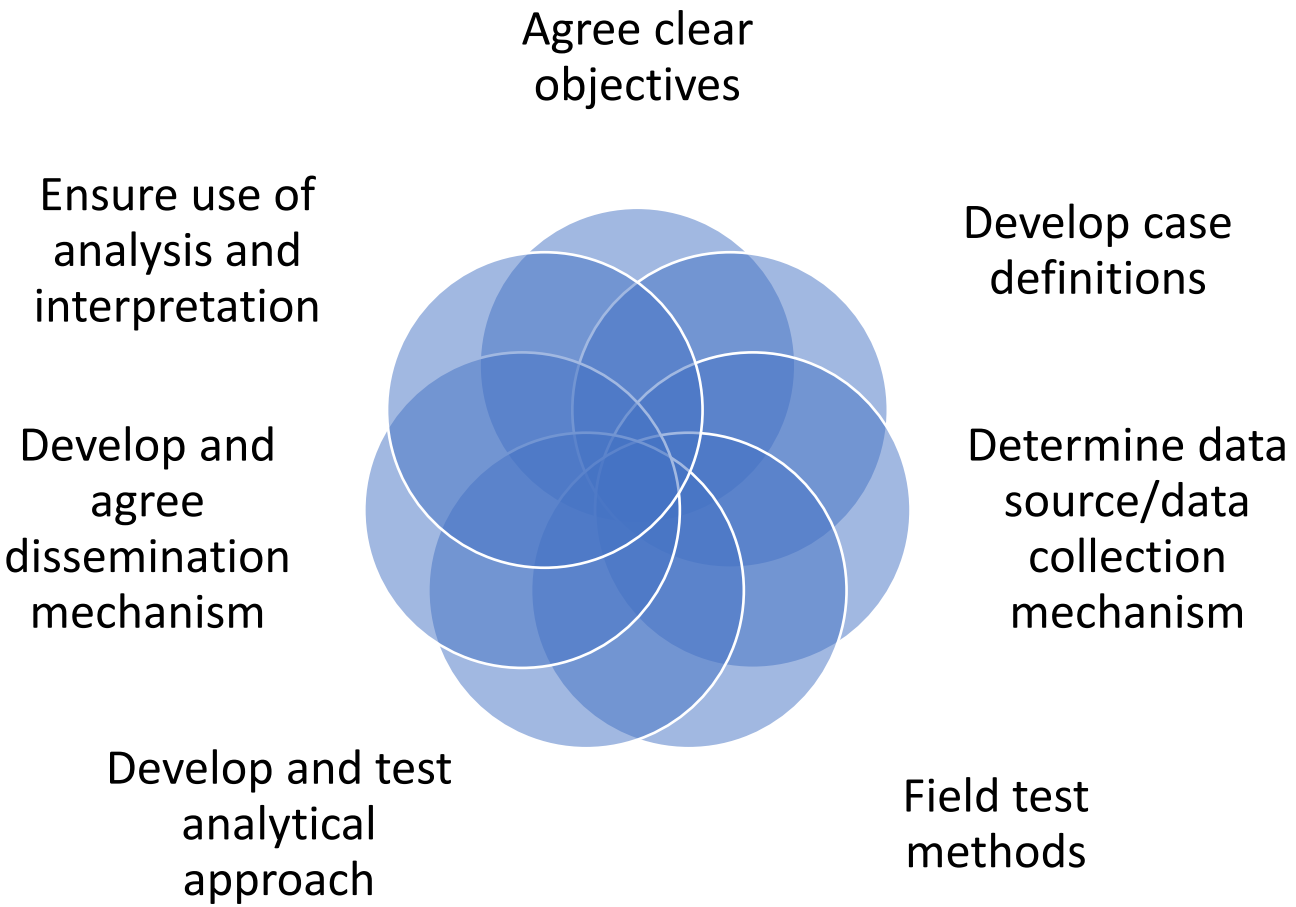
health

influenza and other ratory viruses in the UK 2021

Ethics / governance

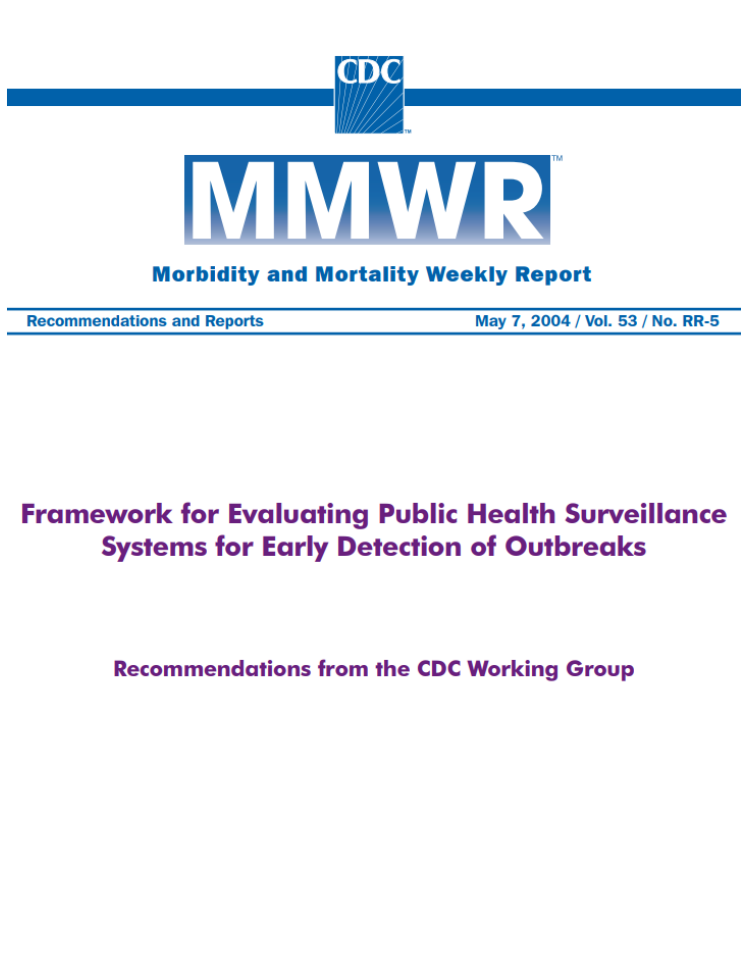
- Data provider – approval/support
- Patient information
- Data security / Caldicott Guidelines
- Reporting (anonymised/small numbers)

Planning a surveillance system

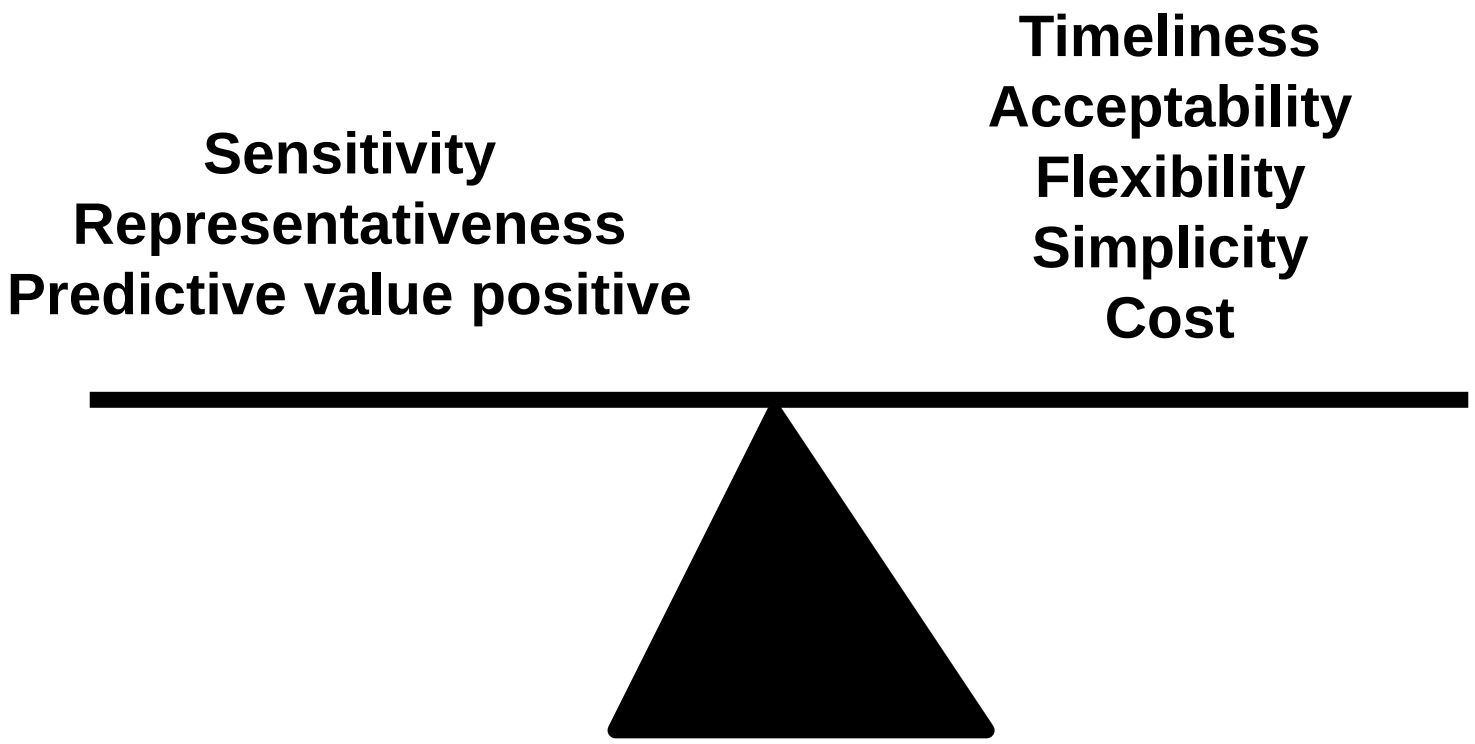


Evaluation

Simplicity	Flexibility	Data quality
Acceptability	Sensitivity	Predictive value positive
Representativeness	Timeliness	Stability



Buehler's balance of systems attributes



Questions?