

Data for Monitoring Vaccine Coverage & Inequalities

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Learning objectives

- Explain the **role of vaccine coverage monitoring** in supporting immunisation programmes
- Describe the concepts of **inequalities and inequities** related to vaccine coverage
- Compare strengths and limitations of **administrative data, surveys, and electronic health records** for monitoring vaccine coverage
- Calculate and interpret **measures of vaccine coverage**
- Critically assess the **biases and limitations** of vaccine coverage data

Structure

- **Lecture:** Foundations – 75 minutes
- **Break:** 15 minutes
- **Practical:** Quantifying and critically evaluating uptake inequalities – 75 minutes
- **Q&A and synthesis:** 15 minutes

Why monitor vaccine coverage?

Beyond efficacy: why monitoring coverage matters

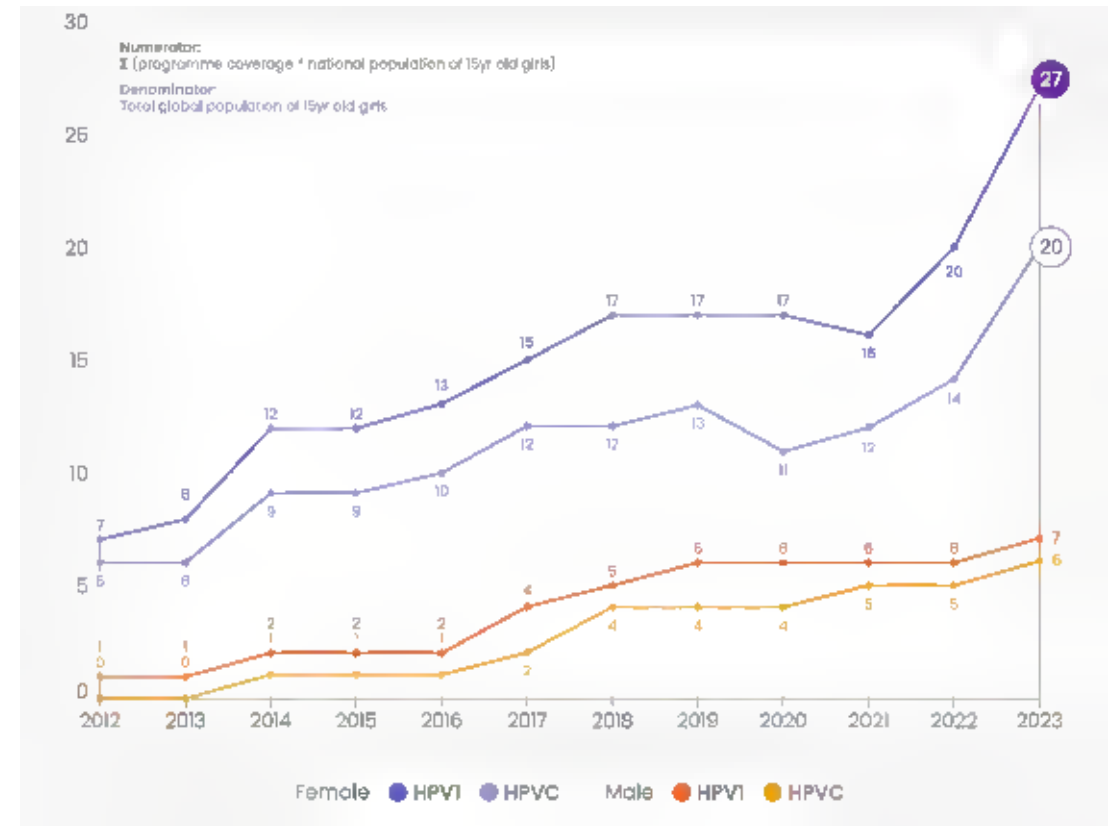
Evaluate programme performance

Are vaccines reaching target groups?

Are vaccines delivered on time?

Is coverage sufficient to reduce (or eliminate) disease?

Global human papillomavirus vaccine (HPV) coverage following shift to 1-dose schedule in 2023



Beyond efficacy: why monitoring coverage matters

Evaluate programme performance

Are vaccines reaching target groups?

Are vaccines delivered on time?

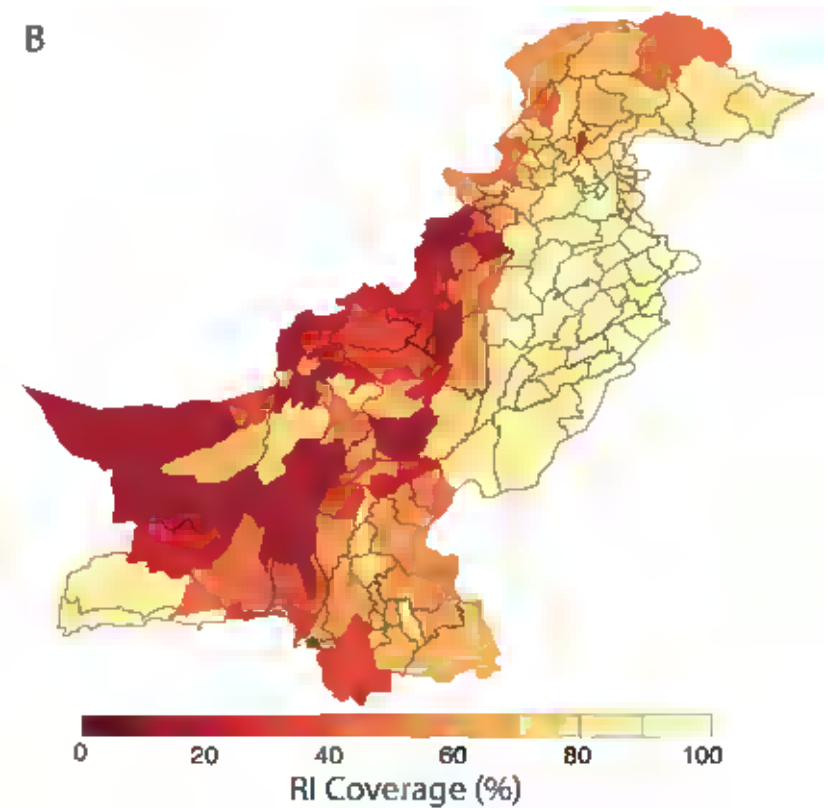
Is coverage sufficient to reduce (or eliminate) disease?

Identify gaps and inequalities

Who is not being vaccinated?

Is there important variation according to region, ethnicity, socioeconomic status, or clinical risk?

Spatial distribution of routine immunisation (RI) coverage in Pakistan (2016)



Beyond efficacy: why monitoring coverage matters

Evaluate programme performance

Are vaccines reaching target groups?

Are vaccines delivered on time?

Is coverage sufficient to reduce (or eliminate) disease?

Identify gaps and inequalities

Who is not being vaccinated?

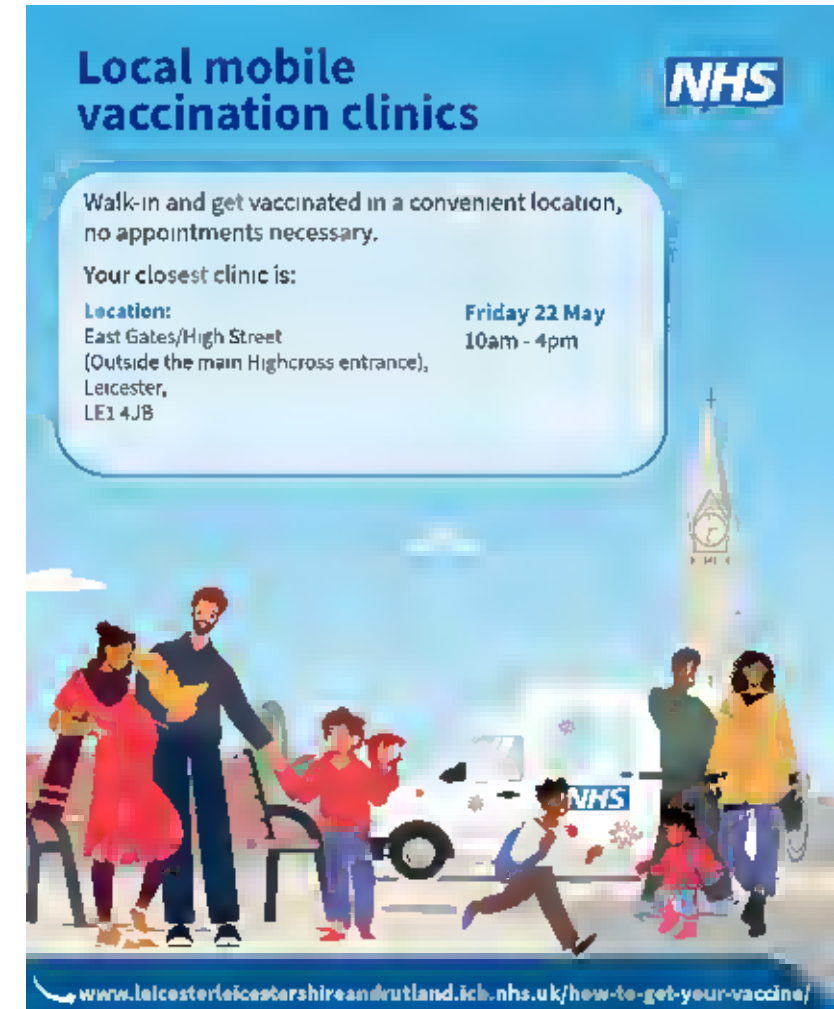
Is there important variation according to region, ethnicity, socioeconomic status, or clinical risk?

Inform and evaluate policy

Can targeted interventions improve access and coverage?

What is the cost–effectiveness of future campaign options?

Can vaccines be allocated more equitably?



A real-world problem: the return of measles in England

Measles resurgence despite effective vaccine

- Measles cases in England have risen
 - 367 in 2023
 - 2911 in 2024
 - 959 in 2025
- Vaccine highly effective (~99% after 2 doses)



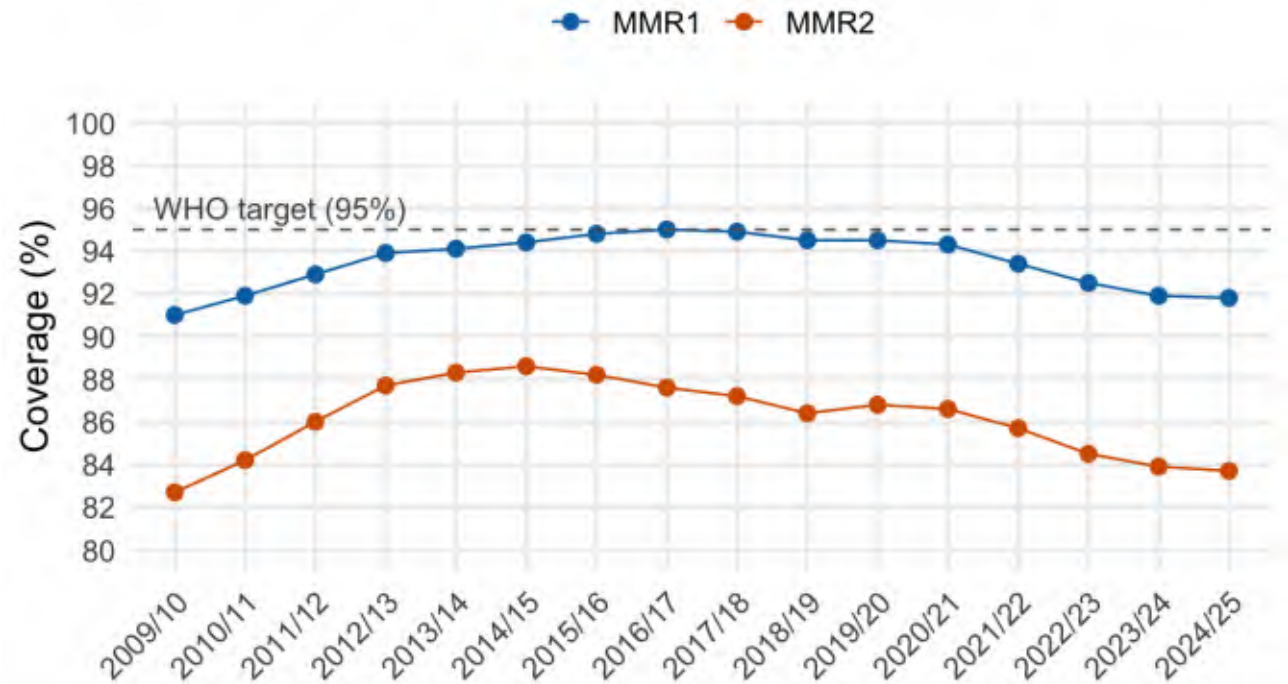
A real-world problem: the return of measles in England

Declining coverage at national level

- Gradual decline in routine childhood vaccination coverage for the past decade
- MMR2 coverage at 5 years has fallen from 88.6% (2014/15) to **83.7% (2024/25)**

MMR vaccine coverage at age 5 years in England

Children reaching their fifth birthday, 2009/10 to 2024/25



Source: COVER programme (UKHSA)

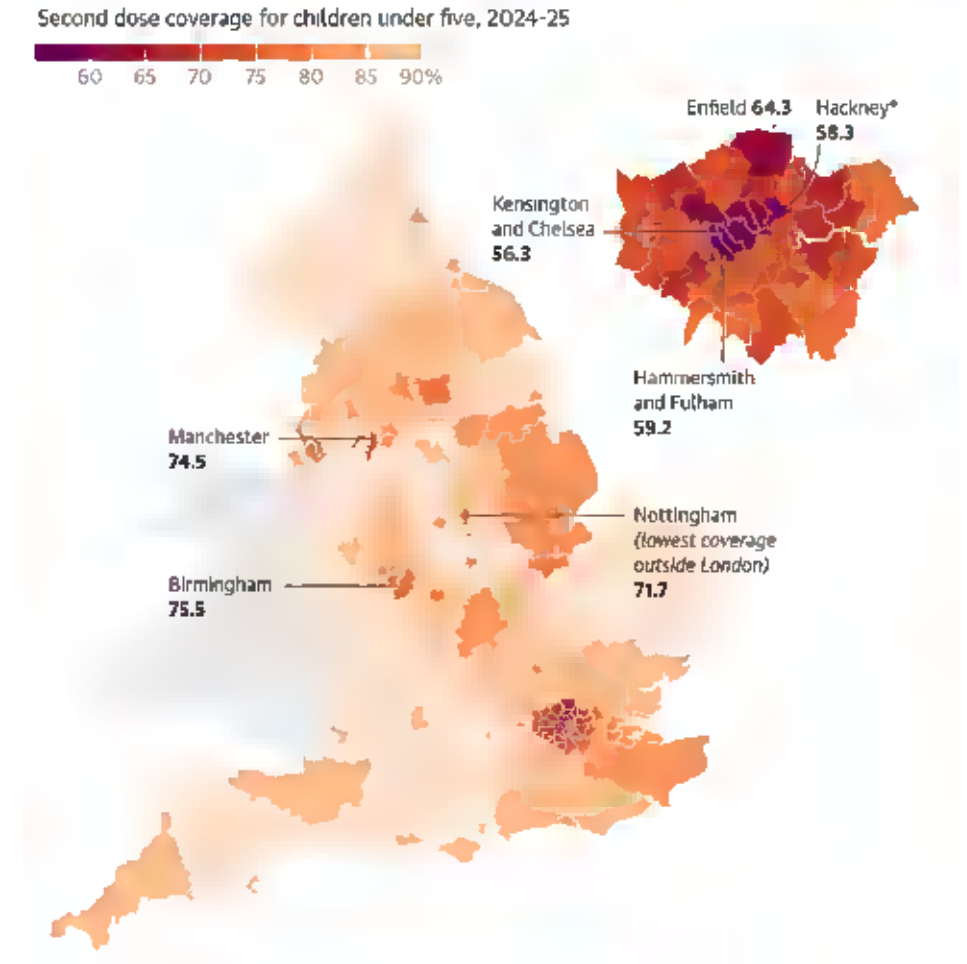
A real-world problem: the return of measles in England

Identifying the gap: where is coverage low?

- Lower in:
 - Urban areas (e.g. London ~70%)
 - Deprived communities

Why gaps matter

- $\geq 95\%$ coverage for elimination
- Majority of cases in **unvaccinated individuals**
- Large outbreaks in areas with low vaccine uptake
 - Hotspots in West Midlands, North West, London



A real-world problem: the return of measles in England

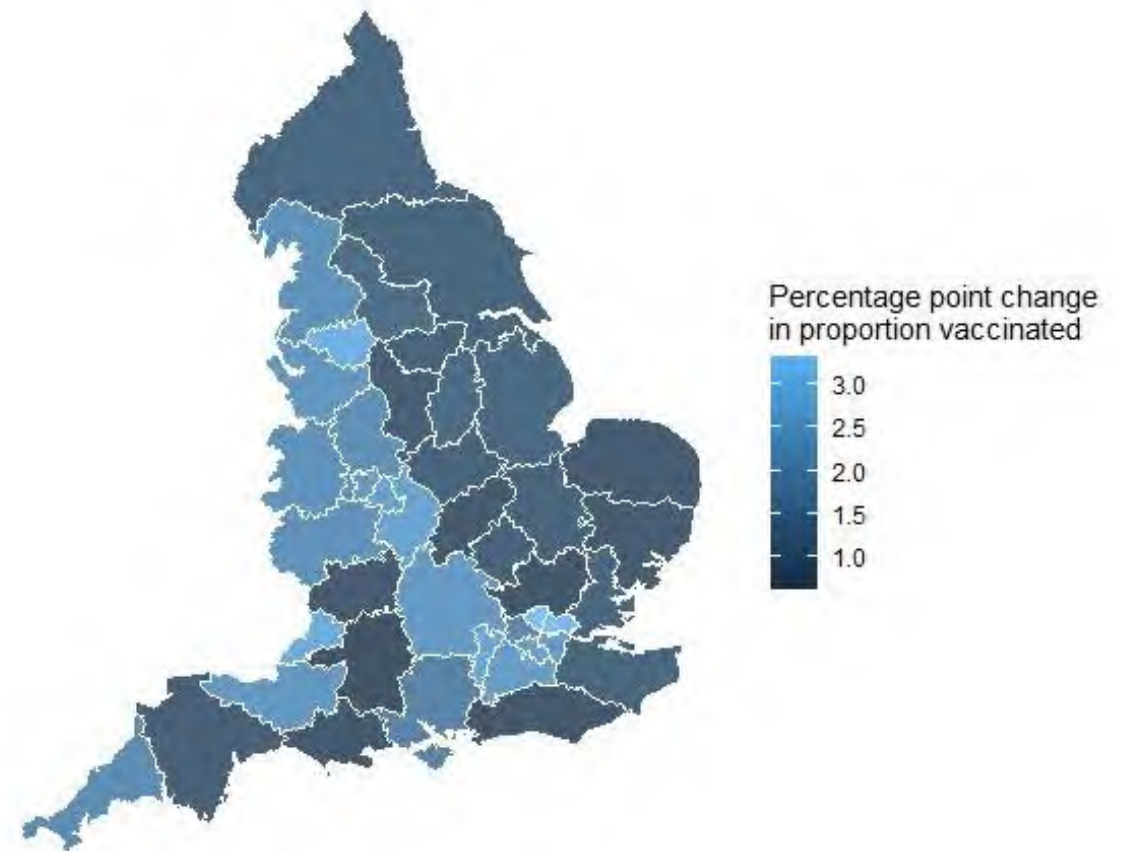
National catch-up activities in 2023/2024

- Targeted children and young people who missed MMR doses
- National and local call-recall (texts, letters, NHS app)
- GP-led outreach and opportunistic vaccination
- Targeted activity in high-risk areas (e.g. London, West Midlands)
- Delivered alongside a wider communications and access campaign to encourage uptake

Impact

- >180,000 additional doses delivered
- ~13% of previously unvaccinated under-5s received MMR1 during the campaign]
- National coverage still ~92% for MMR1 at 5 years

Change in percent vaccinated with MMR1 among children aged 15 months to 5 years following regional catch-up activities

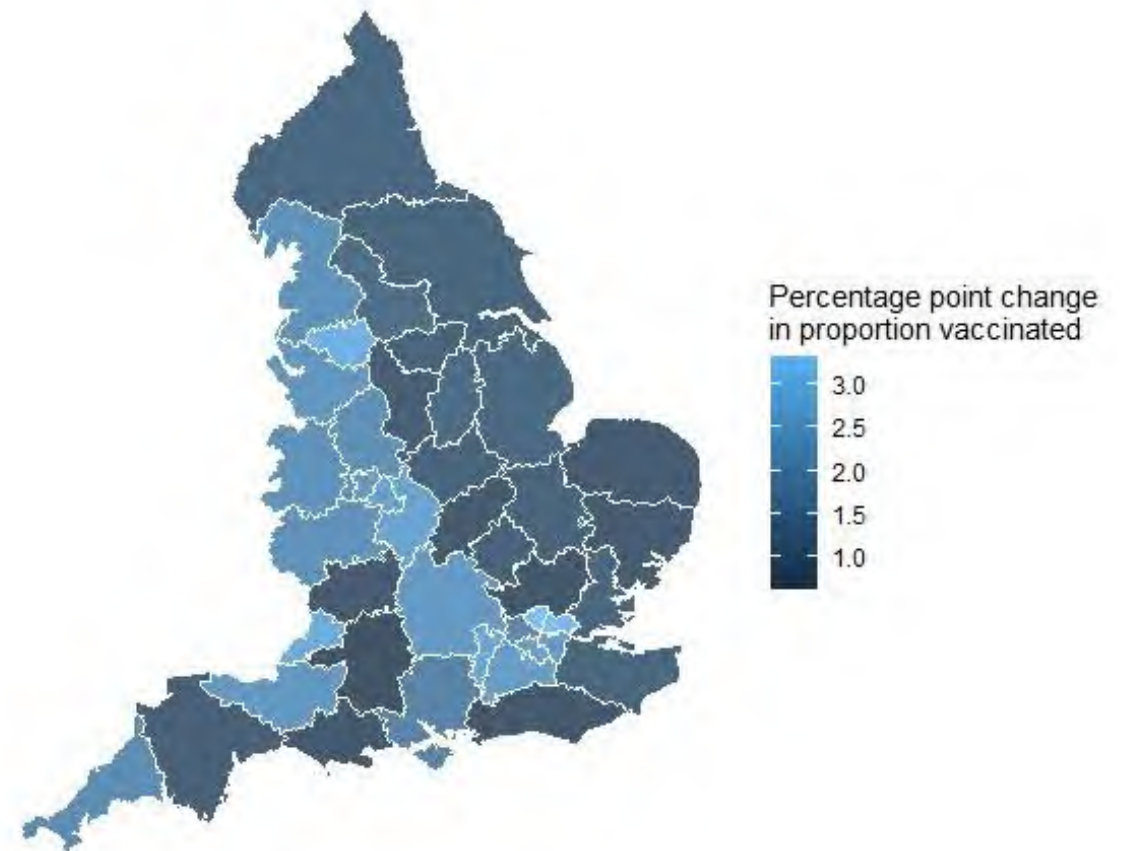


A real-world problem: the return of measles in England

Change in percent vaccinated with MMR1 among children aged 15 months to 5 years following regional catch-up activities

Monitoring uptake supports response

- **Identify** groups and areas with low uptake
- **Act** through national catch-up campaigns and targeted outreach in underserved communities
- **Evaluate** impact of interventions



Equity and prioritisation

Disparities, inequalities, inequities

	Disparities	Inequalities	Inequities
Definition	Differences in health outcomes or healthcare use between groups	Systematic differences between population groups (e.g. by deprivation, ethnicity)	Differences that are unfair, avoidable, or unjust
Key feature	Descriptive	Descriptive	Requires value judgement and context

- Disparities / inequalities are often used similarly
- Disparity covers any measurable difference
- Inequality often implies systematic patterning (e.g. linked to social gradients or structural disadvantage)

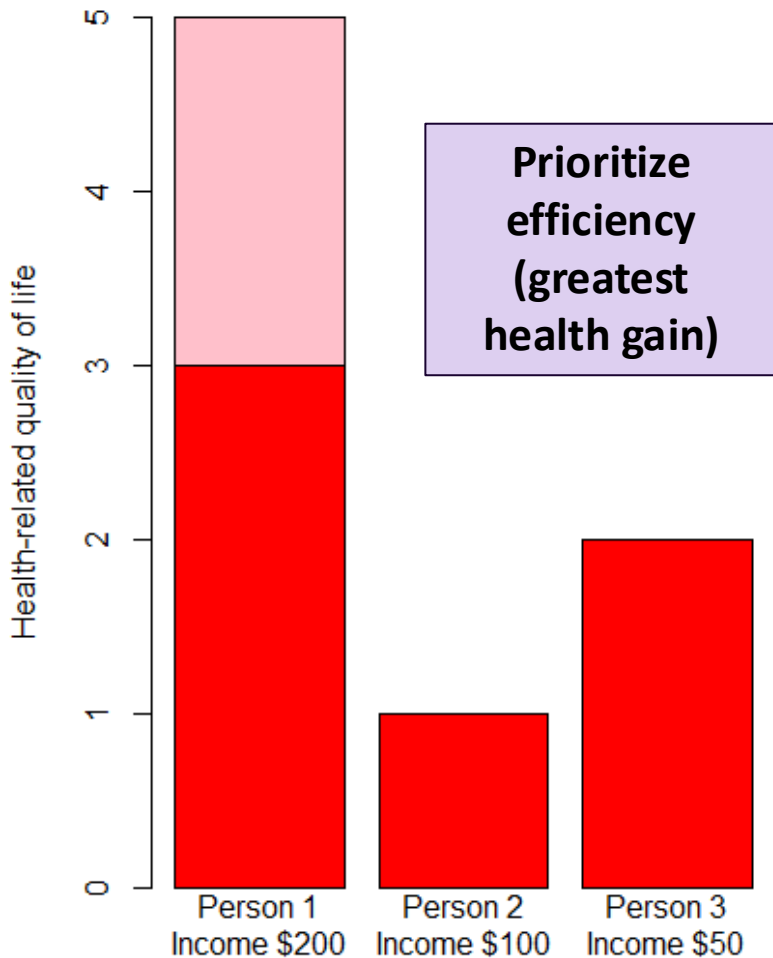
Is the difference:

- Avoidable?
- Linked to disadvantage?
- Driven by barriers to access, trust, or information?

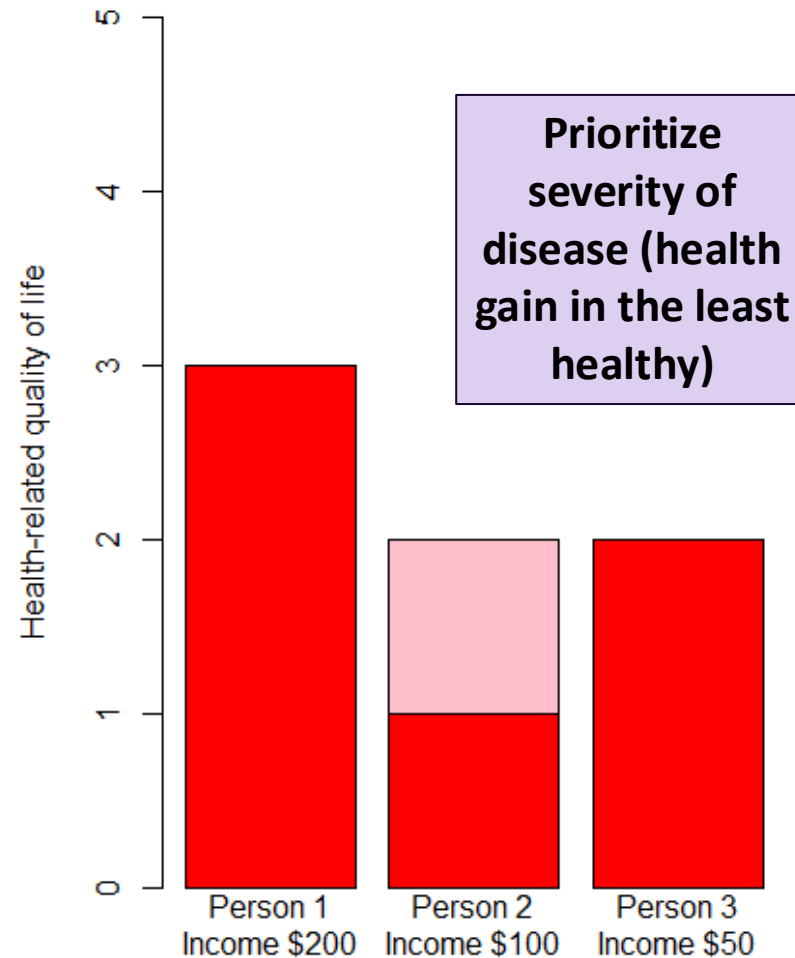
Equity trade-offs

A, B and C are interventions with identical costs. Which of them would you prioritize?

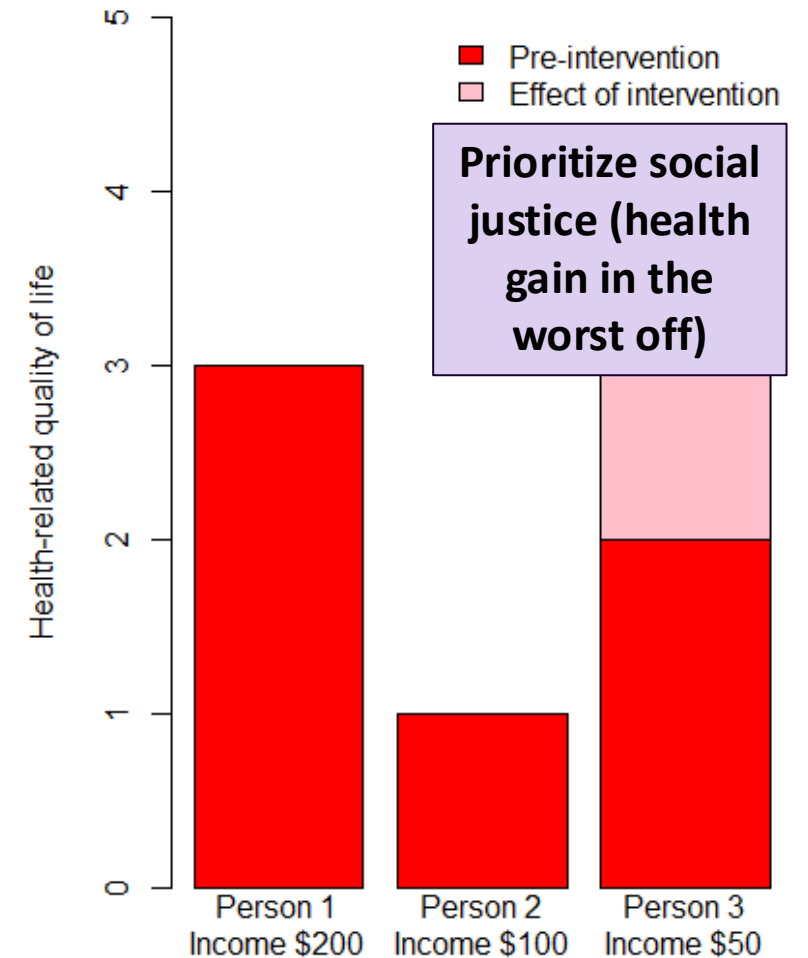
Intervention A



Intervention B

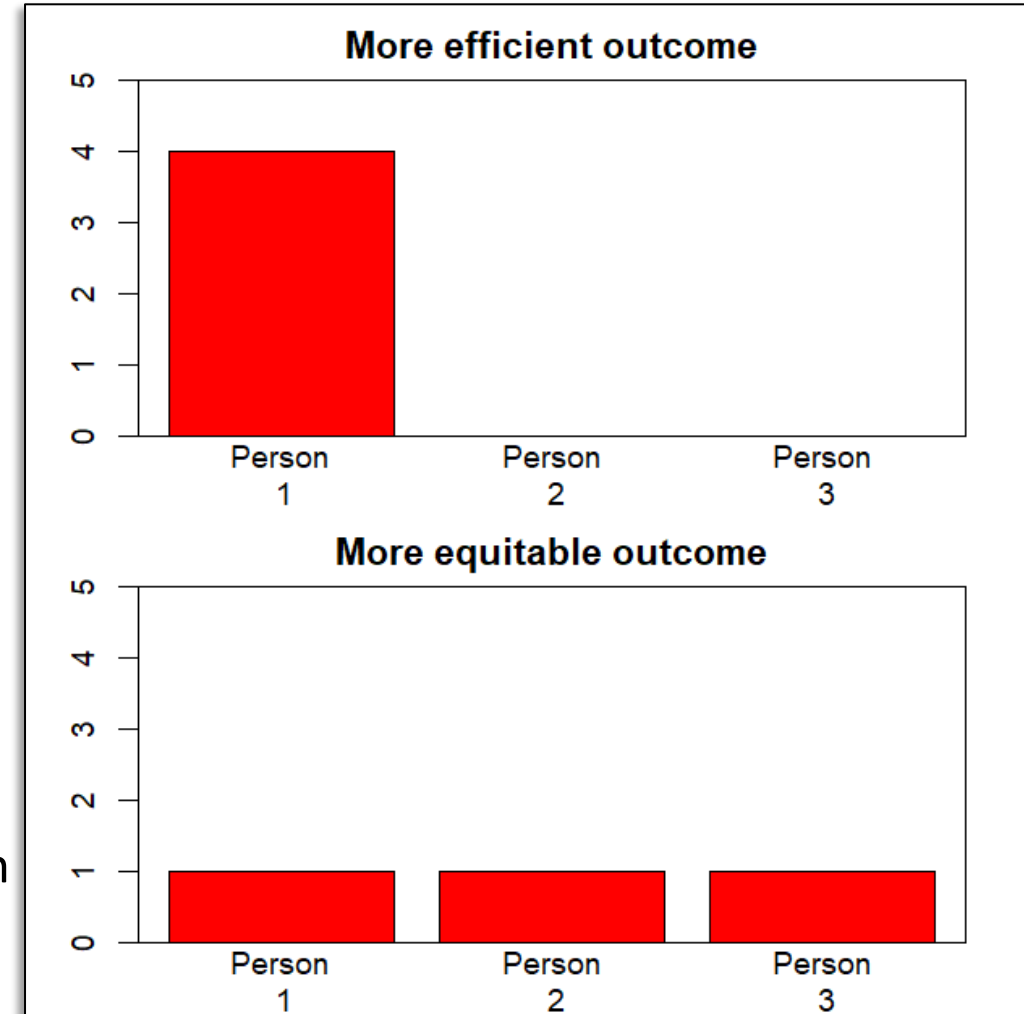


Intervention C



Efficiency vs. equity: two aims of priority setting that sometimes conflict

- **Efficiency** – Optimal use of scarce resources (e.g. money) to maximise the desired outcome (e.g. health). “... the greatest happiness of the greatest number.” (Jeremy Bentham)
- **Equality** – Equal distribution of scarce resources in a population
- **Equity** – Fair distribution of scarce resources and desired outcomes in a population.
- **Horizontal equity** – Equal treatment of equals: people in the same circumstances should be treated the same. Example: Two patients with the same condition should have the same healthcare access regardless of where they live.
- **Vertical equity** – Differential treatment of unequals. People with greater needs or ability to benefit should receive greater priority. Example: A patient who had a stroke should be prioritized in the ER over a patient with a broken leg.



What are relevant personal characteristics to consider?

(This is a key normative question)

		Better off	Worse off
Increasingly contested	Addresses horizontal health inequality	Better access to health care	Worse access to health care
	Addresses vertical health inequality	Better health	Worse health
	Addresses inequality in broader social determinants (which may affect future health)	Higher income and/or wealth	Lower income and/or wealth
		Better access to employment, infrastructure, education etc. (e.g. urban in some settings)	Worse access to employment, infrastructure, education etc. (e.g. rural in some settings)
		Less likely to suffer discrimination (e.g. on account of race, ethnicity, caste, gender, sexuality etc.)	More likely to suffer discrimination (e.g. on account of race, ethnicity, caste, gender, sexuality etc.)
	"Fair innings" argument (contested)	Older	Younger

N.B. The above dimensions are highly correlated (intersectionality)

The objective of priority setting: different approaches

Approaches	Key proponents	Principle	Advantages	Disadvantages
Entitlement	Robert Nozick	Respects what has been fairly earned or given (e.g. property rights)	Respects autonomy; avoids coercion	Accepts inequalities if they arise from free exchange e.g. rich get better care
Utilitarianism	Jeremy Bentham, John Stuart Mill	Maximize total utility (“greatest good for the greatest number”)	Maximizes overall health; avoids value judgments	Justifies sacrificing a minority (severely ill) for overall good
Weighted prioritarianism	Derek Parfit, Matthew Adler	Give more (but not all) weight to worst off	Flexible; balances efficiency and equity	Choice of weights is subjective and contested
Maximin (the difference principle)	John Rawls	Prioritize the worst-off group, regardless of effect on others	Prioritizes equity; protects most vulnerable	Ignores all other groups.
Egalitarianism	Ronald Dworkin	Aim for equality for everyone	Treats inequality as the central problem	Can justify making better-off worse to achieve equality (“levelling down”).

Utilitarianism

Utilitarianism is a moral philosophy developed by Jeremy Bentham (1748 – 1832) that judges the rightness of an action based on **maximising welfare**:

... it is the greatest happiness of the greatest number that is the measure of right and wrong.
- Bentham, *Fragment on Government* (1776)

On the surface, utilitarianism is equity-neutral / equity-indifferent (although there are ways of incorporating equity in a utilitarian framework).



Above: Bust of Jeremy Bentham at University College London
(Phila frenzy, CC-BY-SA 4.0)

Maximin: the “veil of ignorance”

...no one knows his place in society, his class position or social status, nor does anyone know his fortune in the distribution of natural assets and abilities, his intelligence, strength, and the like. I shall even assume that the parties do not know their conceptions of the good or their special psychological propensities. The principles of justice are chosen behind a veil of ignorance.

John Rawls, *A Theory of Justice* (1971)



John Rawls (1921 – 2002)

Harvard philosopher

Photo: Harvard Gazette Dec 5, 2002 (used under fair dealing provision)

Approaches to the ethics of priority setting: example

You have \$1 million which can be spent on one of the following vaccines:

- **Option A:** Meningitis vaccine – prevent severe illness in 10 children
- **Option B:** Rotavirus vaccine – prevent milder illness in 100 children.

Option	Cases prevented	DALYs before vaccination	DALYs after vaccination	DALYs averted (in a year)
A	10	0.8	0.1	$(0.8 - 0.1) \times 10 = 7$
B	100	0.3	0.1	$(0.3 - 0.1) \times 100 = 20$

Which option would the following approaches suggest?

**Entitlement, utilitarianism, weighted prioritarianism,
maximin, egalitarianism.**

Approaches to the ethics of priority setting: example

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- **Entitlement:** Treat any patients with legitimate claims (e.g. ability to pay, health insurance coverage)
- **Utilitarianism:** B as this will maximize QALYs gained.
- **Weighted prioritarianism:** Either A or B, depending on how much weight you give to equity vs efficiency.
- **Maximin:** A because they are worst off.
- **Egalitarianism:** A because it will make the two groups more equal (A decreases to 0.1, B stays at 0.3).

Measuring vaccine coverage

Coverage vs uptake: what's the difference?

Vaccine coverage

- Proportion of a population that is vaccinated at a given point in time
- Reflects **population-level protection**
- Analogous to **prevalence** – e.g. 900 vaccinated on 31 December among 1,000 eligible = 90%

$$\text{Coverage} = \frac{\text{Number vaccinated (cumulative)}}{\text{Target population}}$$

Vaccine uptake

- Proportion of individuals vaccinated over a defined period of time
- Reflects **vaccination activity**
- Analogous to **incidence** – e.g. 500 vaccinated from September–December among 1,000 eligible = 50%

$$\text{Uptake} = \frac{\text{Number vaccinated in a period}}{\text{Number eligible for vaccination}}$$

In practice, the two terms are often used interchangeably!

What challenges can you envision...

Measuring MMR dose 1 coverage among children at 2 years of age in Hong Kong as of April 2026?

What challenges can you envision...

Measuring uptake of seasonal flu vaccine in the UK among clinical risk groups (e.g. diabetes, chronic kidney disease) aged 16–64 years during Autumn 2025 campaign?

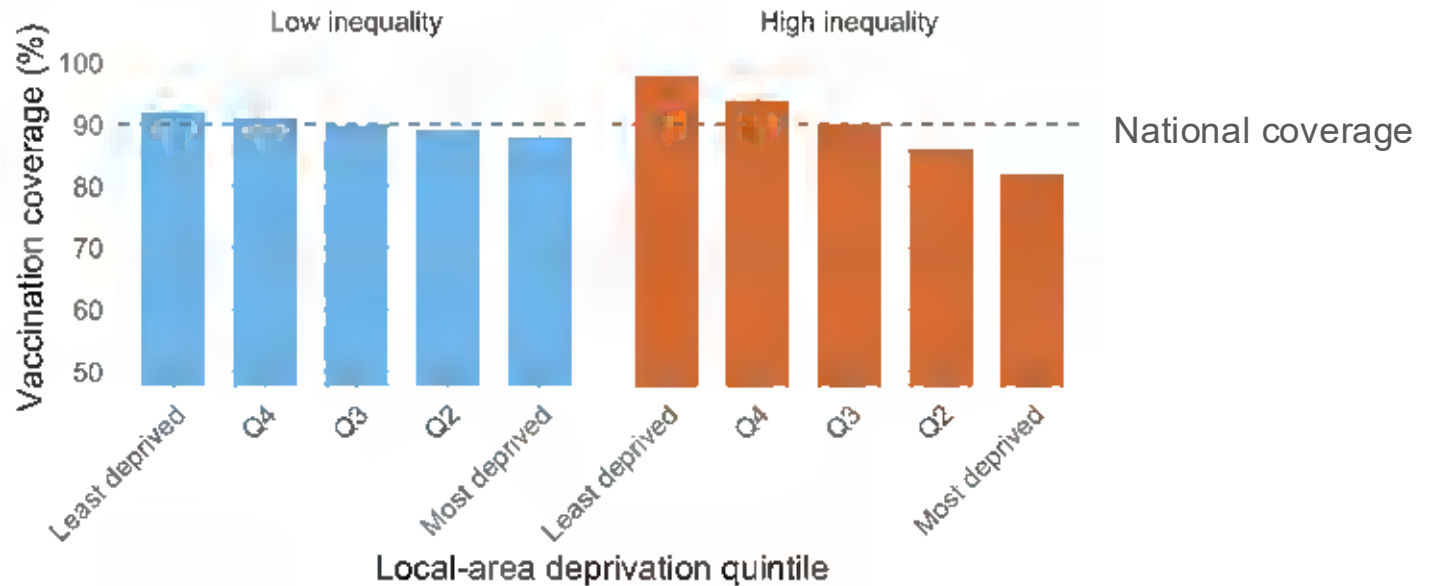
Measuring inequalities in coverage

Dimensions of inequality

Socioeconomic status	Ethnicity and migration status	Geography	Age	Health status
Deprivation, income, education	Cultural, structural, and access barriers	National, regional, local	Eligibility, access barriers	Clinical risk groups, comorbidities, frailty

These differences matter for

- Equity
- Outbreak risk
- Targeting interventions

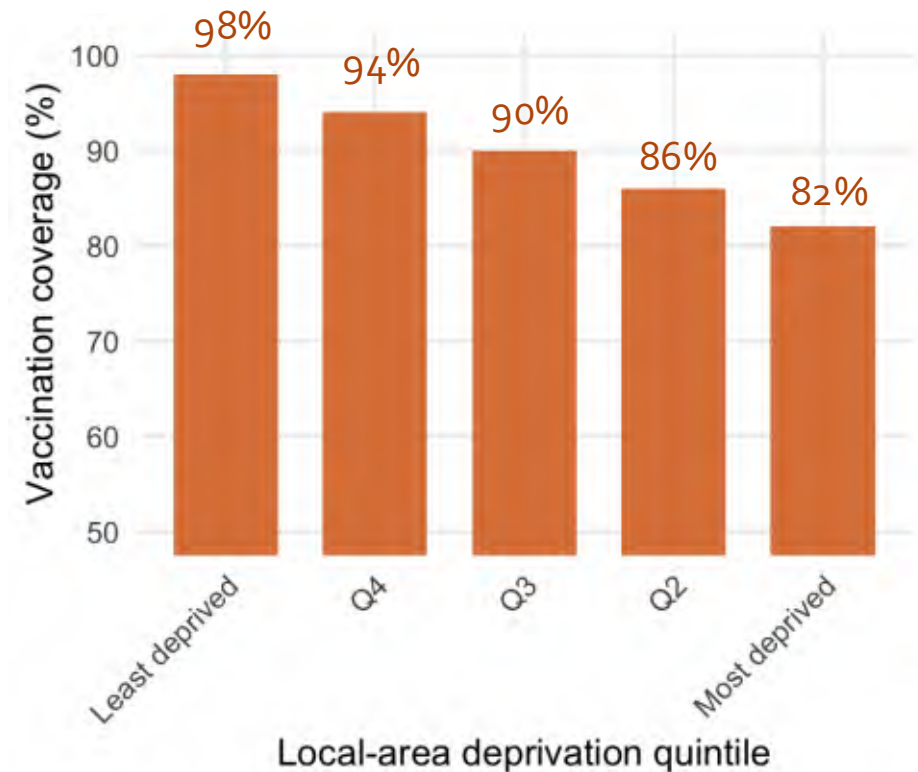


Start simple: stratification

(1) Divide population into groups

- Most vs least deprived
- Ethnic groups
- Regions
- Clinical risk groups

(2) Compare coverage between groups

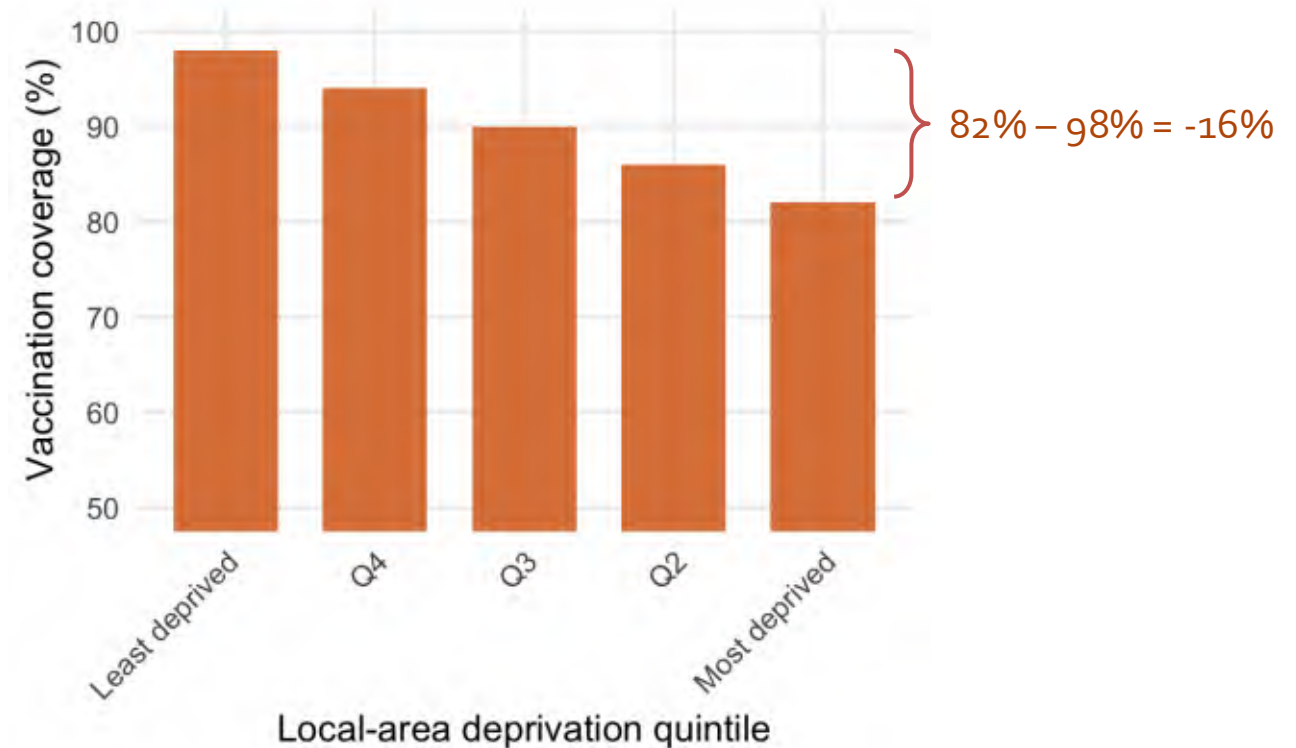


Sometimes the message is clear without complex methods!

Absolute differences – quantifying the 'gap'

Absolute difference = differences in percentage coverage

- $\text{Coverage}_{\text{Comparison group}} - \text{Coverage}_{\text{Reference group}}$
- e.g. "16% lower absolute coverage in most deprived vs least deprived areas"



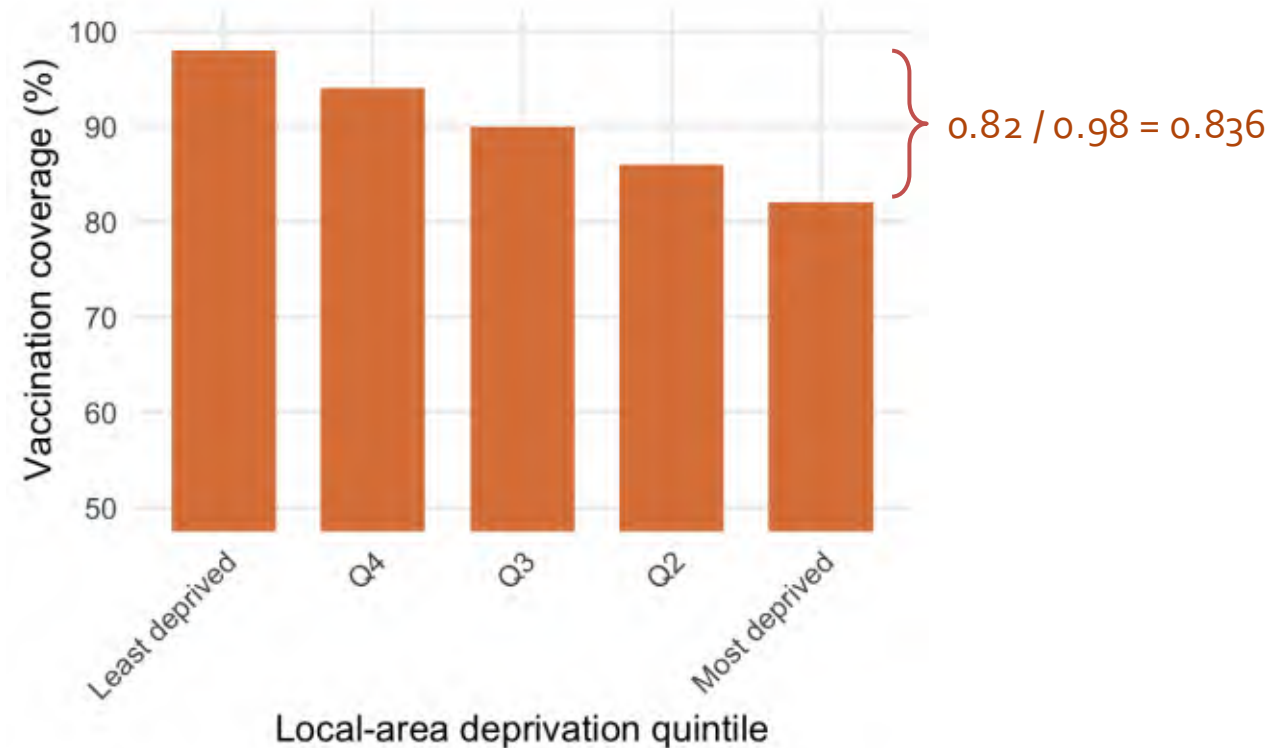
Relative differences – quantifying the ratio

Relative difference = ratio between groups

- $\text{Coverage}_{\text{Comparison group}} / \text{Coverage}_{\text{Reference group}}$
- e.g. “16% relative reduction in coverage in most deprived vs least deprived areas”

Extensions

- Relative rates (accounting for follow-up time)
- Odds ratios (often in case control studies)
- Hazard ratios (time to event)
- Multivariate models for any of the above (accounting for other covariates)



Combining measures for a more complete picture

	Country A	Country B	
Coverage in least deprived area	90%	20%	} Where on the scale are inequalities happening?
Coverage in most deprived areas	80%	10%	
Absolute difference	$80\% - 90\% = -10\%$	$10\% - 20\% = -10\%$	} How big are the inequalities?
Relative difference	$0.80 / 0.90 = 0.88$ (↓12%)	$0.10 / 0.20 = 0.50$ (↓50%)	

Data sources for vaccine uptake

1. Administrative data

Administrative data: what is it?

Numerators (counted as vaccinated)

- Doses recorded at point of delivery
- Clinic registers, school records, outreach logs
- Electronic immunisation registries

Denominators (target population)

- Census projections
- Birth registries
- Local administrative population estimates

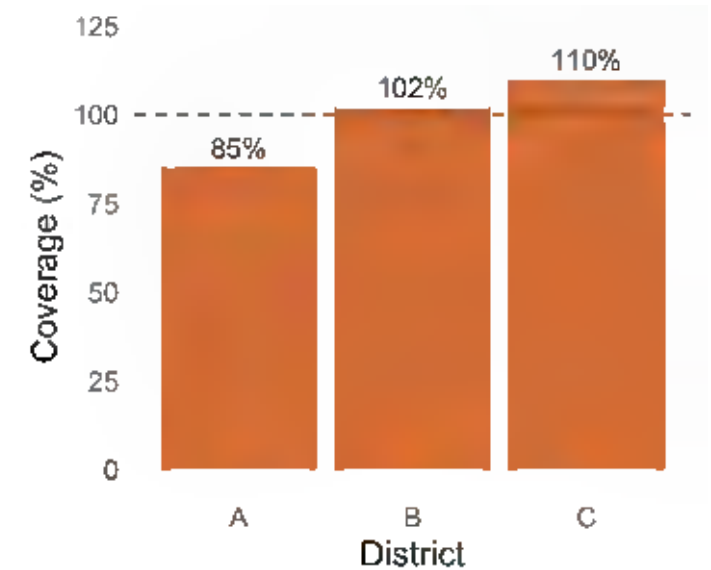
Strengths

- Near real-time monitoring
- Large population coverage
- High geographic resolution (sometimes)
- Enables rapid policy response

Key biases in administrative data

	Bias	Example / context
Numerator bias (who is counted as vaccinated?)	Non-target vaccination	Vaccines given to non-target groups are included
	Missing providers	Vaccines given by private or non-governmental organisations not included
Denominator bias (who is included in population?)	Outdated census data	Census projection does not accurately account for births, deaths, or migration
	Population mobility	Children are vaccinated in areas authorities where they do not live
Other	Ecological fallacy	Associations at regional level may not be replicable at individual level

Coverage estimates >100%



Other limitations

- Potential for doses to be double-counted
- Limited covariate information

Case study: global COVID-19 vaccine implementation

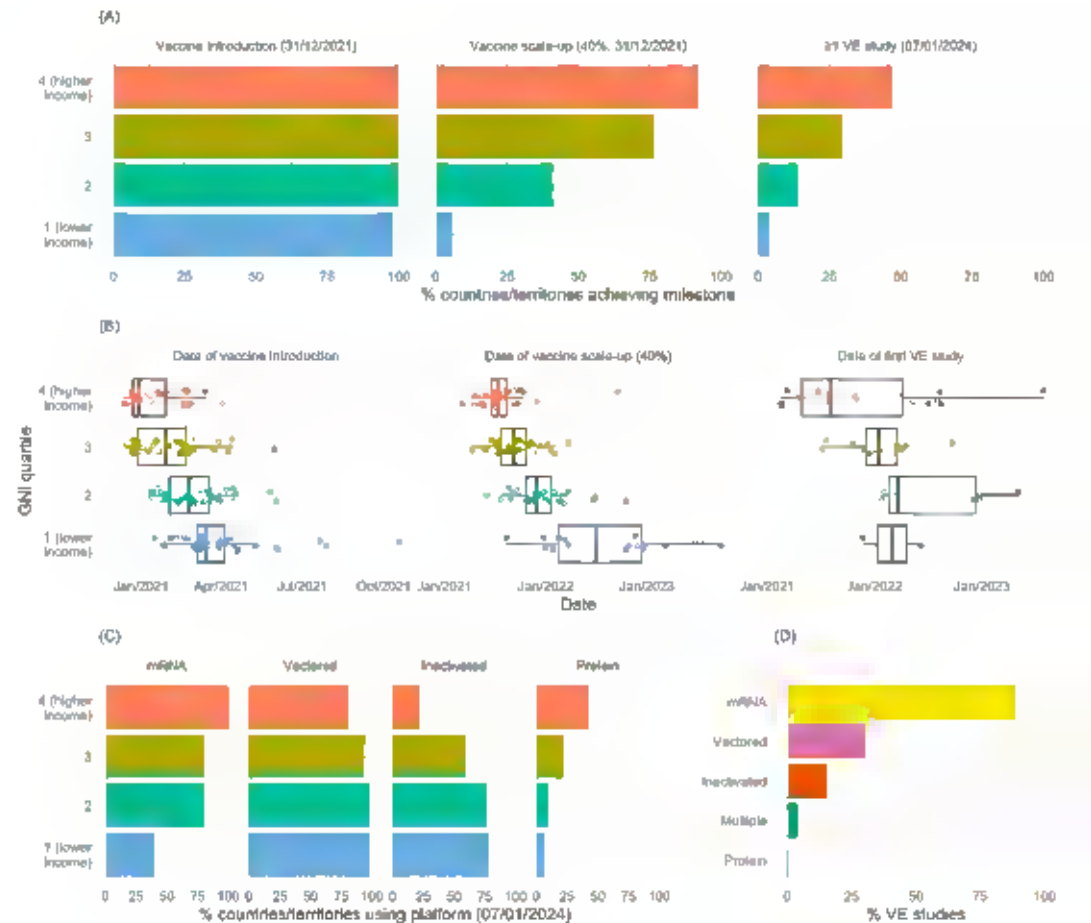
Approach

- Linked international open-source datasets
 - WHO COVID-19 vaccination database
 - Our World in Data vaccination database
 - World Bank income data
 - Published vaccine effectiveness studies
- Examined vaccine introduction, scale-up, and evaluation across 204 countries and territories

Findings

- Lower-income countries introduced vaccines later, were less likely to achieve key coverage milestones, and were slower to do so where milestones achieved

Disparities in COVID-19 vaccine introduction, scale-up, and effectiveness evaluation by income quartile



Case study: falling routine vaccine coverage in Brazil

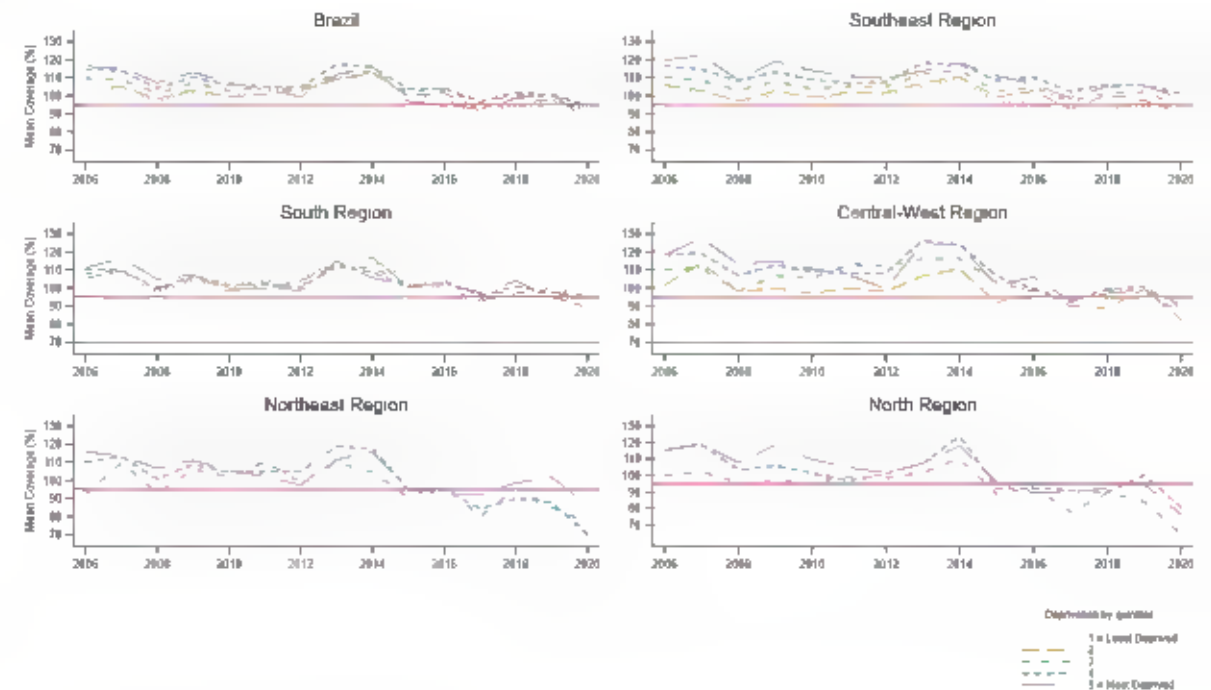
Approach

- Nationwide ecological study of routine MMR coverage
- Coverage based on administrative data from the Brazilian National Immunisation Programme
- Data covering 5,565 municipalities from 2006–2020
- Coverage data linked with municipality-level deprivation index

Findings

- Mean MMR coverage declined by ~1.2% per year
- Most deprived municipalities had higher average coverage but **steepest declines**, with larger drop in first year of COVID-19 pandemic
- By 2020, <50% of municipalities in most regions achieved the national target of 95% MMR coverage
- Denominator issues – areas with **coverage > 100%**

MMR first dose coverage between 2006 and 2020 by quintile of deprivation at municipality level



The 95% line is corresponding to Brazil MMR coverage target

The North and Northeast regions had no municipalities in the 1st and 2nd quintiles of deprivation.
The Central-West region had no municipalities in the 1st quintile of deprivation

Data sources for vaccine uptake

2. Survey data

Survey data: what is it?

Numerators (counted as vaccinated)

- Vaccination cards
- Caregiver recall

Denominators (target population)

- Survey sample of population in clusters

Cluster-based sampling

Typical steps:

- **Step 1:** divide population into strata (e.g. regions, provinces, urban vs rural)
- **Step 2:** select clusters (census areas, villages, neighbourhoods) with **probability proportional to size**
- **Step 2:** select households within clusters
- **Step 3:** interview eligible individuals in households



Strengths

- More accurate denominators
- Rich covariates (income, education)
- Potential for individual-level inequality analysis
- Better population inference

DHS vs MICS

Two dominant global survey platforms for vaccination coverage

	Demographic and Health Surveys (DHS)	Multiple Indicator Cluster Surveys (MICS)
Lead agency	USAID	UNICEF
Coverage	~90+ countries	~100+ countries
Sample size	5000 – 30,000 households per country	5000 – 30,000 households per country
Frequency	~5 years	~3–5 years
Vaccination measurement	Card + recall	Card + recall
Regional representation	Strong in sub-Saharan Africa, South/Southeast Asia	Strong in sub-Saharan Africa, plus broader coverage in fragile, humanitarian, and middle-income settings
Illustrative covariates	Maternal education Household wealth index Urban/rural residence Child sex and birth order	Household wealth index Education (maternal / head of household) Geographic region Child health indicators
Strengths	Rich demographic data	Strong focus on equity indicators

Key biases in survey data

	Bias	Example / context
Numerator bias (who is counted as vaccinated?)	Recall bias	Caregiver incorrectly reports vaccination status
	Missing vaccination cards	Child classified as unvaccinated without documentation
Denominator bias (who is included in population?)	Selection bias	Survey non-responders are more likely to be under-vaccinated
	Sampling frame error	Mobile or marginalised communities less likely to be included

Other limitations

- Infrequent (every 3–5 years)
- High cost

Card vs recall vs truth?

Overview

- Systematic review of 27 studies from 1975–2017 comparing: caregiver recall, home-based records (vaccination cards), facility records, serology

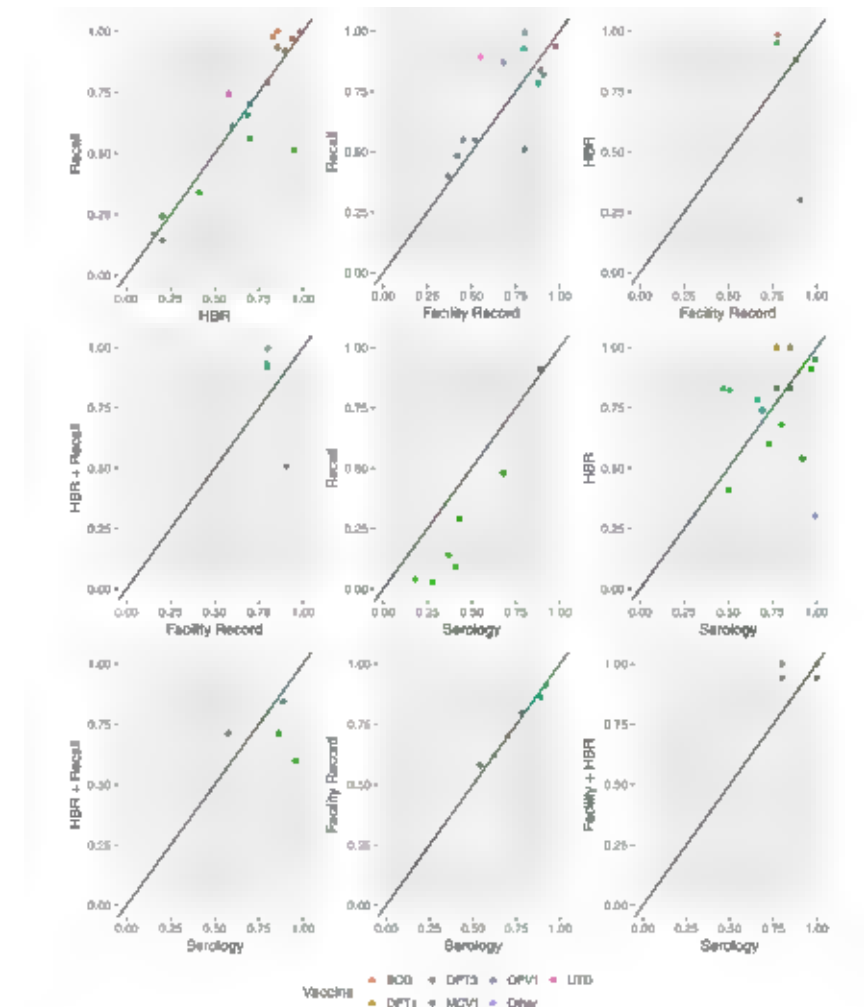
Key findings

- Poor agreement for multiple comparison
- Recall vs home-based records: median +1% (range -43% to +17%)
- Recall vs facility records: median +5% (range -29% to +34%)

Conclusion

- Recall and home-based records can overestimate or underestimate coverage depending on the setting
- There is no single gold standard

Comparison of vaccination coverage estimates based on different sources of vaccination history



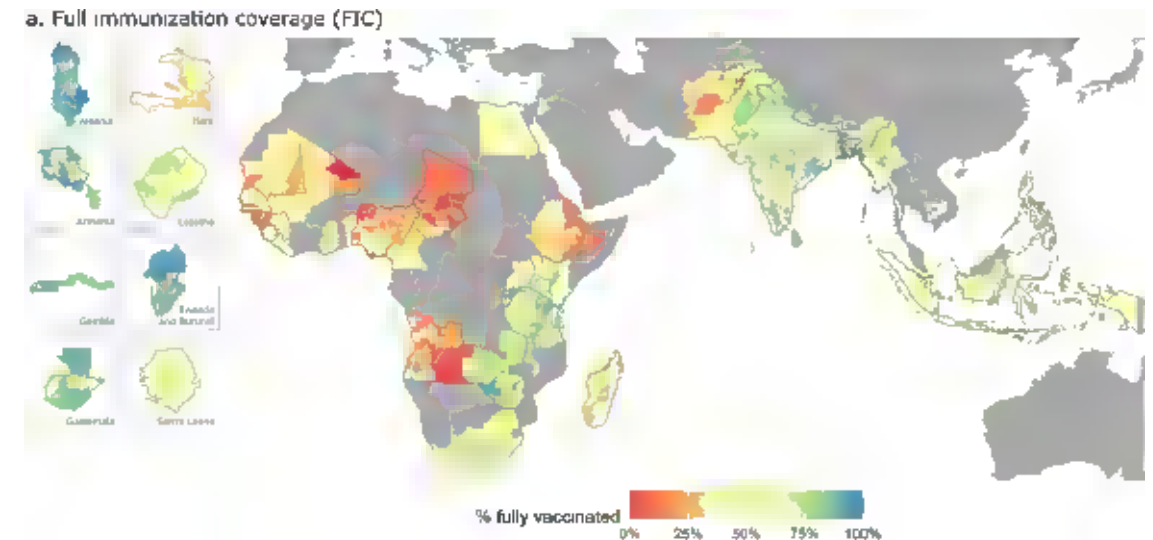
Case study: measuring inequalities across LMICs

Approach

- Demographic and Health Surveys (DHS) across 43 LMICs
- 221,693 children aged 15–35 months from 1,366 subnational administrative regions
- Investigated:
 - national and subnational vaccine coverage
 - socioeconomic inequalities in coverage based on household wealth
 - spatial clustering of low-coverage areas

Findings

- National averages masked important local gaps
- Regions with **<10% full immunisation** coverage in Angola, Chad, Nigeria, Guinea, and Afghanistan
- In most countries, children from poorer households were less likely to be fully vaccinated (strongest association in Angola, Nigeria, and Pakistan)



Case study: from survey clusters to 1 x 1 km vaccination maps

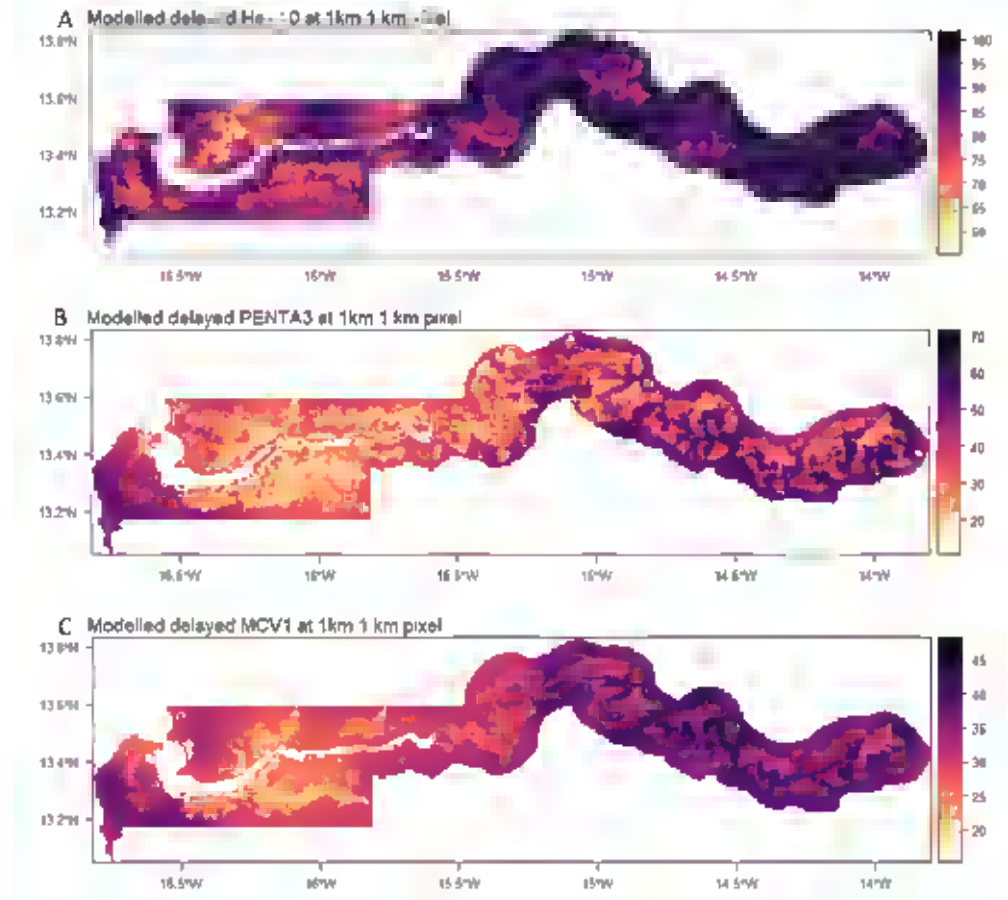
Approach

- 2019-20 DHS in The Gambia
- Examined delayed vaccination for:
 - Hep B birth dose (HepBo)
 - Third pentavalent dose (PENTA₃)
 - First measles-containing vaccine dose (MCV₁)
- Bayesian geospatial models used to estimate delayed vaccination at 1 × 1 km resolution across the country (incorporating socio-economic, environmental, and physical geospatial covariates from WorldPop)

Findings

- Identified highly localised "hotspots" of under-vaccination in central, eastern, and coastal regions

Predicted prevalence of delayed vaccination
(darker colour = larger percentage delayed)



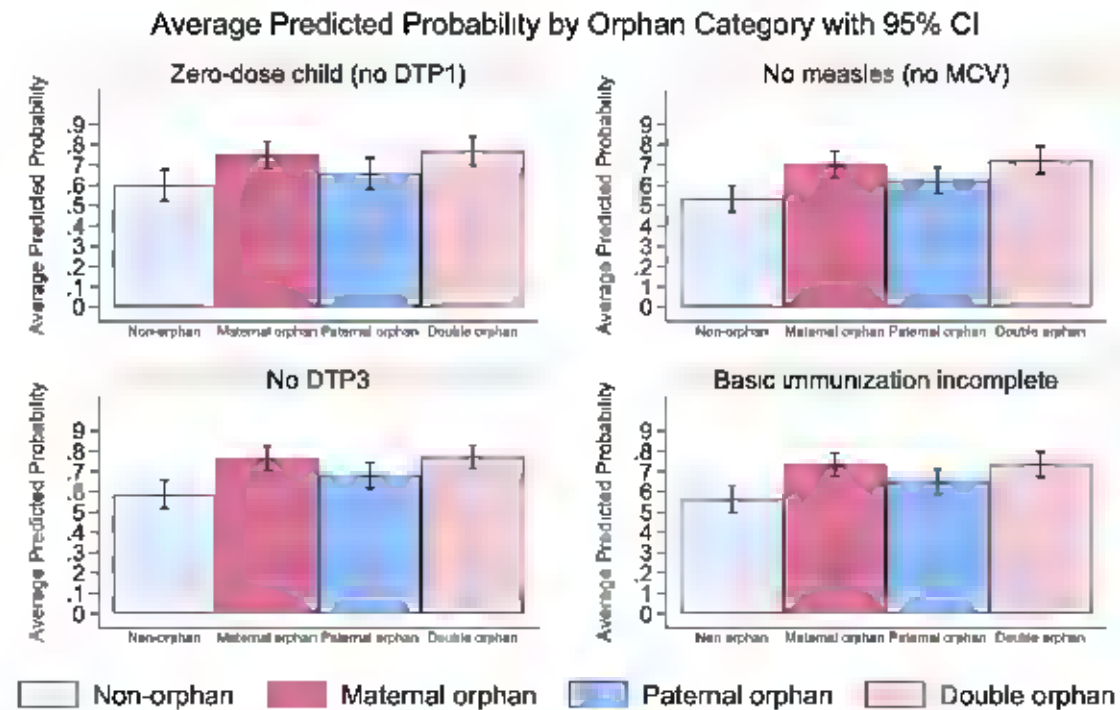
Case study: investigating determinants of under-vaccination

Approach

- Multiple Indicator Cluster Surveys (MICS) from 82 countries
- 189 nationally representative surveys between 2005–2022
- >739,000 children aged 12–59 months
- Multilevel logistic regression used to examine whether orphanhood and lack of parental care were associated with under-vaccination

Findings

- Orphaned children had higher odds of sub-optimal vaccination based on four binary endpoints
- Associations persisted after adjustment for wealth, residence, age, and sex



Data sources for vaccine uptake

3. Electronic health records

What do we mean by 'electronic health records'?

Large-scale digital records generated during routine clinical care

What information do EHRs contain?

Demography



- Age, sex
- Ethnicity
- Deprivation

Clinical history



- Diagnoses
- Test results

Vaccinations



- Product
- Date

Prescriptions

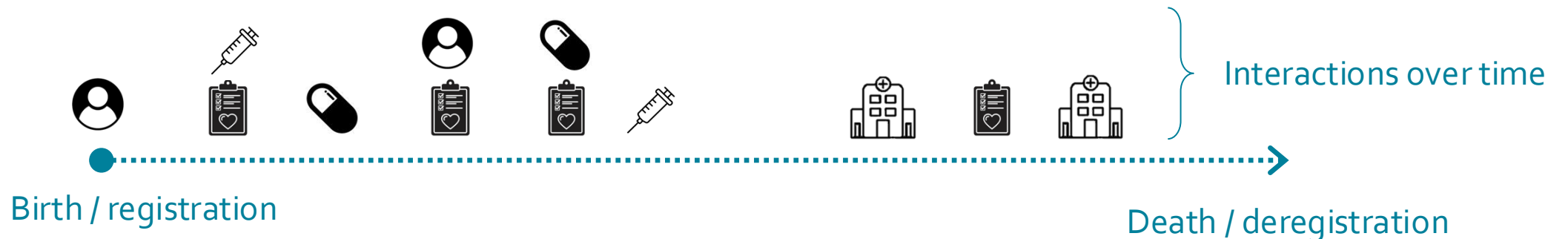


- Product
- Quantity
- Duration

Healthcare utilisation



- GP visits
- Hospital admissions



Coverage in EHRs

Numerators (counted as vaccinated)

- Recorded vaccination events in clinical systems

Denominators (target population)

- Registered patient population within system

Strengths

- Large-scale individual-level data
- Rapid availability (depending on platform)
- Longitudinal follow-up
- Potential for subgroup analyses (age, comorbidities, ethnicity)
- Supports advanced study designs (time to event, longitudinal models, etc)

Examples of EHR data – UK



- Primary care records for ~25% of population
- Anonymised data shared securely with researchers, but shifting to trusted research environment model
- Linkages: ONS mortality data, Hospital Episode Statistics, Maternity data, Cancer registry, others



- Primary care records of >99% of GPs, but analyses separated by primary care provider (TPP: 45%; Emis/Optum: 55%)
- Trusted research environment
- Linkages: ONS mortality data, Hospital Episode Statistics, various others during pandemic



Examples of EHR data – UK

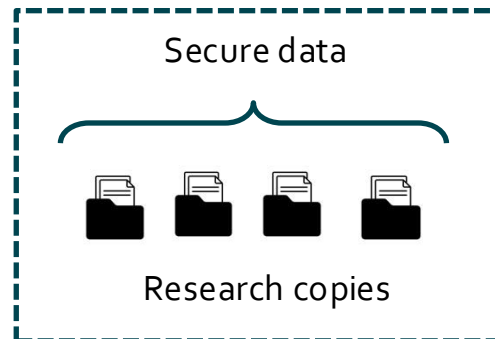


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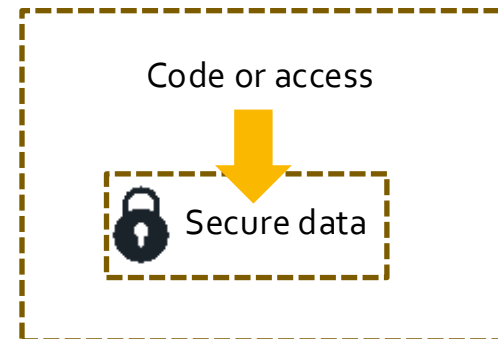


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Distributed data model



Trusted research environment



Examples of EHR data – Hong Kong

Clinical Data Analysis and Reporting System (CDARS)

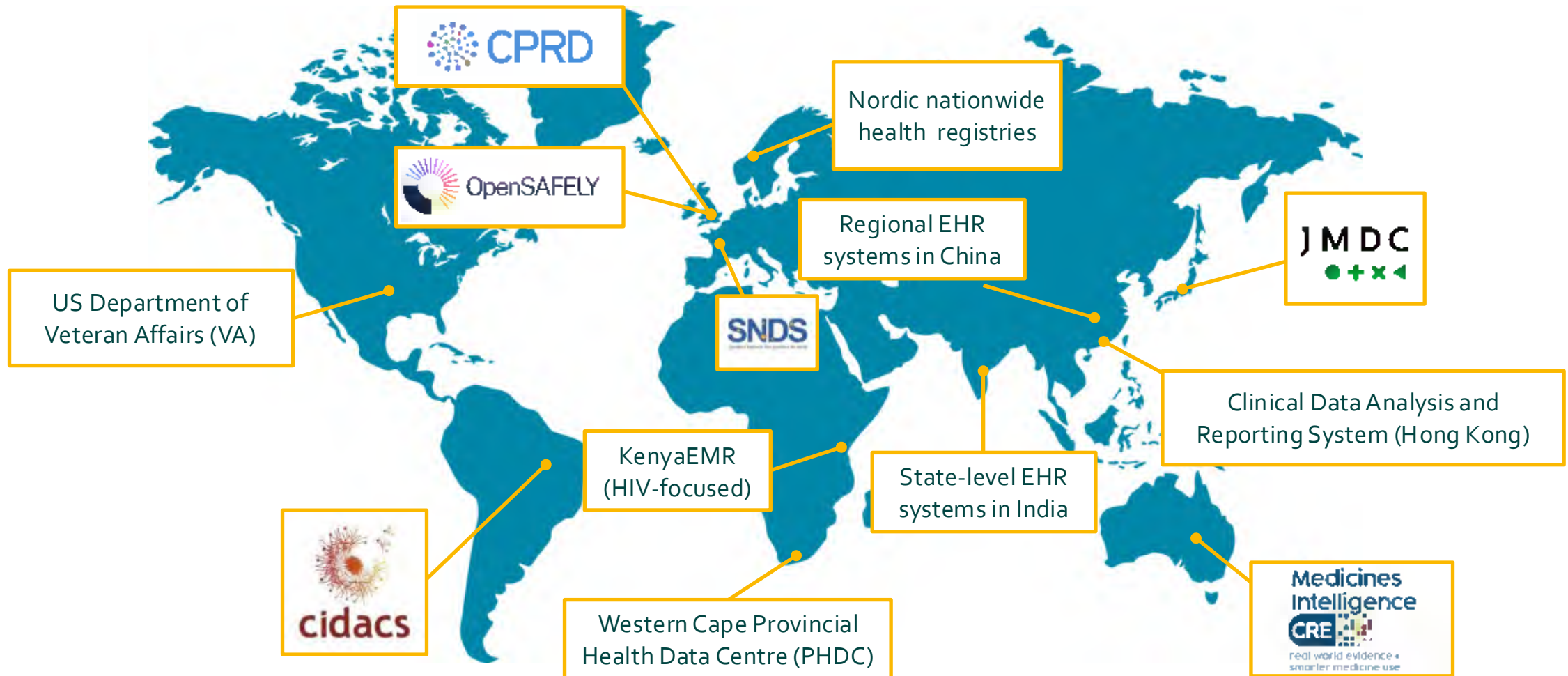
- Territory-wide EHR database operated by Hong Kong Hospital Authority (~90% of secondary and tertiary care in Hong Kong)
- Anonymised data from **all public hospitals** and **outpatient clinics** on: demographics, diagnoses, lab tests, procedures
- Can be linked to government vaccination records and other administrative datasets
- No territory-wide primary care EHR system equivalent to UK GP records



醫院管理局

HOSPITAL
AUTHORITY

Examples of EHR data – global



Research networks supporting multi-database studies:



Data ecosystems

Mature highly linked
EHRs

Fragmented EHRs with
some linkage

Network- or facility-
specific EHRs

Characteristics	Examples
Longitudinal records with linkage to vaccination, mortality, hospital, and demographic data	OpenSAFELY (UK), Nordic registries, CDARS (Hong Kong)
Large-scale records across healthcare sectors or regions with some linkages	Western Cape PHDC (South Africa), regional EHRs (China)
Records focused on specific conditions, facilities, or healthcare programmes	KenyaEMR, AMPATH Medical Record System

Key biases in EHR data

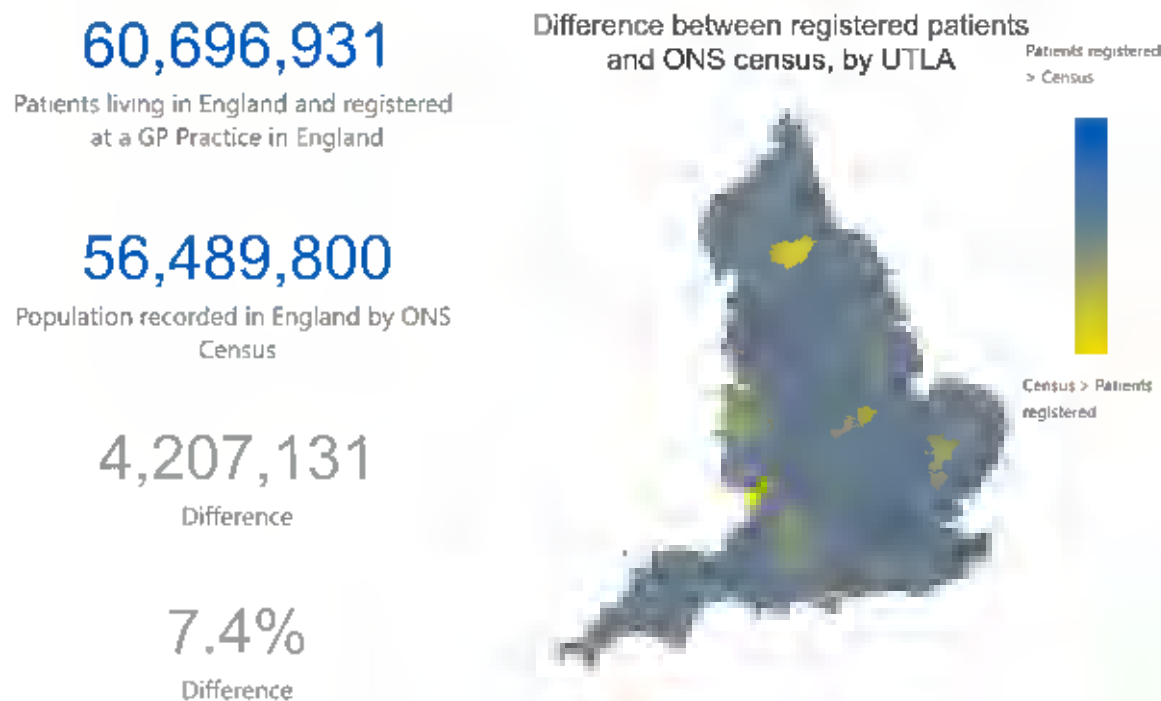
	Bias	Example / context
Numerator bias (who is counted as vaccinated?)	Missing doses	Vaccines given outside system (e.g. at private clinics) not recorded
	Coding errors	Codes used to identify vaccines in clinical records are incomplete
Denominator bias (who is included in population?)	Selection bias	Registered population not representative of region
	Population mobility	'Ghost patients' are registered in primary care but have moved abroad
	Eligibility misclassification	Individuals are incorrectly assigned to risk groups eligible for vaccination

Other limitations

- Fragmented data systems
- Complex data processing
- Hidden biases in study designs
- High data access costs

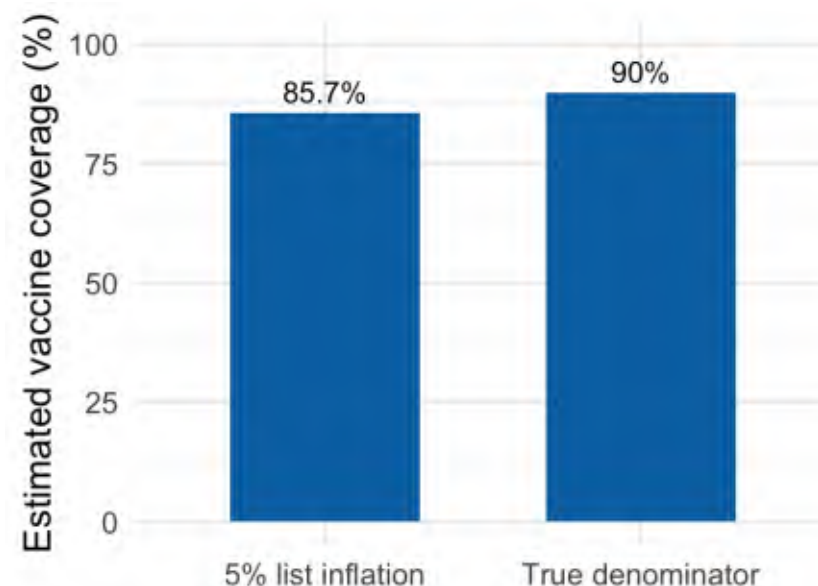
'Ghost patients' and denominator inflation

Comparison of registered patients and census population estimates as of April 2021



ONS, Office for National Statistics; UTLA, upper tier local authority

- Degree of 'list inflation' rising over time in England
- Concentrated in cities (especially London) and areas of high population mobility



Also an issue for administrative data that rely on registered populations to establish denominators

Case study: real-time COVID-19 vaccine uptake in England

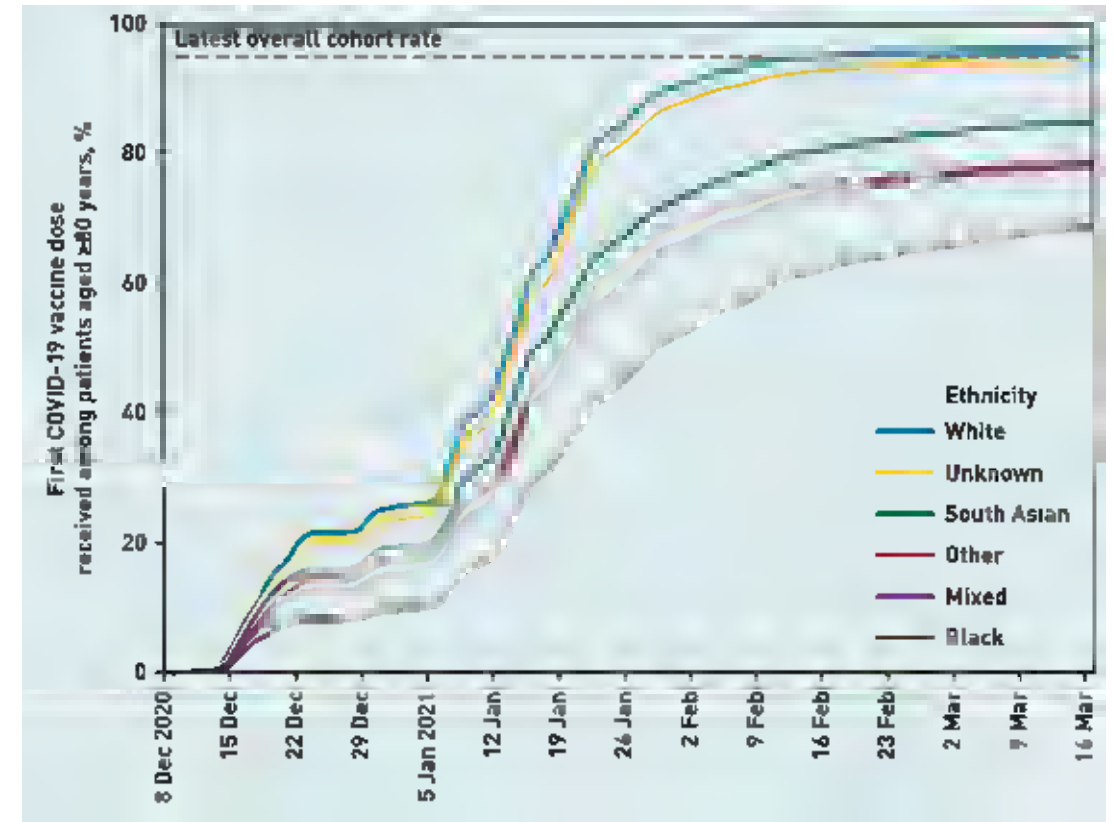
Approach

- Analysed primary care records from 57.9 million patients (~95% of the English population) using 'federated' OpenSAFELY platform (combining GP IT suppliers)
- Measured uptake by age, ethnicity, clinical risk, and other factors
- Weekly reports released in addition to research papers: <https://reports.opensafely.org>

Findings

- Almost 95% coverage among adults aged ≥ 80 years by March 2021
- Uptake substantially lower among some ethnic minority groups and people living in more deprived areas
- Lower coverage also observed among people with severe mental illness and learning disabilities

First dose COVID-19 vaccine uptake among adults aged 80 years and over



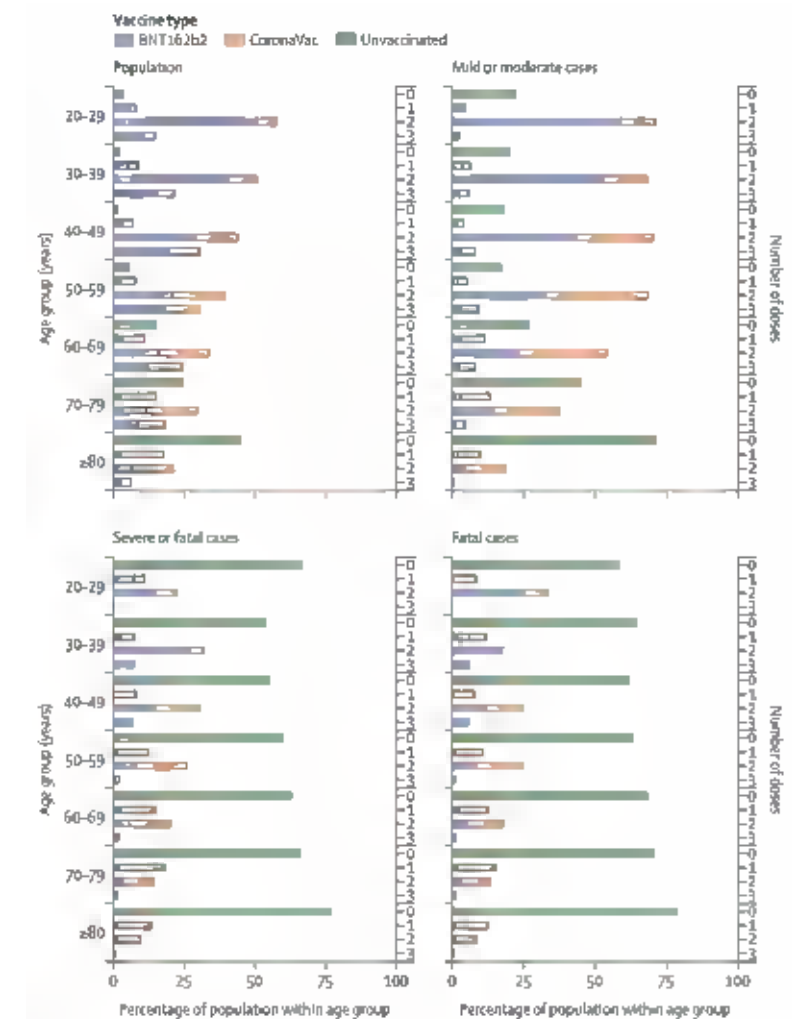
Case study: COVID-19 uptake and effectiveness in Hong Kong

Approach

- Population-based observational study using administrative data, census data, and EHRs in **CDARS**
- **Ecological design:** used administrative/census data for population at risk + individual-level data for cases

Findings

- Substantially lower uptake in older adults (misaligned with risk)
- High effectiveness of third doses against severe outcomes
- Two doses of both vaccines protected strongly against severe COVID-19
- Effectiveness was higher for BNT162b2 than CoronaVac in older adults and boosted by third dose



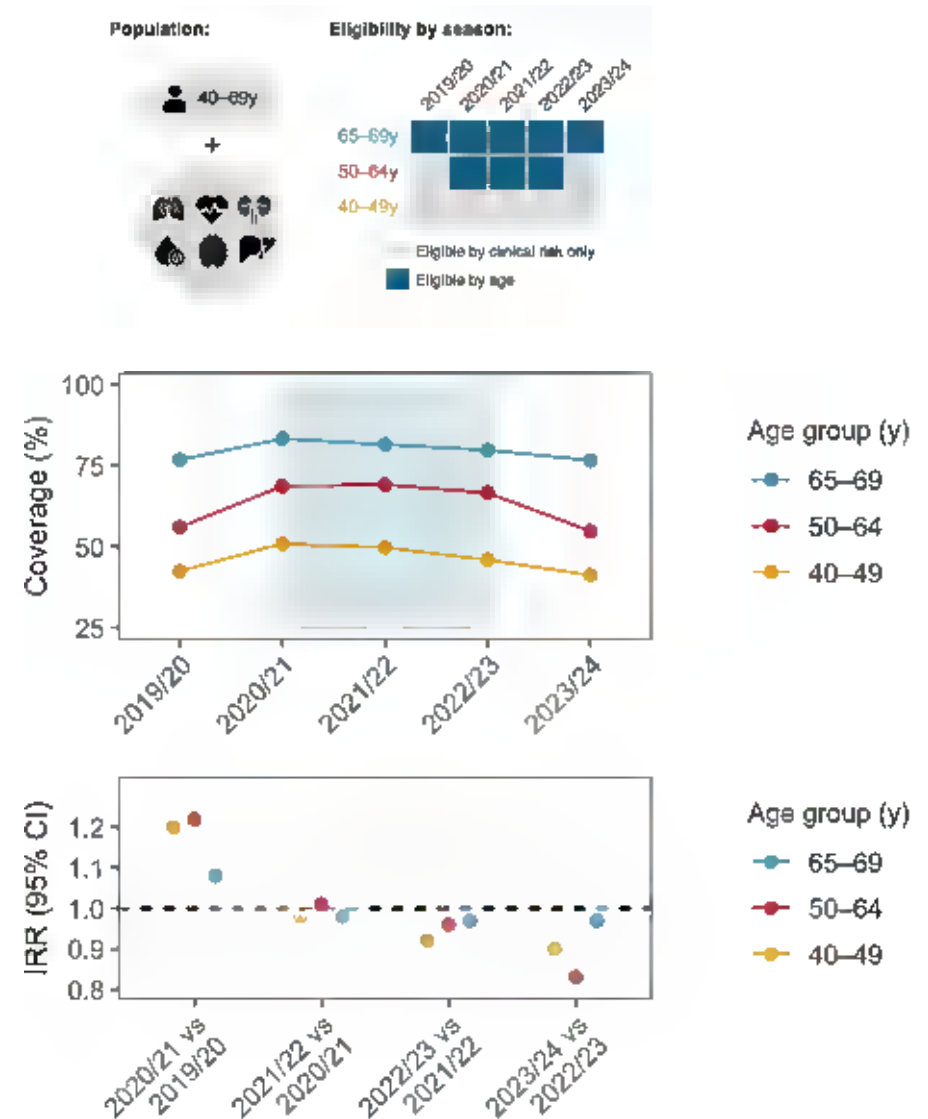
Case study: a natural experiment in flu vaccine eligibility

Overview

- Used the Clinical Practice Research Datalink (CPRD) to create annual cohorts of approximately >1.2 million adults aged 40-69 years with clinical risk conditions between 2019 and 2024
- Exploited natural experiment in which influenza vaccine age eligibility expanded from ≥ 65 years to ≥ 50 years

Findings

- 12% increase in coverage among 50–64 year-olds relative to adjacent age bands during period of expanded age eligible
- Consistent effect across clinical risk groups



Comparing data sources

If you want to know...

Real-time coverage insights

How coverage varies geographically

How coverage varies across population groups

Coverage in groups missed by routine systems

Impact of policy changes or interventions

Administrative data	Surveys	EHRs
		
		
 *		 **
		
		

 Yes / usually

 Sometimes

 No / rarely

* Ecological analyses possible – e.g. coverage in regions with high deprivation vs low average on average

** Limited to variables collected in EHRs

Take-home messages

(1) Coverage is a core indicator of programme performance

- Monitor whether target populations are being reached
- Support outbreak prevention, outbreak response, and policy decisions

(2) National averages can hide important disparities

- Coverage often varies by socioeconomic status, geography, age, and clinical risk
- Stratification, absolute differences, and relative differences provide complementary perspectives

(3) Coverage estimates are only as good as their data

- Data quality issues, bias, and denominator uncertainty can lead to inaccurate estimates

Hydration break!

Practical materials on Dropbox

