Applying Linked Data to Strengthen Equity in HPV Immunisation and Cervical Screening Uptake, and to Monitor Outcomes Over Time

HPV Prevention & Control Board Meeting

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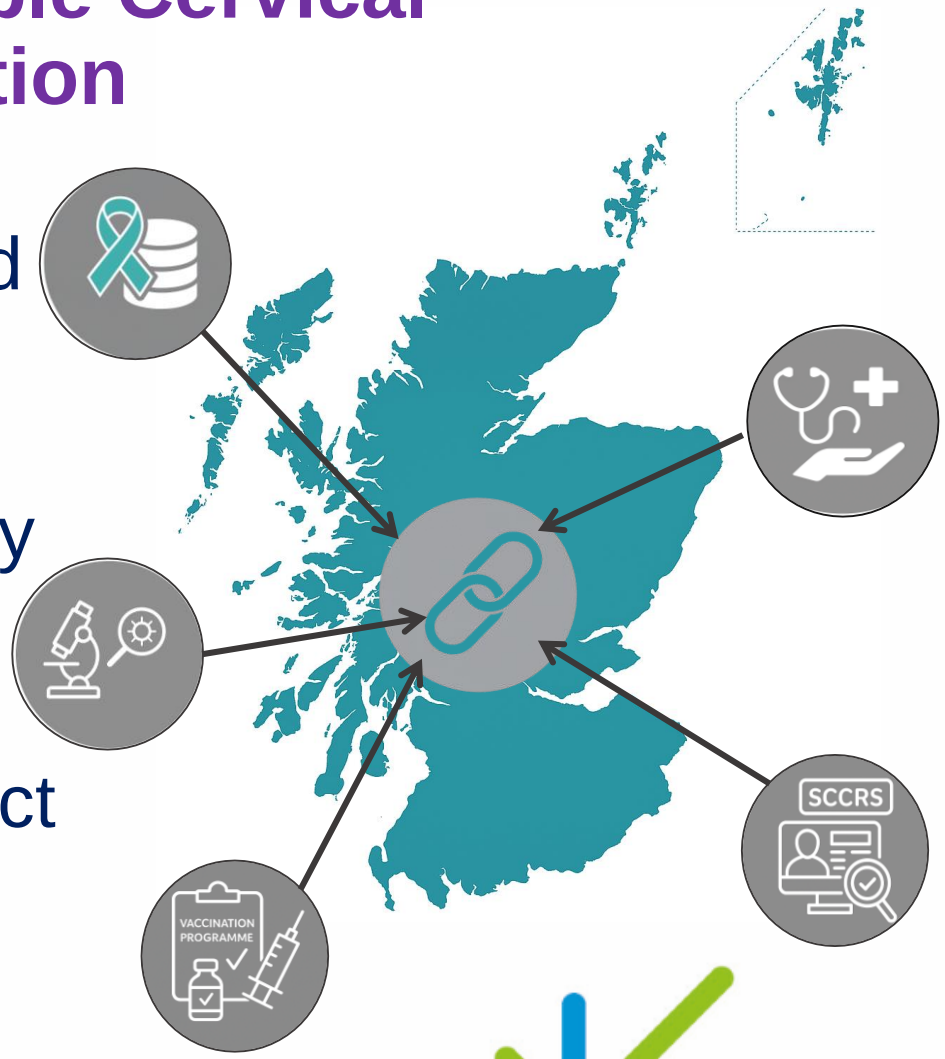
Data Linkage for Equitable Cervical Cancer Elimination

- Connecting immunisation, screening and outcomes data over time
- Enables analysis by deprivation, ethnicity and other higher-risk populations
- Reveals inequalities in access and impact to be addressed

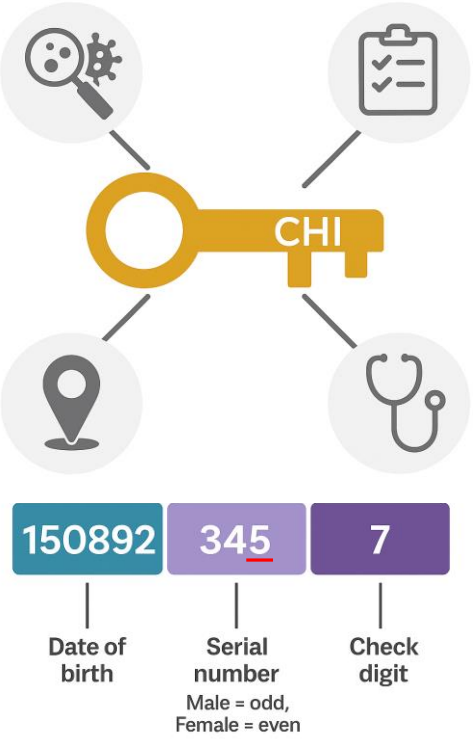


System Foundations for Effective Data Linkage

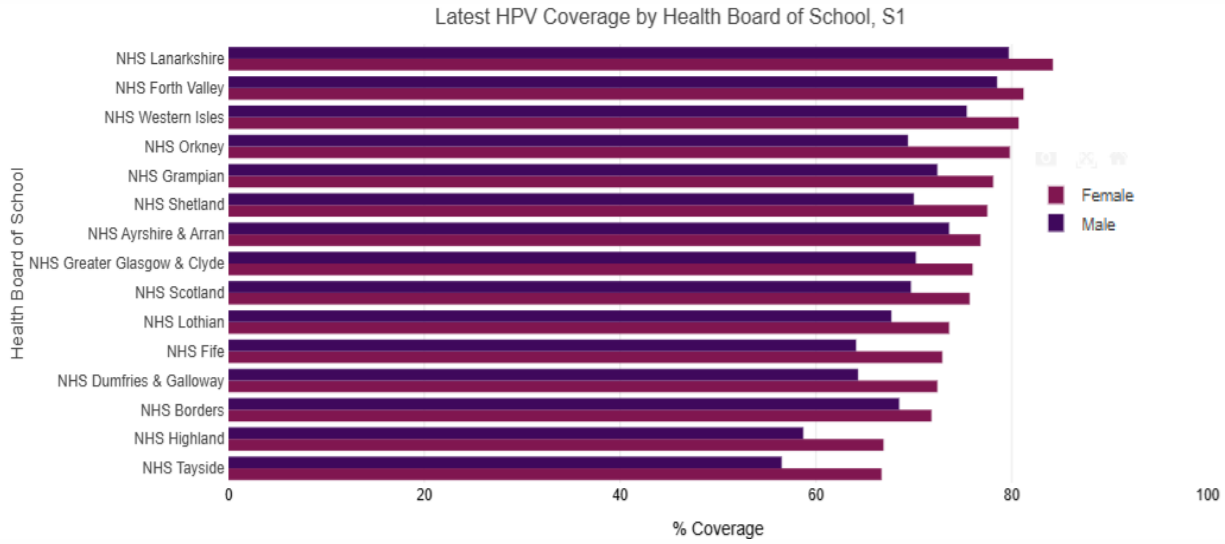
- NHS Scotland is a single, national health system
- Delivered across 14 local NHS Boards
- Stability of organisational structures over time
- National programmes with clear eligibility
- Strategic commitment to data and evidence with emphasis on health intelligence, population-level analysis & inequalities monitoring
- National Digital Infrastructure
- Proportionate governance frameworks and public trust

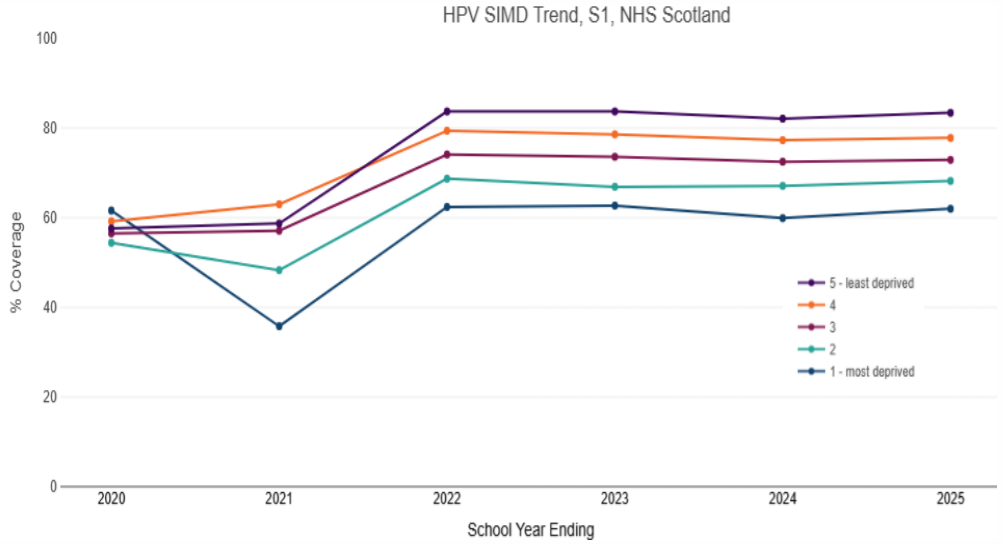
The Role of the Community Health Index

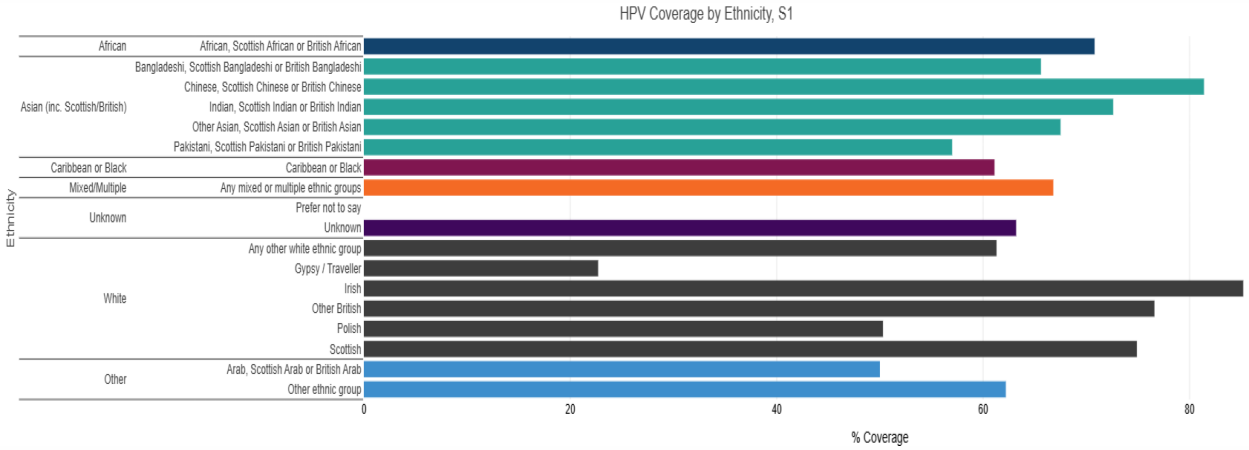
- Unique person-level identifier
- Near universal assignment
- Consistent use across national healthcare data sets e.g. primary care, secondary care, immunisation, screening, prescribing
- Stable identifier across the life course enables
    - Longitudinal follow-up
    - Accurate record matching with low linkage error rates

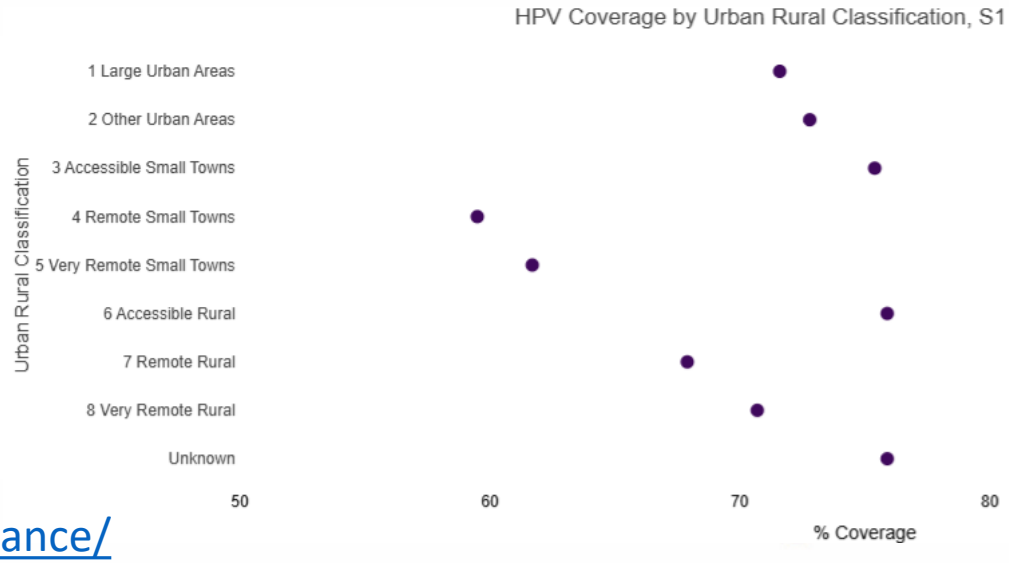


HPV Immunisation Coverage Rates for Pupils (aged 12-13 years)









https://scotland.shinyapps.io/phs-vaccination-surveillance/

Demonstrating Impact: Outcomes Across the Disease Pathway

- Reductions in HPV 16/18 and X-protected types
- Evidence of herd protection
- No type replacement

- Reductions in CIN1, 2, and 3
- 80-90% vaccine effectiveness
- Strong impact in vaccinated groups

- No HPV16/18 cancers in those first vaccinated at 12-13 yrs
- High protection in those vaccinated later
- Early signs of population impact

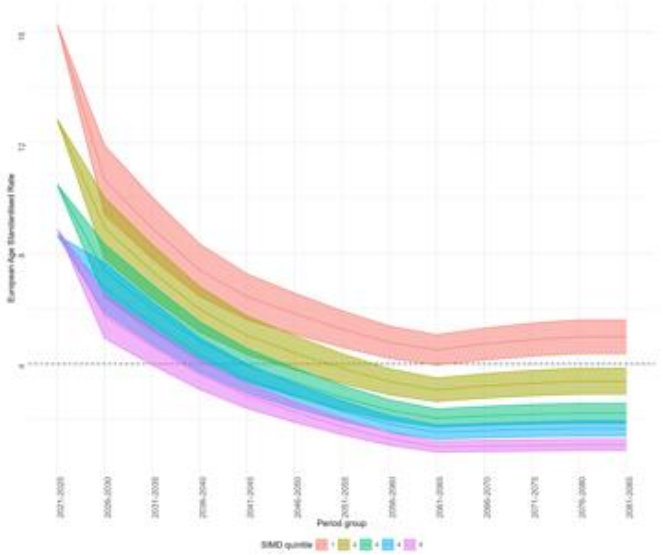
Impact is greatest with early vaccination and requires equitable uptake to be realised at population-level

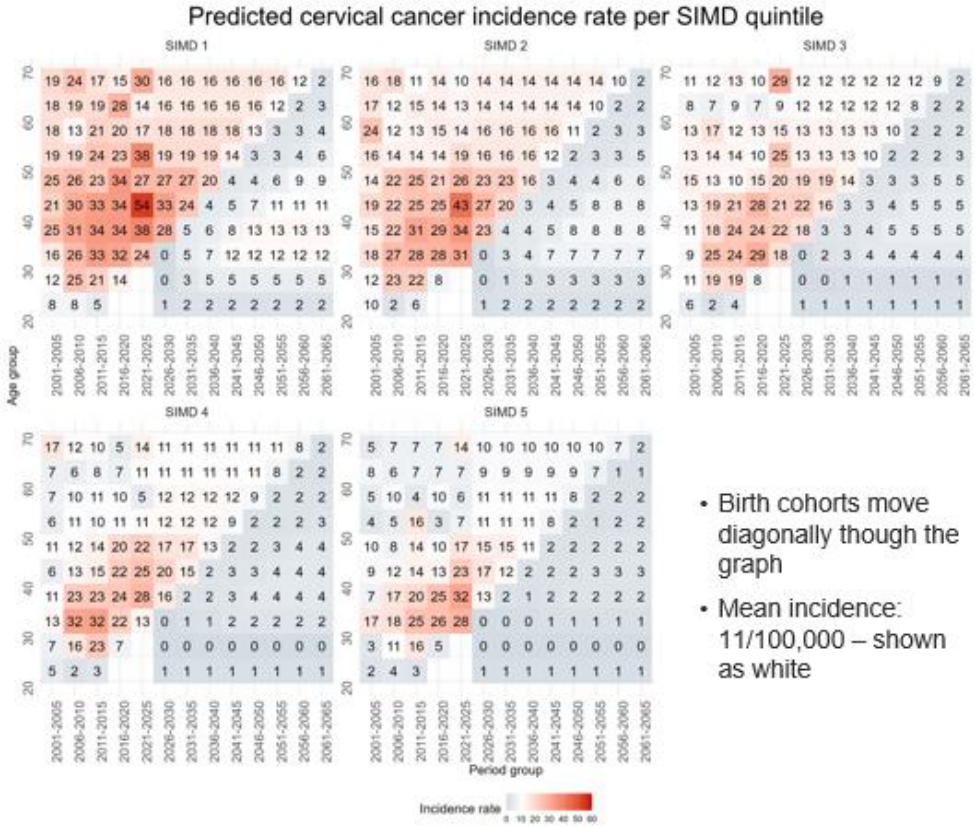
Cameron et al. 2024. Assessing real world vaccine effectiveness: A review of Scotland's approach to monitoring human papillomavirus (HPV) vaccine impact on HPV infection and cervical disease. Vaccine 24: 21: 126177

Informing Elimination Focused Policy

Scenario 1: current situation

- Clear divide between the birth cohorts in routine school vaccination vs earlier cohorts.
- Vaccinated cohorts have reached the WHO elimination threshold in the SIMD 4 and 5
- Differences between SIMD quintiles although reduced in the routine school vaccination cohorts
- Most cases predicted in the most deprived quintiles (SIMD 1 & 2)
- The problem of the unvaccinated older generations where disease is already present is persistent in all but the least deprived group.
- Overall elimination by 2046-50, varies massively by SIMD





- Birth cohorts move diagonally though the graph
- Mean incidence: 11/100,000 – shown as white

SIMD	EASR	Year
1 (most deprived)	4.51	2061-2065
2	3.83	2051-2055
3	3.94	2041-2045
4	3.46	2041-2045
5 (least deprived)	3.62	2036-2040

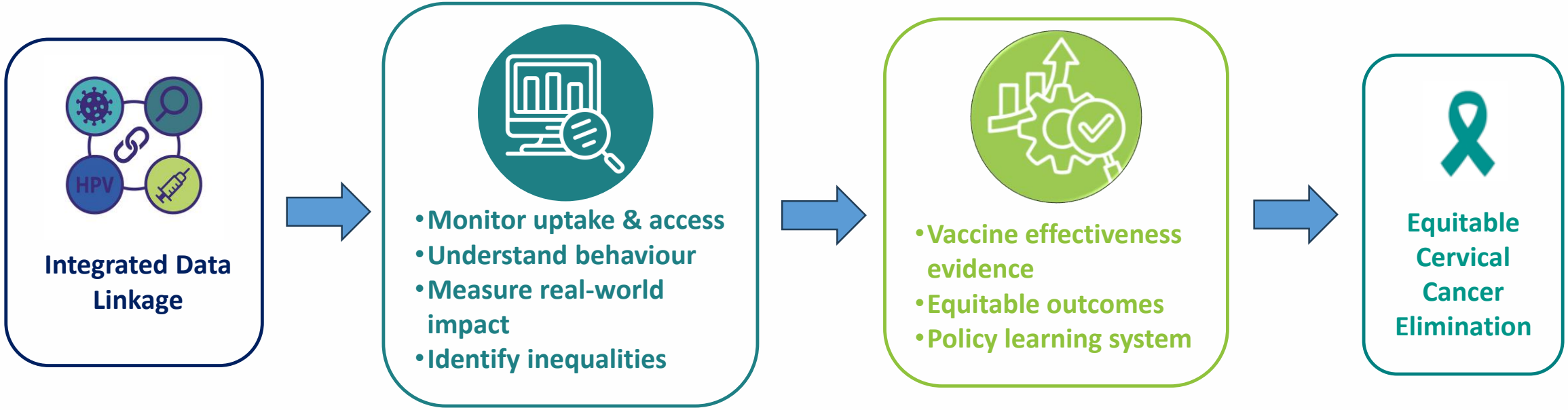
Tunde et al. Inequalities in Scotland's Path to Cervical Cancer Elimination: Findings from an Age-Period-Cohort Model. Lancet Regional Health – Europe (under review)

Screening Behaviour and Inequalities

Factor	Adjusted findings	Key insight
 Deprivation	Clear gradient with lowest coverage in most deprived	Inequalities reflect overlapping socioeconomic factors.
 Ethnicity	Persistent differences after adjustment	Ethnicity independently influences coverage, but effects are context-specific and heterogeneous
 Rurality	Higher odds of never being screened in remote small towns	Apparent urban disadvantage is explained by population mix; residual rural effects may reflect access barriers.
 HPV immunisation	Lower coverage among partially vaccinated and vaccine-ineligible groups	Differences by vaccination status are weak and reflect demographic factors

- Screening participation is shaped by intersecting social, geographic and behavioural factors
- Improving uptake requires culturally informed and locally tailored multi-layered interventions

Closing the Gaps: The Case for Data Linkage



- Reveals inequalities that aggregate data hides
- Supports programme optimisation
- Improves effectiveness and efficiency
- Strengthens policy decisions

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