

BMJ Open Estimate of global human papillomavirus vaccination coverage: analysis of country-level indicators

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ABSTRACT

Background Mortality rates from cervical cancer demonstrate deep inequality in health between richer and poorer populations. Over 310 000 women died of this preventable disease in 2018, mostly in low-income and middle-income countries (LMICs) where screening and treatment are beyond the capacity of health systems. Immunisation against human papillomavirus (HPV) offers a primary prevention strategy, but rates of vaccination uptake are unclear. Understanding coverage levels and factors affecting uptake can inform immunisation strategies.

Objectives The aim of this study is to evaluate the status of HPV vaccination coverage from nationally reported indicators and to estimate global coverage in a single year cohort of vaccine-eligible girls.

Design This study provides quantitative population-level estimates of important global health indicators. Using data from the Global Cancer Observatory and WHO/UNICEF, incidence of and mortality from cervical cancer and HPV vaccination coverage are described for countries, categorised by income group. Characteristics of LMICs achieving high coverage are explored using selected development indicators from World Bank sources. Global HPV immunisation coverage is calculated and its impact on cervical cancer mortality estimated.

Results Incidence and mortality for cervical cancer correlate with poverty. Whilst all WHO member states report high infant measles vaccination rates, fewer than half report on HPV vaccination. Even amongst high-income countries, coverage varies widely. In upper-middle-income countries, there is a trend for higher coverage with increased health spending per capita. Four LMICs report good coverage levels, all associated with external funding. Global HPV immunisation coverage for 2018 is estimated at 12.2%. Of the global cohort of 61 million 15-year-old girls in 2018, 7000 are likely to die from cervical cancer, almost all in LMICs.

Conclusions Countries in all income groups must devise strategies to achieve and maintain higher levels of HPV immunisation. For all but the richest, affordability remains a barrier.

INTRODUCTION

The burden of cervical cancer

Over 310 000 women died of this preventable disease in 2018, 90% of whom were in

Strengths and limitations of this study

- This study collates immunisation data submitted by all 195 WHO members for 2018.
- Data for human papillomavirus vaccination coverage are missing for over half of WHO members for 2018, limiting the conclusions which can be drawn from analysis.
- Data for immunisation coverage, cancer incidence and mortality and development indicators are drawn from three databases maintained by separate organisations for different purposes, potentially limiting comparability.
- Analysis is limited by variable methods used for data collection by individual countries including administrative, survey and estimated data.
- The study analyses a single year of reported immunisation data with the attendant risk that this might not be truly representative.

low-income and middle-income countries (LMICs).¹

Cervical cancer is a sexually transmitted disease caused by the human papillomavirus (HPV).² In 2018, there were an estimated 570 000 new cases of cervical cancer worldwide.¹ High-income countries (HICs) report age-standardised incidence rates (ASIRs) of 5–10 per 100 000 women, with age-standardised mortality rates (ASMRs) as low as 2 per 100 000 women.³ This compares to an ASIR over 40 per 100 000 in much of sub-Saharan Africa, where ASMRs are 30–60 per 100 000.³

In HICs, the incidence of cervical cancer declined by half in the past 30 years largely due to screening⁴; the case fatality rate also declined as a result of treatment advances which can now achieve survival rates of up to 87% in early-stage disease⁵ and 70% with locally advanced disease.⁶ In contrast, incidence in sub-Saharan Africa has increased over this period, with high case fatality rates⁷ due to late stage presentation⁸ and limited treatment availability.^{5,9}



Prevention of cervical cancer

The Pap smear has enabled effective prevention of cervical cancer since the 1950s.¹⁰ Alternative screening approaches requiring less skill and fewer resources include visual inspection with acetic acid¹¹ and self-sampling for HPV DNA testing.¹² All these methods require colposcopic follow-up to ablate abnormal epithelial cells.

The discovery of HPV as the causative agent of cervical cancer² offered the opportunity to develop primary prevention approaches. Early clinical trials of vaccines against HPV-16 and HPV-18, the strains responsible for 70% of cervical cancers, showed high efficacy against infection in adolescent girls.¹³ Additional strains (HPV-6 and HPV-11) are now included in a quadrivalent vaccine which offers effective prevention of precancerous cervical lesions, as well as precursors of vaginal, vulval, anal canal, penile and oropharyngeal cancers.^{14 15} Population-based studies (all in HICs) demonstrated that, with greater than 50% vaccine uptake, HPV-16 and HPV-18 infections decreased by 68% in girls aged 13–19.¹⁶ Cross-protection against other HPV strains and infections in older women were noted, suggesting herd effects.^{17 18}

HPV immunisation programmes began in 2007, mostly in HICs,¹⁹ and cost-effectiveness studies have shown clear benefits.²⁰ Programmes have increasingly used school-based implementation strategies supplemented by opportunistic delivery through primary care providers.²¹ Resource-stratified guidelines have been developed²² to encourage adoption of HPV immunisation programmes in LMICs, but barriers to implementation remain.²³

The success of programme implementation remains unclear. A 2016 pooled analysis of data from published literature, government websites and donor aid sources estimated that only 1.2% of women had received a complete course of vaccine with wide variations: 33.6% of females aged 10–20 years in developed regions, but only 2.7% in less developed regions.²⁴ A review of 28 studies to 2013 also reported wide variations in coverage.²⁵ A survey of 45 LMICs found high uptake could be achieved in school-based programmes²⁶ but, where school enrolment was low, supplementary approaches were needed.²⁷ Two recent reviews found wide differences in policy and uptake across Europe.^{28 29} Many HICs have registries providing estimates for coverage (see literature review in online supplemental file 1), but few such sources are available in LMICs. Furthermore, estimates based on widely different methodology cannot easily be compared across time or geography. A recent WHO/UNICEF report estimated that less than one in three girls live in a country with HPV vaccine in the immunisation schedule³⁰ and, even where provided, many girls are not reached, regardless of country income levels.³¹

WHO strategy towards the elimination of cervical cancer

The key challenge for HPV immunisation is how to extend its benefits to most of the world's population. The WHO Global strategy for elimination of cervical cancer has adopted targets of 90% vaccination coverage, 70%

twice-lifetime screening and 90% treatment of preinvasive lesions and invasive cancer by 2030.³²

Any evaluation of progress towards achieving these targets requires country-level statistics using reliable, consistent and clearly defined indicators. A database compiled by WHO and UNICEF, released in 2019, provides indicators of HPV vaccination coverage, as reported by member countries.³⁰ The aim of this study is to provide a baseline estimate of global HPV immunisation coverage from these data, and to compare coverage levels between and among countries in different income strata.

METHODS

This study uses data from three publicly available databases to examine the burden of cervical cancer globally and evaluate coverage with HPV vaccination. Data are gathered at nation state level and analysed by strata of gross national income (GNI per capita), according to World Bank criteria.³³ Categories are: HICs, upper-middle-income countries (UMICs), lower-middle-income countries (here abbreviated as LrMICs, to distinguish from LMICs) and low-income countries (LICs).

Global Cancer Observatory

The global cancer observatory (GCO)³⁴ is an interactive web-based platform provided by the International Agency for Research on Cancer (the specialised WHO cancer agency). This includes estimates of incidence, mortality and prevalence of the main cancer types, by sex and age group.³⁵ The GCO Today database³⁴ was interrogated for country-level data for cervical cancer incidence and mortality in 2018, including absolute numbers and crude and age standardised rates per 100 000 women.

World Bank

Classification of countries according to World Bank Income Groups was obtained for the 2018 calendar year.³³ Demographic and economic data for 2018 were extracted from the World Bank Open Data web page.³⁶ Mortality and school enrolment data were sourced from the World Bank Development Indicators database.³⁷

UNICEF-WHO immunisation databases

Global immunisation data are requested annually by UNICEF/WHO from the Ministries of Health of every WHO member state³⁸ and are collated and made available through the UNICEF website.³⁹ The dataset 'WHO estimates of HPV immunisation coverage 2010–2018'⁴⁰ (a copy is provided in online supplemental file 2) contains country-level first and last dose reported HPV vaccination coverage according to a locally defined age schedule and/or by age 15.

To provide a comparator for HPV immunisation reporting, the UNICEF measles immunisation dataset was accessed³⁹ to obtain 2018 indicators for percentage

of infants receiving a first and second dose of measles-containing vaccine.

The selected data from each of the three sources were downloaded and amalgamated into an Excel spreadsheet, matching countries to the 195 WHO member list grouped by income strata.

Cervical cancer incidence and mortality

Cervical cancer incidence and mortality data were tabulated by country; incidence of and mortality from all other cancers (ie, all cancers excluding cervical cancer) was calculated by subtracting cervical cancer from all cancer. Data were expressed as crude incidence rates per 100 000 females for age bands 0–24, 25–39, 40–54, 55–69 and over 70.

Immunisation coverage and development indicators

Data for measles and HPV immunisation coverage and selected economic and development indicators were tabulated at country level. Scatter plots were used to demonstrate potential associations between these variables and HPV immunisation completion in 2018. Trend lines were added using Excel tools (using a least squares method).

Estimation of global HPV immunisation coverage

To estimate global HPV vaccination coverage, cohort size for each country was approximated from the following indicators provided by the World Bank for 2018³⁶:

- Total female population age 5–14.
- Female deaths age 5–14, using the formula:

$$\text{Cohort size} = (a \div 10) - (b \div 2)$$

This provided an estimate of the female population cohort at age 15. The numbers of vaccinated and unvaccinated girls in each national cohort were calculated. For non-reporting countries, immunisation rates were assumed to be zero. Estimates of predicted cervical cancer deaths in the unvaccinated cohort were calculated using the country-specific remaining lifetime mortality risk at age 15, available from the GCO database.³⁴ As the HPV vaccine is estimated to prevent infection causing 90% of cervical cancers,⁴¹ in the vaccinated cohort, the disease-specific mortality rate was estimated at 10% of the unvaccinated cohort.

Patients and public involvement

Neither patients nor the public were involved in this study.

RESULTS

Demographic and cancer data, immunisation rates and selected development indicators are shown at country level in tables A–D in online supplemental file 3. Countries are categorised by income group, within which they are listed alphabetically. Data are given for 2018 or the most recent year available. Data sources are described in the Methods section.

Burden of cervical cancer

Estimates of ASIR and ASMRs in 2018 for cervical cancer are shown at individual country level in tables A–D in online supplemental file 3. These data are summarised for income groups in figure 1, stratified by age bands and compared with all other cancers. Cervical cancer is more common in younger age groups compared with other cancers and, in every age band, the rate of new cases of and deaths from cervical cancer is clearly associated with poverty.

Immunisation reporting

Immunisation reporting for 2018 submitted by individual countries to WHO is shown in tables A–D in online supplemental file 3. While all 195 participating countries submitted data on measles vaccination, only 78 countries reported on HPV immunisation programmes, of which two (Zimbabwe and Thailand) had delivered only first doses. Seventy-six countries reported on completed courses to the locally defined target female population. These data are included in tables A to D in online supplemental file 3, except where higher coverage was reported for completed courses by age 15, suggesting vaccination catch-up. The HPV vaccine coverage data, therefore, provide a best-case scenario snapshot of vaccination coverage in 2018 for the 76 reporting countries.

Immunisation reporting by income group is summarised in table 1, showing the number of countries in each income group that submitted records of measles and HPV vaccination. Measles first dose vaccination coverage was over 80% in all but 35 countries, many of which were LrMICs or LICs affected by conflict (eg, South Sudan, Syria and Somalia). However, reporting of second dose measles vaccination showed lower coverage levels, particularly in LrMICs and LICs.

Similarly, the proportion of countries reporting HPV immunisation was related to income level although, even in HICs, there were significant gaps in reporting. To examine factors that might contribute to establishment and success of HPV immunisation programmes, selected development indicators were compared with rates of HPV completion.

HICs and UMICs

Scatter plots in figure 2 show 2018 HPV immunisation completion in HICs, plotted against four indicators: GNI per capita, health expenditure per capita, percent of health expenditure from private sources and female secondary school enrolment.

Data on HPV immunisation completion were available from 41 of 59 HICs. Of reporting nations, 11 recorded immunisation completion rates above 80% and only four had rates below 20%. The charts in figure 2 suggest no correlations between the development indicators examined and levels of HPV immunisation in HICs.

The same set of indicators, plotted against HPV immunisation completion rates for UMICs, are shown in figure 3.

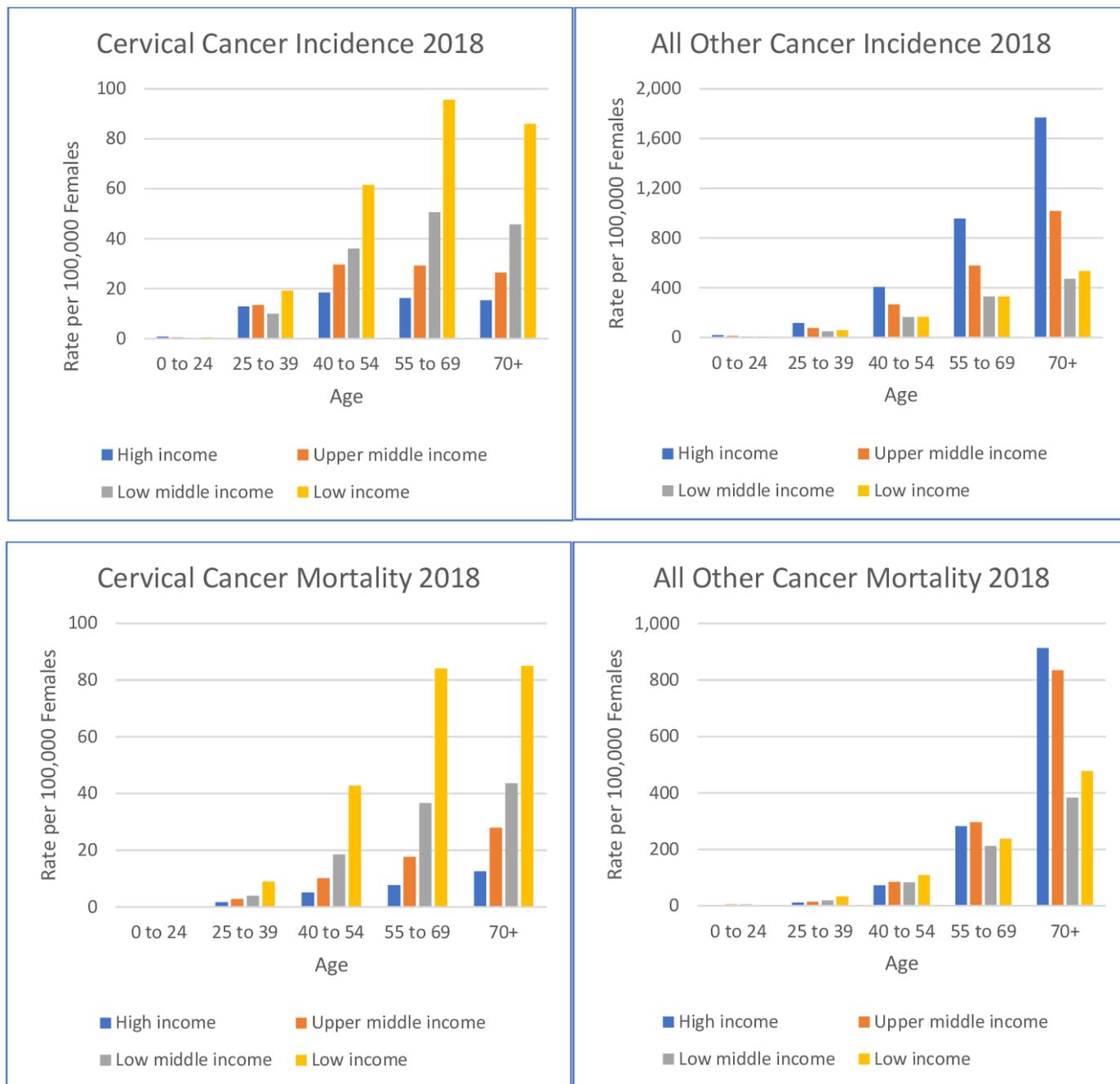


Figure 1 Incidence and mortality of cervical and all other cancers in 2018, by income group and age bands. Data are shown as crude rates per 100 000 females. Note differences in scale of x-axes.

Among 59 UMICs, 33 did not report on HPV immunisation; of the 26 that did, 7 had completion rates below 20% and only 6 achieved completion rates above 80%. Of the development indicators analysed, there was no apparent correlation in UMICs between HPV immunisation completion rates and either the proportion of health expenditure from private sources, or the rate of female secondary school enrolment. The data, however, suggest trends relating both GNI/capita and health expenditure/capita (both at purchasing power parity, PPP) with HPV immunisation completion rates.

LrMICs and LICs

The World Bank income group classification for 2018 lists 46 LrMICs and 31 LICs among WHO members. Both groups have very few nations reporting on HPV immunisation completion (see tables C, D in online supplemental file 3). Of those that do, several are very small (eg, Bhutan, Micronesia and Sao Tome) and will not be discussed further here.

Two countries in each of the LrMIC and LIC groups report relatively high levels of HPV immunisation completion: Bolivia and Honduras (both at 61%) among LrMICs; and Rwanda (at 84%) and Uganda (at 72%) among LICs.

Table 1 Number of countries in each income group reporting immunisation data to WHO/UNICEF

Income group	No of countries	Total population (Millions)		No of countries reporting in 2018							
				Measles first dose		Measles second dose		HPV first dose		HPV complete	
		No	%	No	%	No	%	No	%	No	%
High	59	1173	100	59	100	57	97	41	69	41	69
Upper middle	59	2920	100	59	100	57	97	27	46	26	44
Lower middle	46	2754	100	46	100	39	85	7	15	6	13
Low	31	707	100	31	100	17	55	3	10	3	10
World	195	7554	100	195	100	170	87	78	40	76	39

HPV, human papillomavirus.

Estimate of global HPV immunisation coverage and preventable mortality

Country-level HPV immunisation rates and an estimated cohort size for 15-year-old girls in 2018 were used to calculate numbers of immunised and unimmunised girls in this single global cohort. These data are summarised for each income group in [table 2](#).

If the absence of reporting indicates a lack of immunisation (which is far from clear), then the rate of HPV immunisation globally in this cohort was only 12.2%. Extrapolating from this, approximately 7000 girls in this 1-year global birth cohort might be expected to die from cervical cancer, almost all in poorer nations.

DISCUSSION

This study shows that poverty is a major contributor to the burden from cervical cancer. Women die now from this preventable disease due to lack of knowledge, insufficient screening and an absence of diagnostic and treatment services. The data demonstrate that cervical cancer affects a younger age group than most cancers and that, at all ages, incidence and mortality from cervical cancer increase with poverty. Widespread HPV immunisation could resolve this inequity.

An important limitation of this study reflects the limitations of the data sources on which it is based. Estimates of cancer incidence and mortality in most HICs are based on registry data. In poorer countries such estimates may be less reliable as registries are often absent, incomplete or out of date. Cancer data are often based on household surveys and extrapolation from limited hospital data and neighbouring communities.⁴² It is likely that many cancer cases in LMICs go unrecorded. If so, then the gaps described in cervical cancer mortality between richer and poorer nations may be wider than estimated.

Similar criticisms apply to data for vaccination coverage. All WHO member states reported on infant immunisation in 2018 (shown here by 100% reporting of first measles vaccination), confirming the commitment and administrative capacity (at least in theory) to comply with reporting. However, fewer than half submitted data on HPV immunisation. Even in rich countries, these data are suspect because many do not have national organised programmes and/or do not maintain adequate registries (see literature review in online supplemental file 1). Coverage estimates based on survey data can be subject to selection and recall biases and may not differentiate between initiation and completion of vaccination courses. Where survey data are described in the literature for such countries, it suggests low rates of coverage,^{43–46} associated with opportunistic approaches to HPV immunisation.

Unsurprisingly, economic and development-related indicators do not explain wide variations in coverage rates in HICs. Most have well-organised and well-funded public health programmes, exemplified by high levels of completed measles immunisation. Similarly, female secondary school enrolment is universally high, enabling

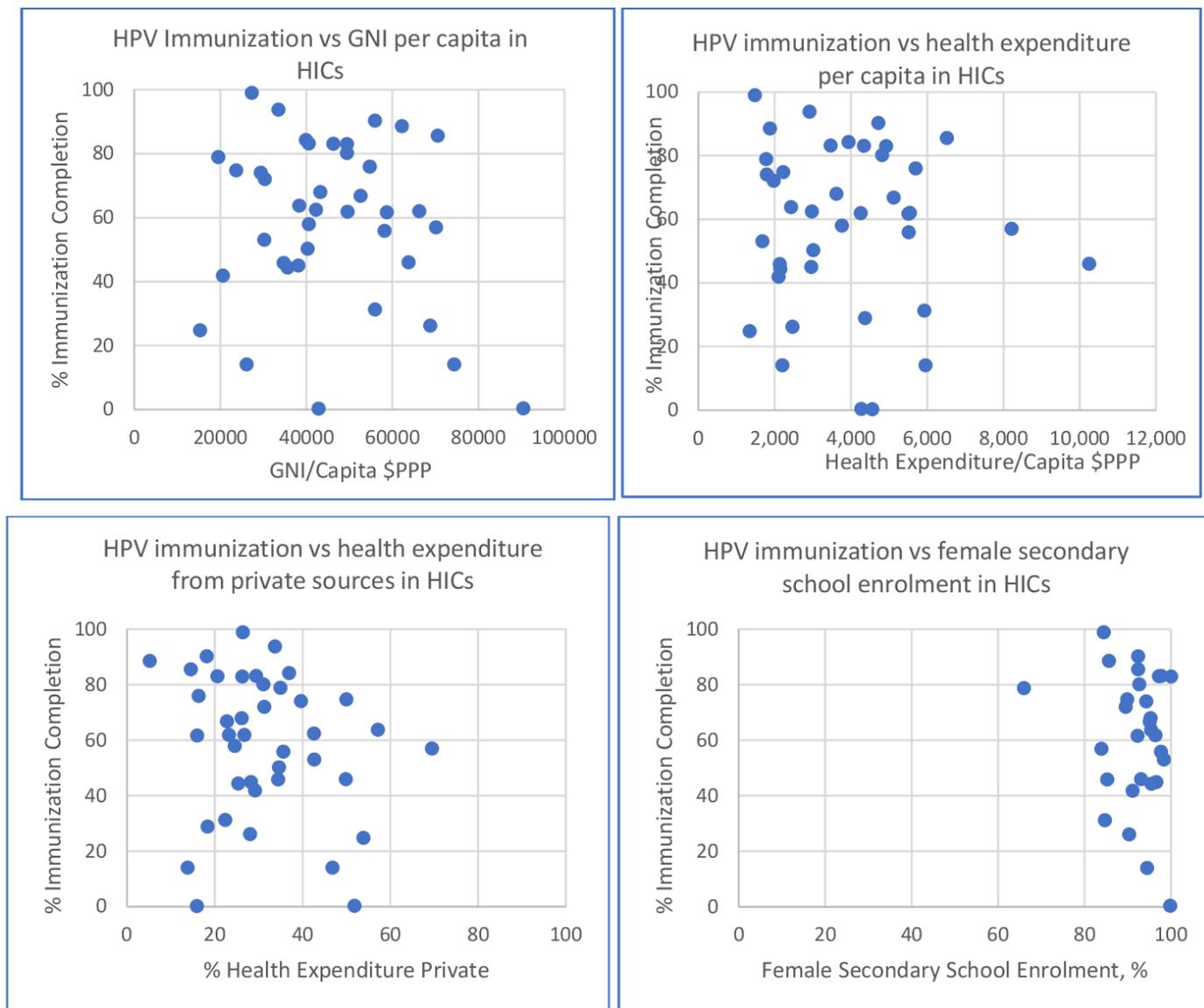


Figure 2 Scatter plots of development indicators against HPV immunisation completion in high-income countries (HICs) in 2018. GNI, gross national income; HPV, human papillomavirus; PPP, purchasing power parity.

organised HPV immunisation. Vaccine hesitancy is a barrier,^{43 44} although information campaigns can be effective to reverse falls in coverage.⁴⁷

Just under half of UMICs reported on HPV immunisation coverage, but few achieved rates above 80%. Most of these countries have organised health systems with excellent performance on childhood immunisation. They also have a high proportion of females enrolled in secondary school. It appears that, for countries in this wealth bracket, a critical factor may be total health expenditure per capita. It is notable that, while most HICs spent over US\$1800/capita at PPP on health in 2018, only 2 of 59 UMICs reached this level and most were well below. While extensive missing data preclude tests for correlation, these findings suggest that, even for these relatively affluent countries, affordability remains a barrier for HPV, but not measles vaccine; it is notable that the cost of one dose of quadrivalent HPV vaccine to UMICs is estimated

at around US\$15 compared with US\$0.69 for one dose of measles vaccine.⁴⁸

Among the 46 countries in the LrMIC group, only half achieve second dose measles vaccine administration above 80%; only 5 countries reported female secondary school enrolment above 80%. It is, therefore, unsurprising that establishment of HPV immunisation does not appear to be a priority in these communities. However, there are two exceptions: Bolivia and Honduras, both with coverage rates of 61%. Development indicators in these countries are mixed: while Honduras does well with second-dose measles, Bolivia does not; the opposite is true of female secondary school enrolment. Both are above the median in their income group for GNI/capita and for health spending per capita, though neither reaches the 90th percentile for either indicator. These indicators do not, therefore, explain the observed outperformance for HPV immunisation rates. Although neither country

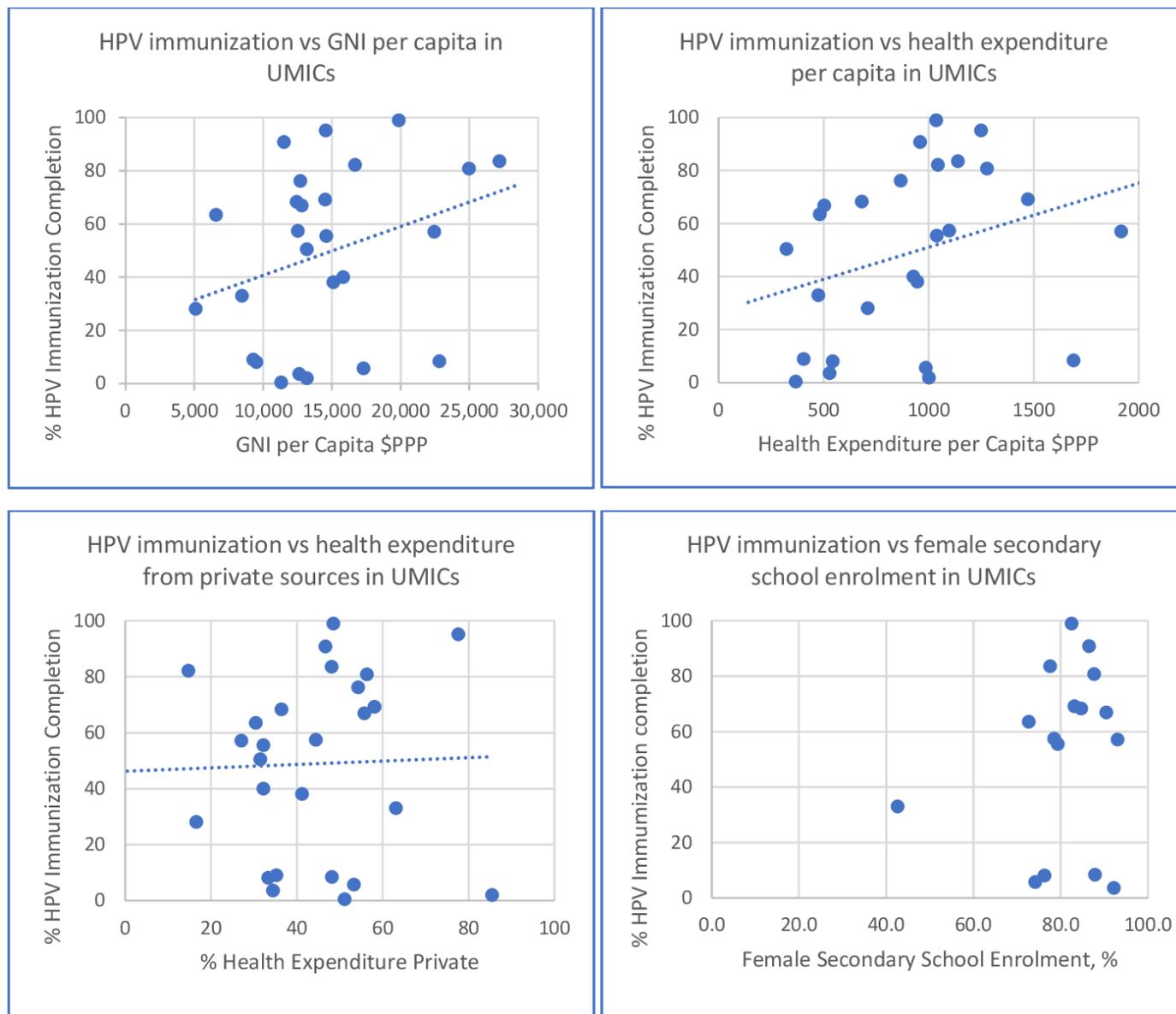


Figure 3 Scatter plots of development indicators against HPV immunisation completion in upper-middle-income countries (UMICs) in 2018. GNI, gross national income; HPV, human papillomavirus; PPP, purchasing power parity.

receives a significant proportion of health funding from external sources (Bolivia 2% and Honduras 5%) they do receive support from GAVI, the Vaccine Alliance for immunisation programmes, in common with a number of other LrMICs.⁴⁹

Low-income nations are defined as those with GNI/capita below US\$1025 per annum (in 2018), reflected in low (or unreported) levels of female secondary school enrolment, low rates of measles second-dose vaccines and high dependence on external sources for health expenditure. Many of these nations are in conflict zones or are recent victims of natural disaster. Limited health budgets allow little for public health measures, such as HPV immunisation programmes. Among LICs, Rwanda and Uganda report high HPV immunisation rates for 2018 (84% and 72%, respectively). Both are close to the median for GNI/capita and health expenditure per capita

but receive high proportions of health spending from external sources. Specifically, both are GAVI supported nations, with funded HPV immunisation programmes.⁴⁹ Both countries have contributed to important lessons in how to structure such programmes, and particularly how to include hard-to-reach out-of-school girls.^{26 50 51}

The global HPV vaccination coverage rate in 2018 is calculated at 12.2%. This is an approximation, based on only 1 year of data, combining different indicators as reported by individual countries. In those countries where vaccination registries are absent, these indicators are often survey based; where countries rely on opportunistic approaches to HPV vaccination, data are estimated. Where indicators are not reported, especially among richer nations, the assumption of no coverage likely underestimates some level of opportunistic vaccination. The estimated global coverage rate depends on a

Table 2 Estimates of numbers of immunised and unimmunised girls among a global cohort aged 15 in 2018, with predictions of lifetime cervical cancer mortality

Income group	Cohort aged 15			HPV immunised %	No immunised	No unimmunised or unknown	Cervical cancer mortality crude rate/100 000 women age 15	Predicted cervical cancer deaths in cohort
	Reporting	Non-reporting	Total					
High	Reporting	5 289 345	51.5	2 723 653		0.55	15	
	Non-reporting	1 131 402	0.0		2 565 692	5.5	141	
	Total	6 420 747	42.4	2 723 653	3 697 094	5.5	62	
Upper middle	Reporting	7 884 611	50.1	3 951 839		0.93	37	
	Non-reporting	11 680 561	0.0		3 932 771	9.3	366	
	Total	19 565 172	20.2	3 951 839	11 680 561	9.3	1086	
Lower middle	Reporting	1 293 279	11.3	146 567		1.29	2	
	Non-reporting	25 271 671	0.0		11 46 713	12.9	148	
	Total	26 564 950	0.6	146 567	25 271 671	12.9	3260	
Low	Reporting	1 533 328	45.1	691 114		2.28	16	
	Non-reporting	7 528 763	0.0		842 214	22.8	192	
	Total	9 062 090	7.6	691 114	7 528 763	22.8	1717	
Total		61 612 959	12.2	7 513 173	54 099 786	11.4	7041	

Countries are shown as reporting or non-reporting on HPV immunisation and grouped by income category. HPV, human papillomavirus.

calculation of cohort size derived from a single year's data for childhood populations in each country.

Despite the limitations of the available data, the estimate of lifetime cervical cancer mortality in a single annual cohort of 15-year-old girls, demonstrates the wide gap between rich nations and all others. In HICs with a collective immunisation coverage rate of only 42%, cervical cancer mortality for this cohort is forecast at 3.4 per 100 000 women. Assuming secondary prevention and treatment approaches remain unchanged from the present, girls in this cohort in UMICs can expect a mortality rate more than twice as high as in HICs; in LrMICs almost four times as high and in LICs more than six times the HIC rate. This calculation assumes that mortality rates in the unimmunised population reflect current mortality rates. This is reasonable as the earliest vaccinated cohorts are only beginning to reach the age at which cervical cancer presents, and therefore, will not yet have reduced observed mortality rates. The calculation assumes HPV vaccination provides protection against 90% of cancers while some of the cohort will have received a vaccine offering 70% protection. On the other hand, partial protection provided by incomplete vaccine courses has been ignored. It is important to note that in HICs, with effective secondary prevention and treatment for cervical cancer, widespread HPV vaccination will save few lives. The primary benefits of immunisation in these settings will be to reduce reliance on invasive screening programmes and to reduce the expense and morbidity of the disease and its treatment.

These data strongly support the proposition that the burden of cervical cancer will continue to be borne by women in poor nations. However, there is cause for optimism. Eradicating cervical cancer is a recent priority initiative of WHO.³² Strategies to support this include ongoing updates to the database recording country-level HPV immunisation coverage. It now includes 107 countries recording vaccine course completion, with evidence of recent programme initiation in others. A July 2020 WHO report³¹ and follow-up study⁵² estimate global HPV immunisation coverage of 15%, slightly above the rate estimated in this study, due mainly to recent introductions of immunisation programmes. A recent agreement with manufacturers is expected to increase supply of vaccine allowing GAVI to reach a broader population of girls in LMICs.⁵³

Countries at all income levels need to maintain high uptake of HPV immunisation. Organised, fully funded, school-based programmes, monitored through centralised registries, offer the most effective strategy. These must be supported by information campaigns to increase awareness of cervical cancer and HPV immunisation, to address vaccine hesitancy and to reach out-of-school girls.

CONCLUSION

Only the richest nations can currently afford routine HPV immunisation. For all others, even though

cost-effectiveness is clear, healthcare budgets and competing priorities limit affordability. Success requires a commitment to universal health coverage and to secondary education for girls, as well as political will and strong leadership. Most importantly, initiatives to address affordability across all LMICs are required. Increased development assistance directed at HPV immunisation, as promised through multilateral organisations with cooperation from vaccine suppliers, will help financially and with technical support. A focus needs to be maintained on these objectives, despite global disruption and competing demands due to the COVID-19 pandemic.

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LITERATURE REVIEW

A literature review was undertaken to identify published country-level data for HPV immunization coverage.

Using the Pubmed search engine (<https://pubmed.ncbi.nlm.nih.gov/>) "Title/Abstract" records were searched for the following terms:

((human papilloma virus OR HPV) AND (vaccination OR immunization) AND (uptake OR coverage)).

The search yielded 1,607 results; these were limited to publication years 2015 to 2020, yielding 944 results. These were hand searched to identify studies measuring HPV immunization coverage representative of national cohorts, excluding studies evaluating narrower groups (eg ethnic) or recruiting from otherwise selective populations (eg from obstetric clinics). Where males and females were included, but reported separately, coverage rates for females were extracted. Thirty studies were identified, listed in the table below. For each study, country and year of data is identified, together with cohort age and sample size. Where immunization coverage is differentiated between first dose and course completion, this is also recorded.

Three types of data were reported: a) from registries based on social insurance, health records or school enrolment, b) surveys, and c) reimbursement records. Surveys are helpful where population based registries do not exist; these are most developed in the United States. Other surveys mostly have small sample sizes, limiting generalizability.

This literature review confirms that there is little published data on HPV immunization coverage outside high income countries, and even in these countries, coverage rates vary widely.

First author, year	Country	Year of Data	Data Source	Sex	n	Cohort Age	Coverage %	
							1st dose	Complete
Bonanni 2015(1)	Italy	2014	Registry	Female	..	11	..	71
Borena 2016(2)	Austria	2014	Survey	Female	254	10	59	..
Braeye 2020(3)	Italy	2018	Registry	Female	2,011,666	15	76	..
	Spain						77-87	..
	UK						60	..
	Denmark						88	..
Buscaill 2016(4)	France	2015	Survey	Female	209	16-18	..	30
Corriero 2017(5)	USA	2014	Survey	Female	2,147	9-33	..	67
Danial 2016(6)	Malaysia	2015	Survey	Female	337	Over 18	..	9
Ding 2019(7)	USA	2017	Survey	All	3,426	18-26	32-38	17-19
Dorji 2015(8)	Bhutan	2014	Registry	Female	7,575	12	98	94
Fonteneau 2015(9)	France	2014	Reimbursement	Female		16	..	19
Garon 2019(10)	Cambodia	2017	Survey	Female	315	9	..	84
Hansen 2020(11)	Denmark	2029	Registry	Female		12-15	50-95	..
Latsuzbaia 2018(12)	Luxemburg	2016	Reimbursement	Female	39,610	13-25	62	56
Lewis 2018(13)	USA	2016	Survey	Female	2,800	9-13	22	9
						14-19	55	33
						20-24	56	33
						25-29	37	28
						30-34	17	12
						35-39	6	3
40-59	2	0						
Lin 2017(14)	USA	2016	Registry	All	1,438,161	9-13	..	53
Martin-Merino 2019(15)	Spain	2016	Registry	Female	388,690	9-18	38	..
Muhamad 2018(16)	Malaysia	2016	Registry	Female	224,761	12-13	..	100
Quendri 2018(17)	Netherlands	2016	Registry	Female		12-13	..	46
Reagan-Steiner 2016(18)	USA	2015	Survey	Female		13-17	63	..
Reagan-Steiner 2015(19)	USA	2014	Survey	Female		13-17	60	..
Riesen 2018(20)	Switzerland	2016	Survey	Female	3,108	14-16	61	..
Skufca 2018(21)	Finland	2016	Registry	Female	240,605	11-15	56	..
Smith 2019(22)	Canada	2017	Registry	Female		..	..	55-92
Suppli 2018(23)	Denmark	2016	Registry	Female	243,415	16-18	92	79
						15	87	71
						14	81	53
						13	53	29
						12	42	15
Thompson 2019(24)	USA	2016	Survey	Female	1,879	18-26	46	..
Walker 2017(25)	USA	2016	Survey	All	20,475	13-17	60	..
Walker 2018(26)	USA	2017	Survey	All	20,949	13-17	66	..
Walker 2019(27)	USA	2018	Survey	All	18,700	13-17	68	..
Wang 2019(28)	Sweden	2014	Registry	Female	689,676	11-24	66-89	..
Williams 2017(29)	USA	2015	Survey	All	1,806	19-26	42	..
Wymann 2018(30)	Switzerland	2014	Survey	Female	2,363	18-24	51	41

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Source of underlying HPV vaccination coverage data

Data was extracted from the WHO/Unicef database “WHO estimates of Human papillomavirus immunization coverage 2010-2018, Version Date 12/07/2019” accessed and downloaded on 20 January 2020 from:

<https://data.unicef.org/resources/dataset/immunization/>.

This dataset may have been updated after this download date. For reference, a copy of the downloaded dataset is provided in the attached excel file. Attention is drawn to the “READ ME” tab which provides notes on methodology and data sources. All copyright and ownership rights of this excel file and the data it contains belong to WHO/Unicef. The authors of this study make no claims or representations regarding this file or the data contained therein.



HPV_estimates
Unicef_WHO 2019.xls

COUNTRY LEVEL DATA TABLES BY INCOME GROUP

	Female popul'n ³⁶	Cohort age 15	HPV immuniz'n complet'n ⁴⁰	1st dose measles vacc ³⁹	2nd dose measles vacc ³⁹	GNI per cap PPP ³⁶	Health exp per cap ³⁶	Health exp per cap PPP ³⁶	Health expenditure ³⁶			Female 2ary school enrolme nt ³⁷	Cervical cancer ASI Rate ³⁴	Cervical cancer ASM Rate ³⁴
	2018 (000s)	2018	2018 %	2018 %	2018 %	2018 \$	2017 \$	2017 \$	2017 % Gov % Ext % Priv			2017 %	2018 /100,000 females	
Andorra	..	..	..	99	95	..	4,041	5,237	49.0	0.0	51.0	..	..	..
Antigua and Barbuda	50	684	..	96	95	20,510	674	1,071	47.0	0.0	52.9	86.6	..	..
Australia	12,541	153,892	80.2	95	93	49,440	5,332	4,816	68.9	0.0	31.1	92.7	6	1.7
Austria	4,494	40,354	..	94	84	56,720	4,940	5,617	72.4	0.0	27.6	87.1	5.5	1.7
Bahamas	198	3,018	..	89	69	34,340	1,772	1,756	43.9	0.6	55.5	66.4	10.9	7.9
Bahrain	570	9,441	..	99	99	44,720	1,127	2,265	58.0	0.0	42.0	94.4	3.8	2.7
Barbados	148	1,697	24.8	85	74	15,320	1,184	1,343	44.2	2.0	53.8	..	15.5	9.4
Belgium	5,781	63,952	66.8	96	85	52,620	4,507	5,119	77.2	0.0	22.8	95.1	7.8	2
Brunei Darussalam	206	3,132	88.6	99	98	62,200	671	1,875	94.8	0.0	5.2	85.6	20.6	6.1
Canada	18,674	191,726	83.0	90	87	49,430	4,755	4,929	73.7	0.0	26.3	100.0	5.7	1.7
Chile	9,501	122,560	74.8	93	93	23,700	1,382	2,229	50.1	0.0	49.9	89.9	12.2	5
Cook Islands	..	..	99.0	99	99	..	..	..	..	..	..	..	..	..
Croatia	2,120	19,819	..	93	95	27,630	902	1,772	82.8	0.0	17.2	94.1	7.9	3.7
Cyprus	594	6,496	63.8	90	88	38,340	1,732	2,430	42.4	0.4	57.2	95.4	5.7	1.5
Czechia	5,401	54,210	..	96	84	38,180	1,476	2,753	81.7	0.0	18.3	91.5	9.9	4
Denmark	2,913	32,003	61.7	95	90	58,700	5,800	5,510	84.0	0.0	16.0	92.3	10.9	2
Estonia	699	7,198	44.4	87	88	35,680	1,300	2,153	74.7	0.0	25.3	95.5	22.5	4.3
Finland	2,798	29,905	61.9	96	93	49,550	4,206	4,255	76.7	0.0	23.3	96.4	4.7	0.94
France	34,544	399,365	..	90	80	47,500	4,380	5,011	77.1	0.0	22.9	95.3	6.7	2.3
Germany	42,000	358,848	31.3	97	93	55,980	5,033	5,923	77.7	0.0	22.3	84.7	7.5	2.2
Greece	5,465	52,097	..	97	83	30,190	1,517	2,295	60.2	0.2	39.6	92.6	8.1	2.1
Hungary	5,126	46,622	72.1	99	99	30,310	981	1,979	68.7	0.0	31.3	89.5	17.2	5.1
Iceland	176	2,333	90.3	93	95	55,920	6,086	4,721	81.8	0.0	18.2	92.4	7.6	1.3
Ireland	2,454	34,713	62.0	92	..	66,250	4,977	5,545	73.3	0.0	26.7	..	11	2.9
Israel	4,468	77,029	50.3	98	96	40,280	3,145	3,015	63.6	1.8	34.6	..	4.8	2.1
Italy	31,043	272,574	68.0	93	89	43,280	2,840	3,620	73.9	0.0	26.1	95.3	7.1	1.5
Japan	64,731	537,109	0.3	97	93	42,840	4,169	4,563	84.1	0.0	15.9	..	14.7	2.7
Korea, Republic of	25,760	223,405	62.5	98	97	42,250	2,283	2,980	57.4	0.0	42.6	..	3.3	2.2
Kuwait	1,636	26,949	..	99	99	59,720	1,529	3,797	87.4	0.0	12.6	94.9	25	6.5
Latvia	1,041	9,780	53.1	98	94	30,220	930	1,682	57.1	0.2	42.7	98.4	18.9	7.2
Lithuania	1,507	13,048	45.9	92	92	34,680	1,078	2,133	65.5	0.2	34.4	85.2	5.6	2
Luxembourg	301	3,105	14.1	99	90	74,400	5,783	5,956	84.9	1.4	13.8	94.5	3.5	1.4
Malta	242	2,188	84.3	96	95	39,900	2,586	3,943	63.1	0.0	36.9	..	..	..
Monaco	..	..	..	87	79	..	2,932	2,991	79.7	0.0	20.3	93.7	5.7	1.4
Netherlands	8,654	92,085	55.9	93	89	58,140	4,911	5,513	64.4	0.0	35.6	97.7	6	1.8
New Zealand	2,461	31,326	58.0	92	90	40,550	3,937	3,768	75.5	0.0	24.5	..	..	..
Niue	..	..	..	99	..	..	..	..	..	..	..	95.6	10.7	1.7
Norway	2,631	30,828	85.6	96	93	70,530	7,936	6,519	85.5	0.0	14.5	92.4	6.3	3.9
Oman	1,643	30,869	..	99	99	27,320	588	1,591	87.7	0.0	12.3	..	..	..
Palau	..	..	78.9	90	75	19,500	1,596	1,778	50.6	14.4	35.0	65.9	18.4	8.8
Panama	2,084	36,227	74.1	98	99	29,380	1,112	1,795	59.9	0.5	39.6	94.2	9.4	4.9
Poland	19,569	188,585	..	93	92	30,520	907	1,958	69.0	0.0	31.0	95.3	8.9	2.8
Portugal	5,421	47,371	93.8	99	96	33,490	1,908	2,917	66.3	0.0	33.7	..	4	3.2
Qatar	681	11,874	..	99	95	94,840	1,649	3,354	80.7	0.0	19.3	97.8	8.4	2
Saint Kitts and Nevis	..	..	..	96	96	25,040	903	1,442	46.6	0.0	53.4	..	..	..
San Marino	..	..	28.9	89	84	..	3,362	4,370	81.6	0.0	18.4	..	..	..
Saudi Arabia	14,304	266,827	..	98	97	49,160	1,093	2,826	64.1	0.0	35.9	89.0	2.5	1.5
Seychelles	47	724	99.0	96	97	27,310	792	1,485	73.0	0.6	26.4	84.4	..	..
Singapore	2,687	22,538	0.4	95	84	90,450	2,619	4,270	48.2	0.0	51.8	99.8	7.7	3.8
Slovakia	2,796	27,311	..	96	97	32,050	1,186	2,184	79.1	0.0	20.9	85.3	16.6	5.7
Slovenia	1,042	10,061	45.0	93	94	38,140	1,920	2,961	71.8	0.0	28.2	96.6	7.1	2.8
Spain	23,818	233,902	83.2	97	94	40,570	2,506	3,469	70.6	0.0	29.4	97.8	5.2	1.7
Sweden	5,082	57,654	76.0	97	95	54,740	5,905	5,700	83.7	0.0	16.3	..	9	2
Switzerland	4,294	40,217	57.0	96	89	70,130	9,956	8,217	30.5	0.0	69.5	83.9	3.8	1.1
Trinidad and Tobago	703	9,438	14.1	90	92	26,140	1,124	2,206	53.2	0.0	46.8	..	15.2	9.4
United Arab Emirates	2,951	44,921	26.2	99	99	68,780	1,357	2,469	72.0	0.0	28.0	90.3	6.4	4.4
United Kingdom	33,652	381,616	83.1	92	88	46,240	3,859	4,338	79.4	0.0	20.6	97.2	8.4	1.7
United States	165,043	2,034,087	46.0	92	94	63,780	10,246	10,246	50.2	0.0	49.8	93.0	6.5	1.9
Uruguay	1,784	23,034	41.9	97	91	20,570	1,592	2,102	70.8	0.0	29.2	91.1	12.4	6

Table A: Demographic and cancer data, immunization rates and selected development indicators for high income countries, 2018 (or latest available).

	Female population ³⁶	Cohort age 15	HPV immuniz'n complet'n ⁴⁰	1st dose measles vacc ³⁹	2nd dose measles vacc ³⁹	GNI per cap PPP ³⁶	Health exp per cap ³⁵	Health exp per cap PPP ³⁶	Health expenditure ³⁶			Female 2ary school enrolment ³⁷	Cervical cancer ASI Rate ³⁴	Cervical cancer ASM Rate ³⁴
	2018	2018	2018	2018	2018	2018	2018	2017	% Gov	% Ext	% Priv	2017	2018	
	(000s)		%	%	%	\$	\$	\$				%	/100,000 females	
Albania	1,406	15,579	..	94	96	13,820	..	..	..	..	..	88.5	6.5	2.3
Algeria	20,896	380,336	..	80	77	11,450	258	975	65.95	0.02	34.02	..	8.1	5.5
Argentina	22,798	355,960	57.1	94	89	22,450	1,325	1,917	72.43	0.50	27.07	93.1	16.7	7.7
Armenia	1,563	18,561	2.0	95	96	13,180	408	1,001	13.24	1.29	85.47	..	8.4	5.6
Azerbaijan	4,981	67,244	..	96	96	13,790	276	1,164	15.11	0.38	84.51	..	6.5	4.6
Belarus	5,070	50,104	..	97	98	18,640	342	1,129	69.96	0.37	29.67	96.9	13.3	3.8
Belize	192	3,766	63.5	97	91	6,580	280	481	67.98	1.58	30.45	72.7	28	16.2
BosniaHerzegovina	1,696	17,027	..	68	76	14,890	460	1,172	70.49	0.00	29.51	..	23.9	4.7
Botswana	1,166	24,513	82.2	97	74	16,680	466	1,044	75.66	9.61	14.73	..	31.6	16.9
Brazil	106,473	1,468,840	69.2	84	69	14,520	929	1,472	41.88	0.07	58.05	83.2	12.2	5.8
Bulgaria	3,612	34,650	8.4	93	87	22,810	664	1,690	51.86	0.00	48.14	87.9	20.3	7.4
China	677,972	7,635,186	..	99	99	15,550	441	841	56.67	0.00	43.33	..	10.7	4.4
Colombia	25,284	377,432	55.5	95	88	14,590	459	1,039	67.80	0.00	32.20	79.3	12.7	5.7
Costa Rica	2,500	34,760	..	94	93	18,790	869	1,262	73.51	0.05	26.44	83.9	11.2	5.6
Cuba	5,707	59,693	..	99	99	..	988	2,486	89.44	0.08	10.48	86.4	14.6	6
Dominica	..	..	..	84	81	11,830	440	657	64.96	3.20	31.83	..	..	..
Dominican Repub	5,314	96,103	5.7	95	31	17,310	433	986	46.00	0.74	53.26	74.2	17.1	9.9
Ecuador	8,537	153,178	90.8	83	74	11,520	518	959	52.82	0.54	46.64	86.5	17.8	9
Equatorial Guinea	582	14,432	..	30	..	15,740	301	759	18.83	1.99	79.18	..	26.9	16.7
Fiji	436	8,279	50.5	94	94	13,170	188	323	66.23	2.33	31.44	..	25.9	19.7
Gabon	1,040	23,340	..	59	..	14,100	204	500	63.29	0.61	36.11	..	20	13.4
Georgia	1,949	22,649	..	98	96	14,030	293	773	37.21	2.38	60.40	95.1	9.8	5.5
Grenada	55	835	..	84	74	15,560	497	721	42.70	0.94	56.36	82.8	..	..
Guatemala	8,298	180,044	33.0	87	76	8,470	260	475	35.84	1.08	63.07	42.6	21.1	11.7
Guyana	388	7,063	9.0	98	84	9,290	231	405	59.89	4.90	35.21	..	32.7	17.3
Indonesia	132,879	2,266,926	0.5	75	67	11,310	115	368	48.37	0.53	51.10	..	23.4	13.9
Iran	40,441	611,553	..	99	98	..	475	1,748	51.25	0.02	48.73	80.4	2.2	1.2
Iraq	18,990	453,033	..	83	81	10,830	210	..	41.86	0.08	58.06	..	1.9	1.3
Jamaica	1,477	22,612	8.1	89	82	9,510	307	543	64.70	1.97	33.33	76.3	28.4	20.1
Jordan	4,917	113,069	..	92	96	10,040	341	757	44.80	9.30	45.90	62.8	2.9	1.8
Kazakhstan	9,414	157,330	..	99	98	22,930	381	820	62.08	0.15	37.77	..	15.7	7.5
Lebanon	3,404	55,914	..	82	63	15,890	719	1,185	50.02	0.97	49.01	..	5.7	3.6
Libya	3,305	60,671	..	97	96	15,640	..	..	..	..	..	..	11.5	4.9
Malaysia	15,316	240,408	83.6	96	99	27,180	384	1,139	50.59	0.02	48.12	77.6	10.5	6
Maldives	192	3,225	..	99	99	17,190	1,007	1,507	71.46	0.08	28.46	..	23.2	13.4
Marshall Islands	..	..	28.1	83	61	5,090	642	710	37.82	45.64	16.55	..	..	..
Mauritius	640	7,811	80.8	99	99	24,970	600	1,278	42.87	0.83	56.30	87.7	12.4	5.4
Mexico	64,470	1,093,140	99.0	97	99	19,870	495	1,036	51.51	0.00	48.49	82.5	11	5.8
Montenegro	315	3,671	..	58	83	21,480	..	..	..	..	..	90.0	12.5	4.2
Namibia	1,262	28,439	..	82	50	9,850	447	895	46.14	4.01	49.85	..	24.2	14.7
Nauru	..	..	..	99	94	15,770	1,107	1,310	71.95	23.45	4.60	..	..	..
North Macedonia	1,041	11,022	40.0	83	97	15,820	328	927	67.35	0.42	32.22	..	10	3.5
Paraguay	3,419	66,183	76.2	93	83	12,710	381	867	45.47	0.28	54.25	..	31.5	16
Peru	16,103	274,057	68.3	85	66	12,440	333	681	63.35	0.24	36.41	84.7	23.2	10.2
Romania	9,998	101,823	..	90	81	28,680	555	1,368	78.59	0.00	21.41	83.3	19.5	8.9
Russian Federation	77,529	802,065	..	98	97	28,040	586	1,404	57.09	0.00	42.91	91.0	17	6.2
Saint Lucia	92	1,118	..	86	68	14,680	460	662	48.95	0.23	50.82	81.9	13	10
St Vincent Gren	54	831	3.6	99	99	12,630	321	528	64.34	1.23	34.43	92.2	..	..
Samoa	95	2,272	..	31	13	6,240	233	364	74.55	13.06	12.40	..	12.6	7.5
Serbia	3,561	36,717	..	92	90	16,670	529	1,382	56.71	0.16	43.13	92.9	20.3	7
South Africa	29,291	543,125	57.4	70	50	12,520	499	1,098	53.65	1.96	44.39	78.5	43.5	19.2
Sri Lanka	11,261	174,757	66.9	99	99	12,810	159	504	42.95	1.34	55.71	90.4	7.8	4.2
Suriname	286	4,991	38.1	98	39	15,100	339	946	58.56	0.25	41.19	..	26.8	14.3
Thailand	35,595	395,809	..	96	87	17,620	247	671	76.13	0.23	23.64	..	16.2	9
Tonga	52	1,152	..	85	85	6,510	222	335	58.34	27.40	14.26	..	..	..
Turkey	41,718	661,541	..	96	87	27,700	445	1,181	77.71	0.00	22.29	86.0	4.8	2.5
Turkmenistan	2,970	54,553	95.2	99	99	14,560	456	1,250	22.29	0.10	77.61	..	13.6	8.8
Tuvalu	..	..	..	88	81	6,090	622	694	72.64	26.84	0.52	..	..	..
Venezuela	14,618	265,782	..	74	39	..	94	141	15.94	0.02	84.04	76.8	23.7	10.9

Table B: Demographic and cancer data, immunization rates and selected development indicators for upper middle income countries, 2018 (or latest available).

	Female population ³⁶	Cohort age 15	HPV immuniz'n complet'n ⁴⁰	1st dose measles vacc ³⁹	2nd dose measles Vacc ³⁹	GNI per cap PPP ³⁶	Health exp per cap ³⁸	Health exp per cap PPP ³⁸	Health expenditure ³⁶			Female 2ary school enrolment ³⁷	Cervical cancer ASI Rate ³⁴	Cervical cancer ASM Rate ³⁴
	2018	2018	2018	2018	2018	2018	2017	2017	% Gov	2017 % Ext	% Priv	2017	2018	
	(000s)		%	%	%	\$	\$	\$				%	/100,000 females	
Angola	15,568	440,299	..	50	35	6,550	114	186	46.3	3.1	50.6	..	36.1	26.2
Bangladesh	79,689	1,473,991	..	97	93	4,750	36	94	16.7	6.8	76.6	68.9	10.6	7.1
Bhutan	355	6,455	89.6	97	91	10,570	97	290	74.5	11.2	14.3	72.8	14.4	10.2
Bolivia	5,652	114,054	60.9	89	38	8,650	220	492	68.5	2.3	29.2	76.6	38.5	19
Cabo Verde	271	5,101	..	99	88	6,860	168	357	60.2	8.3	31.5	75.4	20.5	11.1
Cambodia	8,320	160,900	..	84	70	3,970	82	238	23.8	15.1	61.1	..	13.5	10.1
Cameroon	12,609	329,072	..	71	..	3,610	68	174	13.3	7.7	79.0	..	31.3	21.9
Comoros	412	10,145	..	90	..	3,160	59	123	12.7	11.1	76.1	44.8	50.9	39.8
Congo	2,626	68,485	..	75	..	3,090	50	165	40.7	7.5	51.7	..	17.5	12.1
Cote d'Ivoire	12,414	321,657	..	71	..	4,980	70	176	28.5	13.1	58.5	32.4	28.6	24.1
Djibouti	454	8,332	..	86	81	5,520	70	117	47.0	25.8	27.2	..	13.3	10.6
Egypt	48,690	982,027	..	94	94	11,340	106	614	33.0	0.3	66.7	81.9	2.3	1.5
El Salvador	3,410	56,918	..	81	85	8,320	282	583	63.7	0.1	36.1	60.8	18.5	9.4
Eswatini	581	14,342	..	89	75	8,070	225	600	50.7	23.7	25.5	..	75.3	52.5
Ghana	14,683	344,859	..	92	83	5,210	67	147	33.5	14.5	52.0	55.8	32.9	23
Honduras	4,798	99,691	60.6	89	94	5,350	196	395	40.1	5.4	54.5	46.7	19.6	12.5
India	649,575	11,800,615	..	90	80	6,580	69	253	27.1	0.8	72.1	..	14.7	9.2
Kenya	25,859	663,816	..	89	45	4,230	77	158	42.7	17.9	39.4	..	33.8	22.8
Kiribati	59	1,290	..	84	79	4,270	171	235	75.8	21.1	3.1	..	..	..
Kyrgyzstan	3,195	61,325	..	96	96	5,090	79	241	38.0	5.6	56.4	82.9	19.9	10.9
Lao PDR	3,516	74,049	..	69	57	7,410	62	178	35.1	16.7	48.2	59.3	11.4	7
Lesotho	1,069	21,829	..	90	82	3,200	105	266	62.9	20.4	16.6	..	52.1	39.1
Mauritania	2,194	53,787	..	78	..	5,130	49	170	38.8	7.0	54.2	28.5	32.9	24.8
Micronesia	55	1,153	60.0	73	48	3,640	425	493	25.8	71.5	2.7	..	..	..
Moldova	1,408	13,991	..	93	96	13,280	191	477	50.6	4.7	44.7	77.8	21.4	7.9
Mongolia	1,606	28,800	..	99	98	10,950	149	518	61.7	2.8	35.5	..	23.5	10.2
Morocco	18,160	309,538	..	99	99	7,450	161	438	42.9	0.2	56.9	63.2	17.2	12.6
Myanmar	27,825	478,530	..	93	87	4,970	58	288	14.8	9.0	76.2	62.0	21.5	13.1
Nicaragua	3,279	62,435	..	99	99	5,690	192	506	58.1	7.5	34.4	..	21.2	13.3
Nigeria	96,637	2,567,498	..	65	95	5,030	74	221	14.2	7.9	77.9	..	27.2	20
Pakistan	103,005	2,277,359	..	76	67	5,110	45	161	31.6	1.7	66.7	31.6	7.3	5.2
Palestine	2,252	55,254	..	99	99	6,740	..	..	..	..	..	91.2	2.5	1.9
Papua New Guinea	4,214	96,227	..	61	..	4,220	61	104	75.4	15.6	9.0	..	29.1	19.8
Philippines	53,050	1,069,052	0.7	67	40	9,650	133	372	31.9	2.6	65.5	..	14.9	8.8
S Tome Principe	105	2,874	95.2	95	76	4,060	120	209	45.6	38.9	15.5	..	20.1	12.4
Senegal	8,130	209,489	..	82	63	3,310	55	143	21.0	16.7	62.3	39.4	37.8	29.1
Solomon Islands	321	7,822	..	93	54	2,320	101	115	71.2	23.4	5.4	..	22.6	16
Sudan	20,921	529,326	..	88	72	3,950	194	314	18.0	5.4	76.6	..	8.2	6
Timor-Leste	627	15,181	..	77	54	4,520	83	264	66.0	22.4	11.6	64.7	12.5	6.2
Tunisia	5,833	84,803	..	96	99	10,640	251	863	57.1	0.4	42.4	..	4	2.8
Ukraine	23,957	231,926	..	91	90	12,950	177	585	44.0	1.7	54.3	..	17	6.6
Uzbekistan	16,523	291,611	..	96	99	7,120	99	448	43.3	2.6	54.1	90.4	9.9	5.4
Vanuatu	144	3,520	..	75	..	3,230	106	110	61.5	26.2	12.3	..	17	10.6
Viet Nam	47,862	677,937	..	97	90	7,220	130	376	48.6	2.0	49.4	..	7.1	4
Zambia	8,761	243,030	..	94	65	3,550	68	180	38.6	42.6	18.8	..	66.4	44.5
Zimbabwe	7,560	194,557	..	88	78	2,990	110	201	51.6	14.7	33.7	..	62.3	46

Table C: Demographic and cancer data, immunization rates and selected development indicators for lower middle income countries, 2018 (or latest available).

	Female populat ⁿ ³⁶	Cohort age 15	HPV immuniz ⁿ complet ⁿ ⁴⁰	1st dose measles vacc ⁿ ³⁹	2nd dose measles vacc ⁿ ³⁹	GNI per cap PPP ³⁶	Health exp per cap ³⁶	Health exp per cap PPP ³⁶	Health expenditure ³⁶			Female 2ary school enrolment ⁵⁷	Cervical cancer ASI Rate ³⁴	Cervical cancer ASM Rate ³⁴
	2018	2018	2018	2018	2018	2018	2017	2017	% Gov	2017 % Ext	% Priv	2017	2018	
	(000s)		%	%	%	\$	\$	\$				%	/100,000 females	
Afghanistan	18,079	507,456	..	64	39	2,260	67	..	5.1	19.4	75.5	35.1	6.6	5.3
Benin	5,754	147,823	..	71	..	3,200	31	85	30.0	19.3	50.7	..	23.7	20.2
Burkina Faso	9,895	268,866	..	88	71	2,120	44	129	43.3	18.0	38.7	29.3	45.1	39.4
Burundi	5,635	152,476	..	88	77	780	24	59	24.7	31.0	44.2	31.4	57.4	50.3
Central Africa	2,354	66,162	..	49	..	1,030	24	42	12.8	55.2	32.0	9.7	19.2	17.5
Chad	7,752	220,189	..	37	..	1,590	30	87	15.8	21.1	63.1	..	19.3	16.9
Congo, DR	42,116	1,154,768	..	80	..	1,080	19	37	9.9	42.5	47.6	..	24.8	21.1
Eritrea	..	..	..	99	88	..	33	59	27.2	13.6	59.1	39.0	13.8	11.9
Ethiopia	54,589	1,385,827	..	61	..	2,140	25	67	24.9	22.1	52.9	..	18.9	15.3
Gambia	1,149	30,353	..	91	71	2,160	23	56	22.9	42.0	35.1	..	29	23.1
Guinea	6,433	168,175	..	48	..	2,410	34	89	17.2	13.9	68.9	..	45.5	39.7
Guinea-Bissau	959	24,440	..	86	..	1,990	52	123	8.2	16.0	75.8	..	32.7	28.3
Haiti	5,634	118,767	..	69	38	1,820	62	146	11.9	43.1	45.1	..	17.1	12.5
Korea, DPR	13,054	166,845	..	98	99	..	..	..	..	..	..	..	11.1	3.6
Liberia	2,398	61,344	..	91	..	1,330	57	105	17.2	28.8	54.0	..	37.2	32.1
Madagascar	13,164	332,815	..	62	..	1,600	25	85	46.9	23.0	30.1	30.3	51.6	37.4
Malawi	9,199	253,301	..	87	72	1,040	32	115	30.6	52.4	16.9	..	72.9	54.5
Mali	9,528	272,130	..	70	..	2,270	31	84	34.9	28.0	37.1	26.1	43.9	36.2
Mozambique	15,183	407,927	..	85	59	1,290	21	62	29.9	61.2	9.0	..	42.8	35.7
Nepal	15,318	289,770	..	91	69	3,350	48	150	22.3	15.3	62.4	58.6	21.5	14.3
Niger	11,170	323,676	..	77	48	1,210	29	79	33.4	16.5	50.1	17.1	9.6	8.8
Rwanda	6,257	155,107	84.1	99	96	2,070	49	134	34.3	50.4	15.3	..	31.9	24.1
Sierra Leone	3,834	99,154	..	80	55	1,580	66	205	13.7	18.7	67.6	38.1	13.8	12
Somalia	7,524	211,907	..	46	..	..	..	..	..	..	..	..	24	21.9
South Sudan	5,483	141,176	..	51	..	..	23	176	8.4	68.1	23.4	..	26.9	22.9
Syrian Arab Rep	8,422	171,488	..	63	54	..	..	..	..	..	..	..	3.5	2.7
Tajikistan	4,513	97,889	..	98	97	3,850	58	231	29.0	7.7	63.3	..	5.7	3.2
Tanzania	28,188	762,320	15.7	99	84	2,570	34	104	43.2	31.8	24.9	25.0	59.1	42.7
Togo	3,966	102,189	..	85	..	1,590	38	104	17.7	13.7	68.6	33.5	23.8	18.7
Uganda	21,693	615,900	71.6	86	..	2,110	38	121	15.7	42.5	41.3	..	54.8	40.5
Yemen	14,139	351,851	..	64	46	..	..	..	..	..	..	..	1.9	1.4

Table D: Demographic and cancer data, immunization rates and selected development indicators for low income countries, 2018 (or latest available).