REVIEW 10.1111/j.1469-0691.2012.03982.x

Measles still spreads in Europe: who is responsible for the failure to vaccinate?

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Abstract

All countries in the European Region of the World Health Organization (WHO) have renewed their commitment to eliminate measles transmission by 2015. Measles elimination is a feasible target but requires vaccination coverage above 95% with two doses of a measles-mumps-rubella vaccine (MMR) in all population groups and in all geographical areas. Measles has re-emerged in the EU recently, due to suboptimal immunization levels that led to accumulation of susceptible populations over the last years. In fact, while an overall decreasing trend had been observed until 2009, the number of cases increased by a factor of four between2010 and 2011. According to vaccination coverage data reported to the WHO, between 2000 and 2010, almost 5 million individuals in the EU in the age group 2–12 had not had MMR vaccination. Catch-up vaccination activities for susceptible populations are paramount in order to reach the elimination goal, but only feasible if a multi-component approach is put in place quickly and efficiently. Advocacy and communication are key strategic areas.

Keywords: Elimination, immunization, measles, public health, vaccination
Original Submission: 4 April 2012; **Revised Submission:** 24 June 2012; **Accepted:** 26 June 2012
Editor: M. Paul

Clin Microbiol Infect 2012; **18** (Suppl. 5): 50–56

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Epidemiology of measles in Europe

All countries in the European Region of the World Health Organization (WHO), which includes EU and EEA/EFTA countries, have renewed their commitment to eliminate measles transmission by 2015 [1]. The incidence of measles in Europe had decreased dramatically since 1998, thanks largely to good vaccination coverage achieved through the routine immunization and two-dose vaccination policies of most European countries [2]. Despite some large outbreaks in several member states, this overall decreasing trend was observed until 2010, [3–9] (Fig. 1). In 2011, 30 567 cases of measles were reported by the 29 contributing EU and EEA/EFTA countries [9]. This is similar to the number of cases in 2010 (30 264 cases) and constitutes a four-fold increase compared with 2009 (7175 cases) and 2008 (7817).

The dramatic increase in 2010 was primarily due to a large outbreak in Bulgaria that started at the end of 2009 and exploded in 2010, with more than 24 000 reported cases and 24 deaths. The cases were mainly infants, children and young adults. The majority of cases (~ 90%) were part of the Bulgarian Roma community and almost all cases (95%) had not received the full course of measles, mumps and rubella (MMR) vaccination [10,11].

In 2011, France reported more than half of all reported cases, with nearly 15 000 cases and six deaths. Sixteen patients developed neurological complications and 650 suffered severe respiratory complications. A sharp decrease in the number of reported cases began in May 2011 [9].

Together with France, four countries (Italy, Romania, Spain and Germany) accounted for more than 90% of all measles cases reported in 2011 [9].

Age-specific incidence of measles

According to the ECDC Annual Epidemiological Report, in each year from 2005 to 2009 the most affected age groups in the EU and EEA/EFTA countries were 0–4 year olds followed by 5–14 year olds [2,12–15]. More detailed data

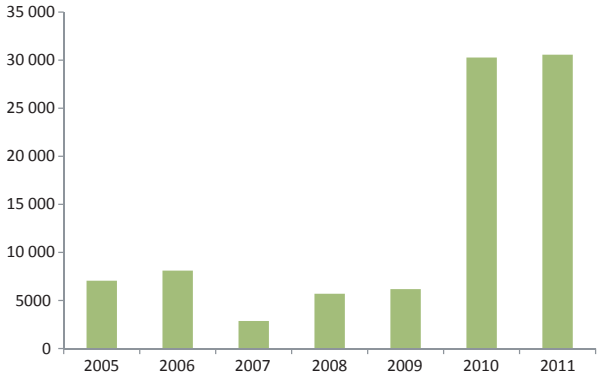

FIG. 1. Reported measles cases in the EU and Norway from 2005 to 2011.

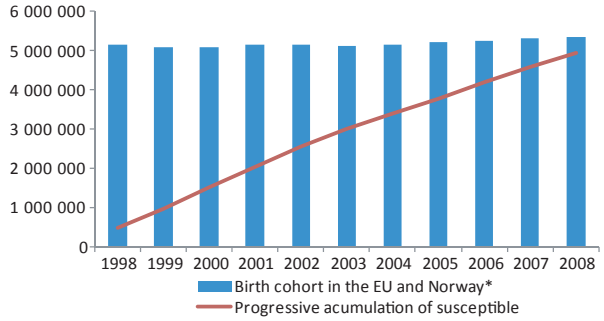

FIG. 2. Progressive accumulation of children susceptible to measles and birth cohorts 1998–2008 (1994–2004 for Germany) in the EU and Norway. Sources: CISID and Eurostat.

from 2011 [9] showed that the highest incidence was among infants under 1 year, followed by children aged between 1 and 4 years. Overall, age-specific notification rates were relatively high up to age 25 years, suggesting a significant additional circulation of measles virus amongst adolescents and young adults, as well as those aged less than 5 years.

Vaccination Coverage and Susceptibility to Measles in Europe

Countries report their MMR vaccine coverage to the WHO, and these data are publicly available through WHO's Centralized information System for Infectious Diseases (CISID) [16].

So far, only some member states in the EU have been able to attain and maintain 95% MMR vaccination, as is required to reach the elimination goal. [16].

We made an attempt to calculate how many children are not vaccinated against MMR in the EU using data from CISID and Eurostat [17], following a methodology described in the Annex.

Taking into account the vaccination coverage reported to the WHO in 2000, the birth cohort for 1998 (1994 for Germany) accumulated 486 559 susceptible individuals in all EU countries. Birth cohorts 1998–2008 (1994–2004 in Germany) had 4 929 607 individuals in the age group 2–12 years who had missed MMR vaccination in the EU between 2000 and 2010. This number is approximately the equivalent of one EU birth cohort (Annex 3, Fig. 2).

This calculation should be taken as a rough estimate, as it relies on assumptions described in the Annex (e.g. using MMR1 coverage). Also, countries use different methodologies and definitions for assessing vaccination uptake and direct comparisons of coverage between countries should be made with caution.

In addition, this calculation has to be considered as a conservative estimate of the susceptible population, as an additional 5% of vaccinated children could be at risk, for example through primary vaccine failure, a physiologically insufficient immune response to the vaccine, low vaccination levels for MMR2, and the absence of significant catch-up programmes.

As part of the European Sero-Epidemiology Network 2 (ESEN2), Andrews *et al.* [18] assessed age-specific measles susceptibility in 17 European countries. They collected national serum banks between 1996 and 2004 and tested them for IgG in a standardized way. In order to compare their data with the WHO European Region targets for measles elimination, age-stratified population susceptibility target levels were set at <15% in those aged 2–4 years, <10% in 5–9 year olds and <5% in older age groups.

Seven countries (the Czech Republic, Hungary, Luxembourg, Spain, Slovakia, Slovenia and Sweden) were very close to elimination targets. Lithuania and Malta had susceptibility levels exceeding WHO targets in some older age groups, indicating possible gaps in protection. Seven countries (Belgium, Bulgaria, Cyprus, England and Wales, Ireland, Latvia and Romania) were deemed at risk of epidemics as a result of high susceptibility in children and, in some cases, adults. This study pointed out that current efforts were insufficient to eliminate measles by 2010, as happened to be the case.

In the case of Bulgaria, the study showed that 30.7% of children aged 2–4 years, 25.9% of those aged 5–9 and 20.7% of 10–19 year olds were seronegative for measles (while WHO coverage data for the first MMR dose was estimated at 94.7% in 2004 [16]). This high proportion of children who were susceptible to measles, together with the concentration of susceptible individuals in population subgroups, in this case the Bulgarian Roma population, were the main drivers for the huge 2009–2010 outbreak [10].

Measles vaccination schedules in Europe are set at national and sometimes local levels. They differ in the way they are

planned, organized and conducted [19]. The WHO recommends that the minimum age to start MMR vaccination in countries with low transmission is 12 months [20]. In the EU, the minimum age for the first dose is 12 months, except for Germany (11 months) and France (9 months for children in day-care), and all first doses have been given by 18 months of age. The age of the second dose of MMR has a wide range of variation, from 12 months to 15 years [19].

Moving countries can pose challenges for immunization if an individual starts the vaccination programme in one country and continues it in another. Many Eastern European countries give their second MMR between 6 and 12 years of age (with the vast majority at 6 years of age). Therefore a 4-year-old child moving from an Eastern European country to a country where the second dose is given before 4 years of age would miss their vaccination, as has been documented in the UK [21]. In the light of such examples of common cross-border movement, a common European schedule could have a significant positive impact on European vaccination.

Determinants of Measles Outbreaks and Potential Areas of Intervention

Resurgence of measles in Europe is the result of the accumulation of a susceptible population over the last decades. Slow accumulation in consecutive birth cohorts may generate large outbreaks, with adolescents and young adults primarily affected. Confinement of susceptible individuals in defined population pockets with a certain degree of segregation (ethnic groups, religious communities, etc.), usually results in an outbreak involving younger children, as occurs in completely unvaccinated populations. Both age patterns have been observed during the recent European outbreaks [10,11].

Even though the epidemiological circumstances leading to measles resurgence are clear, the reasons underlying such circumstances are more complex and worth investigation. Organizational issues, combined with social, psychological and behavioural determinants, are the leading causes of sub-optimal immunization levels. Europe is now experiencing what is called the vaccine paradox, in which vaccines are somehow victims of their own success. In fact, following the introduction of an effective and safe vaccine, vaccination coverage increases. This results in a dramatic decrease in the incidence of disease, followed by a decrease in the perceived risk of the disease and its complications. As the disease is no longer remembered as dangerous, real or alleged adverse events following immunization (AEFI) become the main concern. Even healthcare workers pay less attention to the disease and its consequences, leading to less effective communication with parents of small children.

Risk perception is highly influenced by relatively small yet very active anti-vaccination movements. The arguments of anti-vaccine groups confuse scientific evidence (e.g. on side-effects), with their views being put in a manner that makes it very difficult to differentiate between the two, often effectively using emotional communication [22]. Tactics used by this movement have been categorized by Kata [23] in four categories. (i) Skewing the science, while trying to create legitimacy for unfounded or discredited theories of harm. This is achieved by, on the one hand, denigrating legitimate scientific studies (and the scientific process in general) that fail to support anti-vaccine positions, and on the other hand, legitimating anti-vaccine theories through pseudoscientific conferences. (ii) Shifting hypotheses and presenting new theories regarding vaccines causing harm, when evidence does not support such theories, from MMR to thimerosal, to other 'toxins', to 'too many, too soon'. (iii) Censorship (suppressing dissenting opinions). (iv) Attacking the opposition (attacking critics both via personal insults and by legal actions).

Besides ignoring or avoiding scientific evidence, those that are anti-vaccination have also been offering tropes (mottos or phrases used recurrently) to create fear, uncertainty and doubt about vaccines. Claims such as not being 'anti-vaccine' but 'pro-safe vaccines', that vaccines are toxic or unnatural or claiming that those supporting vaccines do so because they are hired by pharmaceutical companies are commonly used to spread scepticism. Recognizing such anti-vaccine tropes is essential in order to critically evaluate the information and misinformation encountered online [23].

These groups are particularly efficient in spreading their views on the Internet. According to recent studies, the majority of websites popping up after a generic Google search (such as using the term 'vaccination') can be classified as anti-vaccination [24]. Moreover, even a short search for the term 'vaccination' in Google can lead to considerable changes in perception of risk [25].

A major argument against MMR vaccination is its alleged potential link to autism. Wakefield generated a worldwide scare over the MMR vaccine with his publication in the Lancet in 1998 [26] (article retracted). Since then, numerous studies have failed to show a link between the MMR vaccine and autism [27–30] and it has now been demonstrated that this link was artificially manufactured by Wakefield by misreporting the cases [31]. The article was withdrawn from the Lancet in 2010. However, a significant decrease in vaccination trust, and therefore coverage, in several parts of the world, especially in the UK, had already occurred [32].

Anti-vaccination attitudes are often supported by religious or philosophical beliefs. Religious minorities, such as the Orthodox Jewish or Christian Reformed Churches, and anthroposophist groups represent pockets of under-immunized populations that may easily generate outbreaks due to frequent contacts between unvaccinated members of such communities [33].

Moreover, during the last years, measles has spread among ethnic groups that have poor access to healthcare and health promotion, such as the Roma population [34]. In Bulgaria, a number of circumstances converged simultaneously to precipitate the outbreak: virus importation from Germany, health system and socio-economic reform, social marginalization, crowded housing conditions and a high degree of mobility among Roma communities [34]. Control measures implemented included a supplementary MMR vaccination campaign in the affected regions (supplied by the Ministry of Health and offered free of charge through routine immunization services) targeting all individuals from 13 months to 30 years of age who had not received the complete two-dose vaccination regimen. Additionally, special outreach teams consisting of regional epidemiologists, health inspectors and local Roma community leaders were deployed in the campaign to immunize the Roma community. The 2009 to 2010 outbreak has subsided, with Bulgaria reporting only 157 cases in 2011 [9]. All activities put in place for controlling the outbreak should be reinforced and sustained in the future in order to avoid this event being repeated.

A small percentage of healthcare workers are against vaccination in principle, especially among providers of homeopathy and complementary medicines [35]. In the case of measles, the attitudes and practices of healthcare workers in Europe appear at times variable: misconceptions regarding the severity of the disease or the safety of MMR persist not only among parents, but also among doctors and nurses (35, 36). A major problem appears to be insufficient knowledge on vaccine product safety and vaccination schedules, with subsequent misleading, unclear or untrue messages communicated to parents.

There is definitely not a one-size-fits-all solution for improving MMR vaccine coverage in Europe. However, there is the need to assess the level of protection in the older age groups (e.g. more than 5 years) and fill immunization gaps in this population with catch-up programmes or supplementary immunization activities (SIA) almost everywhere in Europe. Additional effort is also required to address the needs of marginalized and hard-to-reach groups.

A multi-component approach is essential to reach the vaccination coverage required for measles and rubella elimination. The following priority areas for intervention, both on the supply and demand sides, should be taken into account.

- Improving the quality of vaccine supply, by facilitating access to healthcare in general and to vaccine providers in particular, is paramount. To this end, financial and human resources should be specifically increased for MMR supplementary immunisation activities.
- Advocacy activities among decision makers and healthcare workers should raise awareness of the importance of eliminating measles and rubella.
- Communication activities involving the general public, tailored to local specific needs, should be put in place in order to increase the demand for immunization. This also implies the distribution of vaccination reminders to parents. New communication tools and social media may play some role in counteracting anti-vaccination movements.

In conclusion, the European commitment to eliminate measles and rubella by 2015 should be addressed in a global context, where the European Region, together with the American and the Western Pacific Region, should be leading the global process of measles and rubella elimination. This is a challenging but still feasible goal. Improved vaccine supply, advocacy and communication are key strategic areas of intervention, necessary to initiate and sustain those extraordinary vaccination activities (catch-up, SIAs) without which such a goal will be missed. Again.

Acknowledgements

The authors would like to thank Pete Kinross for the review of this manuscript.

Conflicts of Interest

The authors state their absence of dual or conflicting interests.

Appendix

To calculate a rough number of the amount of susceptible children (not vaccinated with one MMR dose (MMR1) at 2 years of age) we used the birth cohorts 1998–2008 for 26 EU countries and Norway. For Germany, because vaccine coverage assessment is carried out at school entry (around 6 years), we used birth cohorts 1994–2004. We chose coverage of MMR1 due to the fact that the recommended age for the second dose

of MMR vaccine varies considerably between countries and available data on MMR2 coverage are scarce.

We used CISID data on % of infants vaccinated against MMR1 for the years 2000–2010 (Annex 1). For some years in some countries there were no data in CISID. In that case, we calculated the average of the previous and subsequent available data around the missing one. If there were no data for the last years, the last available year was used. Moreover, we extracted from Eurostat demographic data on children aged 2 years per country from 2000 to 2010, which is the age when vaccination coverage is estimated in most countries, and children aged 6 years for Germany (Annex 2).

Annex 1. Percentage of infants vaccinated against first dose of MMR (MMR1) for the years 2000–2010, CISID data

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Austria	74.7	78.5	78.5	78.8	73.5	91	80	77	83	76	79.1
Belgium	82.2	82.2	82.2	82.2	82.2	88	91.9	91.9	*93*[a]	94	94
Bulgaria	88.6	90.1	92.1	95.5	94.7	96.2	95.7	96	95.9	96.1	96.5
Cyprus	85	85	85	86	86.3	86.3	87	87	87	87	87
Czech Republic	98	98	99	99.1	96.9	98.2	98.2	98.2	98.2	98.2	98.2
Denmark	100	94	100	96	96	95	100	89	*86.5*[a]	84	85
Estonia	93	94.7	95.2	95.2	95.5	95.9	96.1	95.5	95	95	95.1
Finland	96	96	95.8	97	97	97	97	98	97	98.5	*98.5*[a]
France	84	85	85	86	86	*89.5*[a]	*89.5*[a]	93	87	90.1	90.1
Germany	91.7	91	91	92	92.5	93.3	94	94.5	95.4	95.9	96
Greece	88	88	88	88	88	*93.5*[a]	*93.5*[a]	*93.5*[a]	98.9	98.9	*98.9*[a]
Hungary	100	100	99.9	99.9	99.9	*99.9*[a]	*99.9*[a]	99.9	99.9	99.8	99.9
Ireland	79	73	72.5	78.5	81.1	84.2	86.2	87.02	89	90.4	90
Italy	74	76.5	77	83	84	87.2	87	*87*[a]	*87*[a]	*87*[a]	*87*[a]
Latvia	96.9	97.9	98.3	98.6	98.7	95	95.3	97	96.6	95.7	90.1
Lithuania	97	97.4	97.9	97.7	97.7	97.2	96.6	96.9	97	96	96.1
Luxembourg	91	91	95.4	95.4	95.4	95.4	*95.8*[a]	96.2	96.2	96.2	96.2
Malta	74	65	65	90	87.4	86	94	79	78	82	72.5
Netherlands	95	95	96	95.7	96.3	96.3	*96.1*[a]	95.9	96.2	96.2	95.9
Norway	92	93	88	84	88	90	91	92	93	92	93
Poland	97	97.2	97.6	97.5	97.4	98.2	98.2	98.3	*98.3*[a]	98.3	98.2
Portugal	87	86.8	91.9	96.3	94.8	92.6	96.7	95	96.6	95	96
Romania	98	97.8	98.2	97.2	97.1	96.7	*96.9*[a]	97.1	*96.1*[a]	*96.1*[a]	95
Slovakia	98	98.6	98.6	98.6	98	98	98.4	98.8	99	99	98.5
Slovenia	95.2	94	93.5	86.7	94	*95.5*[a]	96.1	95.6	96	95	95
Spain	94	96	96.6	97.2	97.3	96.8	96.9	97.1	97.8	97.5	95.1
Sweden	94.2	88.5	95	95	94.5	95.4	95.4	96.2	96.2	96.7	96.5
[a]United Kingdom	99	98.7	83	80	81	82.1	84.9	86.2	85.5	86	93

[a]Data not available on CISID: we calculated the average of the previous and subsequent available data around the missing one. If there were no data in the last years, the last available year was used.

MMR, measles, mumps and rubella vaccine; CISID, Centralized Information System for Infectious Diseases.

Annex 2. Population at 2 years of age in EU per country (at 6 years for Germany), Eurostat

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Austria	85 029	82 227	79 290	79 881	77 496	80 770	79 354	80 995	79 971	79 715	78 003
Belgium	116 529	114 887	114 257	116 079	114 823	112 949	114 562	118 426	120 831	124 289	125 846
Bulgaria	62 951	64 871	68 105	66 608	67 413	66 199	66 920	69 315	70 509	72 822	73 874
Cyprus	9500	9141	8563	8529	8387	7849	8061	8345	8362	8895	8645
Czech Republic	90 220	90 136	87 964	89 256	91 301	93 126	94 062	97 834	102 988	106 518	115 180
Denmark	68 155	66 775	66 912	67 722	65 885	64 607	65 155	65 080	64 993	66 062	65 205
Estonia	12 090	11 757	12 044	12 922	12 518	12 910	12 940	13 893	14 262	14 797	15 694
Finland	59 272	56 988	57 679	56 876	56 293	55 850	56 978	58 089	58 114	59 505	59 415
France	741 209	757 673	764 660	796 466	789 433	777 830	772 882	780 597	788 026	807 529	792 766
Germany[a]	814 607	782 802	775 663	803 429	819 102	794 354	777 473	773 550	739 386	721 364	708 024
Greece	101 697	99 873	99 684	101 423	101 937	103 532	104 789	105 932	107 909	112 413	112 265
Hungary	98 300	95 398	93 212	97 601	96 217	96 096	94 285	95 131	97 688	100 076	97 748
Ireland	53 785	55 184	56 123	55 862	54 687	58 542	60 521	61 082	63 236	67 372	71 447
Italy	522 615	521 284	525 677	533 305	534 563	543 129	550 865	561 735	559 638	567 379	569 438
Latvia	18 220	17 931	19 050	20 044	19 446	19 949	20 926	20 391	21 823	22 775	23 739
Lithuania	37 114	36 349	35 880	33 755	31 228	29 751	30 266	30 119	30 270	30 987	31 990
Luxembourg	5715	5498	5776	5835	5592	5550	5469	5711	5582	5774	5722
Malta	4827	4530	4358	4294	3944	3921	3938	3833	4233	3917	3911
Netherlands	194 547	201 787	203 816	208 833	205 052	202 834	200 902	193 486	187 173	185 053	182 106
Norway	60 699	59 148	59 953	59 963	57 612	56 616	57 865	58 242	58 391	60 250	60 148
Poland	408 478	392 046	380 856	376 490	362 489	352 386	348 971	353 924	362 331	372 660	386 811

Annex 2. Continued.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Portugal	105 574	105 168	111 759	109 250	111 616	113 163	111 403	108 563	109 055	105 155	102 112
Romania	229 957	230 290	223 377	222 819	211 733	206 453	208 602	212 452	217 538	216 455	212 189
Slovakia	58 574	56 178	55 632	53 919	50 804	50 458	51 353	53 383	54 108	53 648	54 231
Slovenia	18 343	18 057	17 670	18 445	17 776	17 820	17 431	18 127	18 361	19 361	20 392
Spain	365 624	368 176	383 169	405 567	423 357	428 423	451 153	461 899	471 401	477 293	494 837
Sweden	91 008	90 304	89 779	92 180	93 204	97 625	100 798	103 091	103 797	108 612	110 130
United Kingdom	722 052	705 384	689 121	671 189	662 072	670 956	692 756	710 851	724 676	744 168	772 266
Total	5 156 691	5 099 842	5 090 029	5 168 542	5 145 980	5 123 648	5 160 680	5 224 076	5 244 652	5 314 844	5 354 134

[a]Germany population at 6 years.

For each birth cohort and country, we multiplied the number of children by the vaccination coverage. The resultant number was the number of children vaccinated by country and year and the difference between the birth cohort and the children vaccinated was the susceptible children by country and year. Then we added up all the susceptible children for all the countries by birth cohort and finally by year.

Annex 3. Number of susceptible children at 2 years of age per year and country for birth cohorts 1998–2008 (1994–2004 in Germany)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Austria	21 512	17 679	17 047	16 935	20 536	7269	15 871	18 629	13 595	19 132	16 303	184 508
Belgium	20 742	20 450	20 338	20 662	20 438	13 554	9 280	9 593	8 519	7 457	7 551	158 583
Bulgaria	7176	6422	5380	2997	3573	2516	2878	2773	2891	2840	2586	42 031
Cyprus	1425	1371	1284	1194	1149	1075	1048	1085	1087	1156	1124	12 999
Czech Republic	1804	1803	880	803	2830	1676	1693	1761	1854	1917	2073	19 095
Denmark	–	4007	–	2709	2635	3230	–	7159	8774	10 570	9781	48 865
Estonia	846	623	578	620	563	529	505	625	713	740	769	7 112
Finland	2371	2280	2423	1706	1689	1676	1709	1162	1743	893	891	18 542
France	118 593	113 651	114 699	111 505	110 521	81 672	81 153	54 642	102 443	79 945	78 484	1 047 308
Germany	67 612	70 452	69 810	64 274	61 433	53 222	46 648	42 545	34 012	29 576	28 321	567 905
Greece	12 204	11 985	11 962	12 171	12 232	6781	6864	6939	1187	1237	1235	84 796
Hungary	–	–	93	98	96	96	94	95	98	200	98	968
Ireland	11 295	14 900	15 434	12 010	10 336	9250	8352	7928	6956	6468	7145	110 073
Italy	135 880	122 502	120 906	90 662	85 530	69 521	71 612	73 026	72 753	73 759	74 027	990 177
Latvia	565	377	324	281	253	997	984	612	742	979	2350	8463
Lithuania	1113	945	753	776	718	833	1029	934	908	1239	1248	10498
Luxembourg	514	495	266	268	257	255	230	217	212	219	217	3151
Malta	1255	1586	1525	429	497	549	236	805	931	705	1074	9592
Netherlands	9727	10 089	8153	8980	7648	7505	7835	7933	7113	7032	7466	89 481
Norway	4856	4140	7194	9594	6913	5662	5208	4659	4087	4820	4210	61 345
Poland	12 254	10 977	9141	9412	9425	6343	6281	6017	6160	6335	6963	89 308
Portugal	13 725	13 882	9052	4042	5804	8374	3687	5428	3708	5258	4084	77 045
Romania	4599	5066	4021	6239	6140	6813	6467	6161	8593	8550	10 609	73 258
Slovakia	1171	786	779	755	1016	1009	822	641	541	536	813	8870
Slovenia	880	1083	1149	2453	1067	882	680	805	734	968	1020	11 721
Spain	21 937	14 727	13 028	11 559	11 431	13 710	13 986	13 395	10 371	11 932	24 247	160 322
Sweden	5278	10 385	4489	4609	5126	4491	4637	3917	3944	3584	3855	54 316
United Kingdom	7221	8747	117 151	134 238	125 794	120 101	104 606	98 097	105 078	104 184	54 059	979 274
Total	486 559	471 409	557 857	531 983	515 652	429 590	404 393	377 581	409 747	392 233	352 601	4 929 607

Each cell is calculated as the population by year and country (Annex 2) multiplied by 100 – % coverage for that year and country (Annex 1).

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