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Editorials

Are European immunisation programmes recession proof?

D O'Flanagan (darina.oflanagan@hse.ie)[1], D Lévy-Bruhl[2], S Salmaso[3]
1. Health Protection Surveillance Centre (HPSC) Health Services Executive (HSE), Dublin, Ireland
2. French Institute for Public Health Surveillance (Institut de Veille Sanitaire, InVS), Saint-Maurice, France
3. Istituto Superiore di Sanitá, Rome, Italy

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The activities during the European Immunisation Week demonstrate a common momentum by member states of the World Health Organization (WHO) European Region to increase the success of immunisation programmes through advocacy and targeted communication. These efforts ultimately aim to raise awareness and reach people who have not been immunised or did not receive all recommended vaccinations. Fifty-two countries agreed to participate in 2011, the largest number since the first European Immunisation Week in 2005 [1]. This proves increasing political commitment to vaccination throughout the region. It's thus a good time to celebrate advances in vaccination programmes as the first decade of the 21st century has been the most productive in the history of vaccine development. New life-saving and disease-preventing vaccines, such as conjugate vaccines against pneumococcal and meningococcal disease, human papilloma virus (HPV) and second-generation rotavirus vaccines have been developed, and others will soon be available.

These exciting advances, however, must not hide some major challenges of vaccination programmes in the European Region. The first one is illustrated by the failure of reaching the European measles elimination goal by 2010 [2]. In early 2011, thirty countries in the region have reported a marked increase in measles cases, with over 6,500 cases as of 20 April 2011 [1]. This demonstrates the difficulty in reaching in our societies the required high proportion of immune subjects, including the 95% coverage of those targeted for vaccination with two doses of a measles-containing vaccine, as a result of several problems. Firstly there is a growing paradigm where people feel more than in the past responsible for their own health. They wish to choose their own medical care in a context where vaccination is victim of its own success. As vaccine coverage has increased, the incidence of vaccine-preventable diseases has fallen and diseases as well as the related suffering have become less visible. At the same time as the perception of risk associated with the preventable disease has declined, concern about potential side effects of vaccines has increased.

Today, many are questioning national and regional vaccination strategies and methods for setting recommendations, asking for the reassessment of the benefit/risk balance at their own individual level i.e.'This vaccination is good from a public health perspective but do I really need it?' while failing to recognise that the solidarity and cooperation of all are needed to ensure the additional gain of herd immunity. This balance is often negatively biased by misinformation or rumours circulating through the new media (Internet, social networks), which creates doubts and fears. The example of the low vaccine coverage against the 2009 pandemic influenza A(H1N1) in 2009/10 in most members states is an illustration for this [3]. A paper by Betsch in this issue of *Eurosurveillance* discusses the increasing influence of the Internet on vaccine decisions and specifically investigates the influence of anti-vaccine information [4].

To counter the potential negative impact of misinformation, rumours and other misconceptions, well-targeted information and social mobilisation campaigns are required to transform passive acceptance of immunisation into a well-informed demand for vaccines that can protect against life-threatening diseases [5]. Such a transformation requires investment in form of human and financial resources and a strong commitment from health authorities. This is sometimes lacking. Again, using measles prevention as an example, the investment (time, energy, money, identification of innovative communication or vaccine delivery strategies and the staff to do it) required to gain the few per cent of coverage needed to reach the herd immunity threshold through reaching those underserved or reluctant, is considered in many countries as not worth the investment. The challenge is to convince decision makers that 90% coverage in children is unsatisfactory and that even 1% of the number of measles cases that occurred in the pre-vaccination era must now be considered a public health emergency! European failure to meet measles elimination means we must increase investment in supplementary and outreach vaccination activities to ensure we reach also underserved and marginalised groups. In addition those older children and young people who are vulnerable due to sub-optimal immunisation coverage in the past should be offered catch-up opportunities to complete the recommended schedules. Failure to do so will leave Europeans susceptible to importations of measles as illustrated in the communication from Brown et al. in this issue describing the recent appearance of a novel measles G3 strain in multiple European countries [6]. Furthermore, Wicker et al. highlight in their paper that also healthcare workers need to be educated and convinced about the necessity to protect themselves and their patients through for example influenza vaccination [7]. Previous papers in this journal have demonstrated the same for the measles, mumps, rubella vaccine [8-10].

The second challenge is the growing gap in the number of vaccinations offered by the various European countries as new vaccines are marketed. These new vaccines are generally much more expensive than those that have been used for a long time. In the context of growing financial constraints, cost becomes a major impediment in integrating these new vaccines. The example of vaccination against HPV is illustrative of this situation, as shown by the results of the Venice surveys [11,12]. The financial barrier is documented in those surveys by the answers to the question: 'Why did you not introduce the HPV vaccination?' for which the main reason was: 'because of the cost of the vaccine or cost/effectiveness issue'.

The recent financial challenges threaten to unravel hard-won gains particularly in countries hardest hit by the economic turmoil. Many countries are now facing down-sizing of staff working in public health services. With an emphasis on protecting front-line services, vaccine programme functions such as collection of data on vaccine preventable diseases and monitoring vaccine coverage may be threatened. Effective surveillance systems are indispensable in guiding policy decisions for the introduction of new vaccines, monitoring their impact on disease incidence, and conducting post-marketing surveillance to ensure their safety.

It is also essential that we continue to ensure that all vaccines in our programmes continue to be reviewed and where no longer indicated discontinued after careful evaluation. Such a review has recently led the United Kingdom Joint Committee on Vaccination and Immunisation to consider cessation of the elderly pneumococcal polysaccharide vaccine programme [13]. In recent years countries such as France and Finland have discontinued routine universal BCG programmes [14,15].

On a more positive note, these recessionary times may be the impetus needed to review the process whereby European countries procure vaccine. In many countries vaccine procurement is devolved to local levels, losing the economies of scale that national procurement of vaccines can provide. We could learn from the experience of other WHO Regions such as provided by the Pan American Health Organization (PAHO). In 1979, PAHO established a revolving fund to help all countries in the region become more self-sufficient in the purchase of vaccines for routine immunisation [5]. The pooled fund is able to secure low vaccine prices through large volume contracts with manufacturers.

As the current economic downturn unfolds, it will be important for governments to sustain and, when possible, increase investments in immunisation. Comparison of vaccination programmes with other healthcare interventions indicates that vaccines are often one of society's best healthcare investments [16]. We, public health experts, need to ensure that we provide policy makers with the evidence to justify their investment decisions and ensure that our vaccination programmes are recession proof.

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Appearance of a novel measles G3 strain in multiple European countries within a two month period, 2010

K E Brown (kevin.brown@hpa.org.uk)[1], M N Mulders[2], F Freymuth[3], S Santibanez[4], M M Mosquera[5], S Cordey[6], J Beirnes[7], S Shulga[8], R Myers[1], D Featherstone[9]

1. Virus Reference Department, World Health Organization Global Specialised Laboratory for Measles and Rubella, Health Protection Agency - Colindale, London, United Kingdom
2. World Health Organization Regional Office for Europe, Copenhagen, Denmark
3. Centre National de Référence de la Rougeole et des Paramyxoviridae Respiratoires (National Reference Centre for measles and respiratory Paramyxoviridae), Laboratoire de virologie humaine et moléculaire (Laboratory of human and molecular virology), Centre Hospitalier Universitaire de Caen, France
4. National Reference Centre Measles, Mumps, Rubella, Regional Reference Laboratory WHO EURO, Robert Koch Institute, Berlin, Germany
5. Centro Nacional de Microbiología (National Microbiology Centre), Instituto de Salud Carlos III, Madrid, Spain
6. Swiss National Reference Centre for Emerging Viral Diseases, Division of Infectious Diseases, University of Geneva Hospitals, Geneva, Switzerland
7. Viral Exanthemata National Microbiology Laboratory, Winnipeg, Canada
8. World Health Organization Regional Reference Laboratory, European Region, Moscow, Russian Federation
9. Expanded Programme on Immunization, Department of Immunization, Vaccines and Biologicals, World Health Organization, Geneva, Switzerland

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During late 2010, a previously unrecognised strain of measles genotype G3 virus was identified in five different European countries by the World Health Organization Measles and Rubella Laboratory Network. Apart from one, none had a travel history to south-east Asia, the usual source of G3 viruses, although epidemiological links could be established between some of the cases. This case series illustrates the value of genotyping and sequencing in tracking measles infections, and identifying otherwise unrecognised chains of transmission.

Measles and Rubella Laboratory Network (LabNet)

As Europe adopts its resolution to eliminate measles by 2015 [1] confirmation of clinically diagnosed measles, and characterisation of circulating viruses becomes increasingly pertinent. The World Health Organization (WHO) Measles and Rubella Laboratory Network (LabNet), was established in 2002, with the primary purpose of providing laboratory confirmation of suspected cases of measles and rubella using standardised ELISA-based IgM detection in serum or oral fluid. As of July 2010, the LabNet consists of 690 laboratories in 183 countries, all of which follow a standardised set of testing protocols and reporting procedures with a strong focus on quality assurance. The LabNet is structured in four tiers of laboratories: sub national (n=507), national level (n=161), regional reference (n=19), and global specialised (n=3).

The LabNet also supports genetic characterisation of currently circulating strains of measles viruses and is responsible for standardisation of the nomenclature and laboratory procedures that are used for genetic characterisation of wild-type measles and rubella viruses [2-4].
This agreement of a standard nomenclature and classification for describing measles virus has been instrumental in allowing comparison of viruses in different countries, and also for documenting spread within countries, monitoring viral transmission pathways and in providing evidence of progress towards measles elimination [5].

For molecular epidemiologic purposes, the WHO currently recognises eight clades (designated A to H), and within these clades, there are 23 recognised genotypes, designated A, B1, B2, B3, C1, C2, D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, E, F, G1, G2, G3, H1, and H2. There is considerable genetic variability within some genotypes (e.g. B3 and H1) and related viruses are referred to as clusters. The WHO recommends that the 450 nucleotides coding for the carboxyterminal 150 amino acids of the nucleoprotein (N-450) are the minimum amount of sequence data required for assigning a measles genotype [2-4]. A WHO Measles nucleotide sequence database MeaNS ([6], www.who-measles.org) was set up as a repository for sequence information, with tools to allow genotyping and phylogenetic analysis of measles viruses sequences found globally.

Genotyping and sequencing of measles viruses is recommended by the WHO for at least 80% of all laboratory-confirmed outbreaks [7] and in countries where measles is no longer endemic, is encouraged for all sporadic cases. Molecular characterisation of such cases provides the information necessary to determine whether they are part of a single cluster or due to multiple importations, and to identify sources of infection. However, unless appropriate samples are collected (generally throat swab, urine sample, or increasingly common in Europe, an oral fluid sample) genotype information is not always available. In the past three years, six different genotypes of measles virus have been identified in Europe (B3, D4, D5, D8, D9, H1) with large outbreaks associated with B3, D4 and D5 in many countries [8].

Recent infections with measles virus G3 in Europe

Measles genotype G3 is generally associated with measles infections in south-east Asia, or in sporadic cases with links to south-east Asia [4]. There had been no reported cases of measles G3 in Europe since 2006. However, in the last four months of 2010 there have been a total of 25 sporadic (i.e. epidemiologically unlinked) or epidemiologically linked cases, all with viruses with identical sequence belonging to genotype G3, in several different countries in Europe.

The first case, Patient A was a non-vaccinated German adult who was on a roundtrip from Germany to south-east Asia, during the first half of September 2010, and returned to Germany via London on 17 September 2010. Patient A remembered that a passenger sitting one row in front of them had influenza-like symptoms and was coughing frequently, but otherwise had no known contact with potential infectious measles virus carriers. Ten days later Patient A felt ill, developed a rash after two more days and was hospitalised. Measles was confirmed by detection of measles virus RNA in oral fluid and urine sample [9].

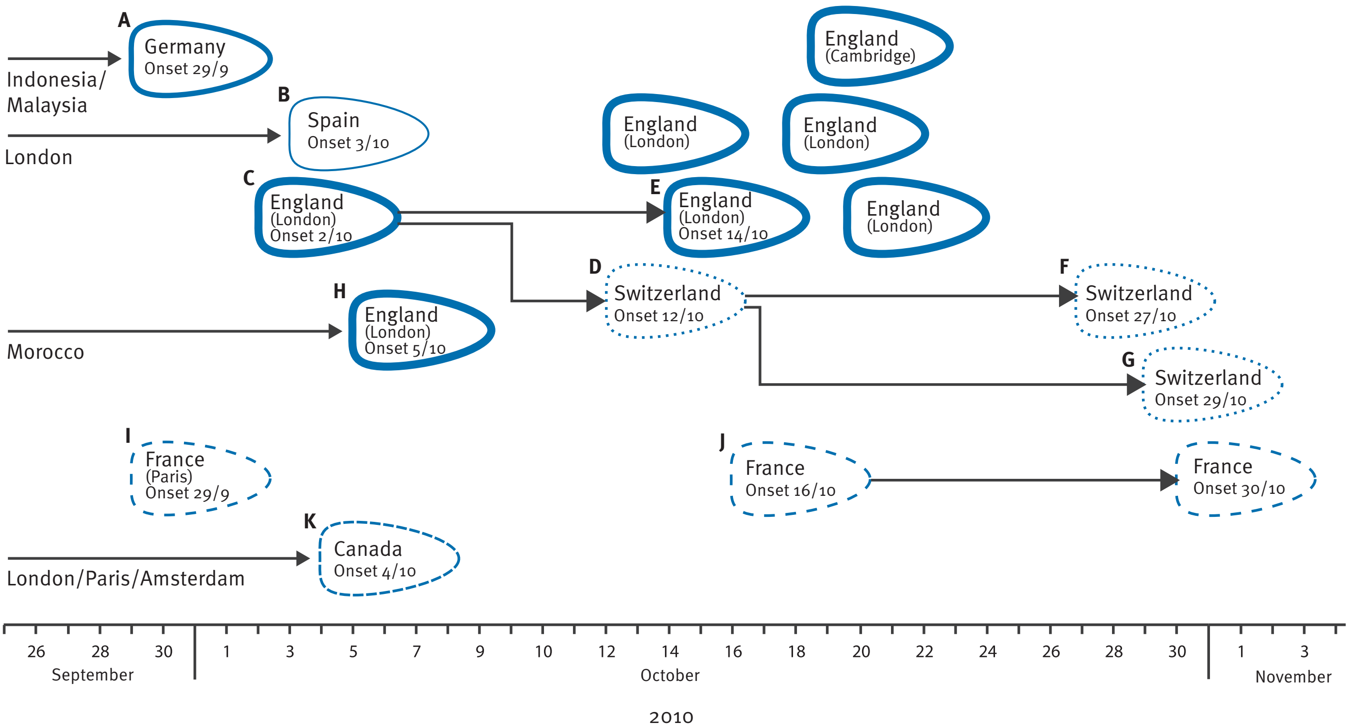
During the same period of symptom onset for Patient A, cases of measles were also detected in Spain, England and France (Figure 1).

The Spanish case (Patient B) returned to Spain on 20 September 2010 after having travelled to London. Like Patient A, Patient B developed the prodrome on 27 September, with rash onset on 3 October. These dates indicate a potential infection of both cases in London around 17 September.

The third case was a college student in London (Patient C) with no history of travel outside the United Kingdom (UK), who became unwell on 28 September and who had rash onset on 2 October. Patient C subsequently infected two students at the same college in London (Patient D, onset date 12 October, and Patient E, onset date 14 October). Patient D had travelled to Switzerland and became unwell and was diagnosed with measles there. Subsequently there were two further cases of measles G3 virus infection, a household contact of Patient D (Patient F, onset date 27 October) and another case (Patient G, onset date 29 October) with no identified links, but living in the same town.

Figure 1

Measles infections with known epidemiological links in different countries, 2010



The different styles of the outlines indicate the different countries where the cases were at the time of infection.

A fourth patient in the UK (Patient H) also developed measles with a G3 genotype at the beginning of October 2010. Patient H had spent holidays in North Africa and returned to the UK on 20 September. The prodrome began on 1 October with rash onset four days later, suggesting infection at the time of travel or shortly after, and although this case did not live in London, they had travelled through London on the way home. Subsequently, over the next two months there were four further sporadic G3 measles cases, all with no history of travel outside south-east England. There were no further cases in the UK for the rest of 2010.

The French patient (Patient I) was a one year-old non-vaccinated infant who lived in the area of Paris, and developed rash on 29 September. Like Patient C, there was no history of recent travel or known epidemiological link to anyone with measles. On 16 October there was a second G3 measles confirmed case in France (Patient J), although no links between the two cases could be determined. Subsequently, there were a further nine sporadic cases of G3 measles identified in France up to the end of 2010, but given the widespread measles activity in France [10] links between these cases have been difficult to identify.

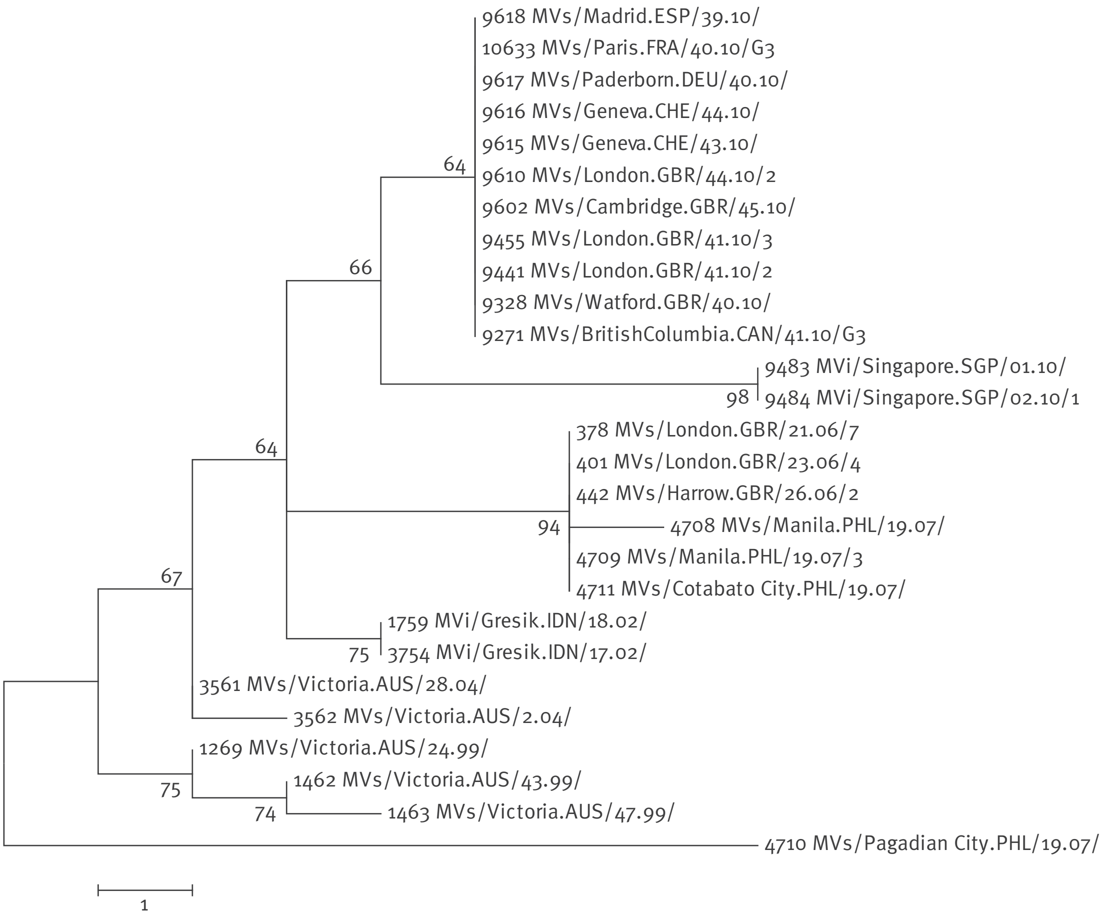
Lastly, a visitor from Canada with a history of one dose of measles-containing vaccine as an infant, (Patient K) travelled to London on 10 September and then spent holidays in London, Paris and Amsterdam. Patient K also developed measles with a G3 genotype, with onset of rash on 4 October, suggesting infection around 20 September before having returned to Canada.

Sequence analysis

Genotyping and sequencing was performed, by the respective national laboratory on a variety of samples from these patients. Sequencing of the recommended minimum 450 nucleotides [3] was performed and confirmed that they were all G3 sequences. Comparison of the sequences confirmed that all the samples, including the one from the German patient with travel links

Figure 2

Phylogenetic tree of representative sequences from the recent G3 measles cases, compared with other historic G3 measles cases, 2010



Numbers represent the ID number in the World Health Organization MeaNS database.

The tree was created using the number of nucleotide differences to generate a distance matrix and the neighbour-joining algorithm to cluster sequences, as implemented within MEGA5.

Branch lengths represent the number of nucleotide differences between each sequence and the resulting phylogeny was bootstrapped using 500 pseudo-replicates.

to south-east Asia, were 100% identical over the N-450 nucleotide sequence window (Figure 2).

Interestingly, there were no other identical sequences in the WHO MeaNS database or GenBank. Two viruses with similar sequences (five nucleotides difference) had previously been identified in cases in Singapore in early 2010 and had links to Indonesia.

The cluster described in this paper highlights a number of important points. Not only is it essential to have an agreed standard nomenclature for describing viruses, both at genotype and at sequence level, but it is also critical that this information is shared. Within the WHO laboratory network of national, regional and global laboratories, genotype information is shared by regular reporting to the WHO Regional Offices of the sequencing results, and depositing sequence information in the WHO MeaNS database or GenBank. The MeaNS database is not only a repository for all reported measles sequences, but it also allows ready identification of identical or similar sequences in different countries, as in this case series. All laboratories performing measles genotyping and sequencing should be encouraged to submit their sequences in a timely manner to facilitate identification.

The cases described here also highlight how quickly measles viruses can spread, and become widely disseminated. Judging by the estimated dates of infection, it could be hypothesised that the person travelling on the plane with Patient A was in the early stages of measles, and transmitted infection to the German co-passenger and then to other cases in London, but that does not explain the index case in France. It is more likely that there were at least two independent importations of this G3 genotype to Europe (to France and the UK), and some early G3 infections have been missed. Almost certainly, the pocket of G3 measles infection in France has continued, with ongoing identification of G3 measles cases in France, as well as three further cases of G3 measles in the UK and two cases in Russia in February and March 2011, all with epidemiological links to infection in France. Similar small clusters of G3 measles cases have also recently been reported in Germany and the West Indies island of Saint Martin.

Conclusions

The number of identified G3 measles cases underestimates the true level of G3 measles activity in Europe, because not all infected individuals seek medical advice, and because in most countries samples suitable for genotyping are not routinely collected from all cases and therefore sequence information is not available. Routine collection of oral fluid from all cases with clinically suspected measles does allow confirmation of infection by serological or molecular methods and offers the potential for widespread genotyping to identify sources of importations and tracking of infection. Genotyping and molecular characterisation of circulating measles viruses are of increasing importance in confirming the absence of endemic infection in each country as Europe aims for the elimination of measles by 2015 [1].

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The impact of the 2009 influenza A(H1N1) pandemic on attitudes of healthcare workers toward seasonal influenza vaccination 2010/11

C Brandt[1], H F Rabenau[2], S Bornmann[3], R Gottschalk[4], S Wicker (sabine.wicker@kgu.de)[5]
1. Institute of Medical Microbiology and Infection Control, Hospital of the Johann Wolfgang Goethe-University, Frankfurt, Germany
2. Institute of Medical Virology, Hospital of the Johann Wolfgang Goethe-University, Frankfurt, Germany
3. Institute of Occupational, Social and Environmental Medicine, Friedrich-Schiller-University, Jena, Germany
4. Health Protection Authority, City of Frankfurt am Main, Frankfurt, Germany
5. Occupational Health Service, Hospital of the Johann Wolfgang Goethe-University, Frankfurt, Germany

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The emergence of the influenza A(H1N1)2009 virus provided a major challenge to health services around the world. However, vaccination rates for the public and for healthcare workers (HCWs) have remained low. We performed a study to review the reasons put forward by HCWs to refuse immunisation with the pandemic vaccine in 2009/10 and characterise attitudes in the influenza season 2010/11 due to the emergence of influenza A(H1N1)2009. A survey among HCWs and medical students in the clinical phase of their studies was conducted, using an anonymous questionnaire, at a German university hospital during an influenza vaccination campaign. 1,366 of 3,900 HCWs (35.0%) were vaccinated in the 2010/11 influenza season. Of the vaccinated HCWs, 1,323 (96.9%) completed the questionnaire in addition to 322 vaccinated medical students. Of the 1,645 vaccinees who completed the questionnaire, 712 had not been vaccinated against the influenza A(H1N1)2009 virus in the 2009/10 season. The main reason put forward was the objection to the AS03 adjuvants (239/712, 33.6%). Of the HCWs and students surveyed, 270 of 1,645 (16.4%) stated that the pandemic had influenced their attitude towards vaccination in general. Many German HCWs remained unconvinced of the safety of the pandemic (adjuvanted) influenza vaccine. For this reason, effective risk communication should focus on educating the public and HCWs about influenza vaccine safety and the benefits of vaccination.

Introduction

Healthcare workers (HCWs) are at risk of occupational exposure to influenza and when infected, may transmit the disease to vulnerable patients [1-3]. The most important prevention strategy is immunisation [4]. However, despite official recommendations, e.g. from the World Health Organization (WHO), the European Union [5] and the Robert Koch Institute (RKI) in Germany, and the availability of a safe effective and well-tolerated vaccine, acceptance of seasonal influenza vaccine among HCWs is problematic and leads to low coverage, as detailed in many studies from all over of the world [6-10].

High influenza vaccination rates among HCWs can reduce the spread of influenza in healthcare facilities and help maintain a sustainable and effective healthcare workforce. Rumours and fears such as 'the vaccine does not work' or 'the vaccine causes flu' about a vaccine for which substantial health-related and economic benefits have been demonstrated also for healthy adults, should not hinder vaccination of HCWs because this ultimately compromises patient safety and public health [11,12].

During the influenza A(H1N1) pandemic in 2009/10 many HCWs worldwide expressed concerns about the safety of the monovalent pandemic vaccine and refused to receive it because it was a 'new' vaccine, 'untested', and 'rushed to the market' [13]. For most, the infection with influenza A(H1N1)2009 virus turned out to be less severe than first feared, however, severe disease and deaths occurred not only in the traditional risk groups for influenza but also in healthy young people and pregnant women [14]. However, if the virus had been more pathogenic and virulent, the impact of the pandemic could have been devastating [13].

A population of vaccinated, working and informed HCWs is crucial for an effective response to the burden of influenza and the mitigation of the associated morbidity and mortality [15]. Although we do not know which influenza virus subtype will cause possible future pandemics, a number of lessons can be learned from the influenza A(H1N1)2009 pandemic in 2009/10. Healthcare organisations and policy makers need to rethink current practices and ought to wonder whether voluntary influenza immunisation programmes for HCWs, which do not lead to satisfactory vaccination rates, are adequate to protect patient safety with regards to both seasonal and pandemic influenza [11,16].

The influenza H1N1/09 pandemic was discussed with HCWs of the university hospital Frankfurt for the first time in July 2009, when the first cases became hospitalised. In order to prevent transmission, HCWs caring for patients with respiratory symptoms were obliged to wear a surgical mask. Moreover, HCWs were instructed to wear a FFP2 mask during direct contact with a patient with laboratory confirmed 2009 pandemic influenza A(H1N1) when they had not been vaccinated against the relevant virus. The pandemic vaccine became available from 26 October, 2009. The uptake of the pandemic vaccination at the university hospital Frankfurt was 36.3% in the 2009/10 season.

We conducted a cross-sectional study to characterise the reasons why HCWs vaccinated against influenza in 2010/11 had refused the pandemic vaccine in 2009/10 at a time when it was unclear how the pandemic would unfold. Further, we evaluated their attitudes towards the pandemic. In this paper, we describe why the results support the need for well-defined risk communication.

Study population and questionnaire

The Frankfurt University Hospital is a 1,169-bed hospital with approximately 3,900 employees including 726 physicians, 1,300 nurses and 850 medical technicians. It has approximately 42,000 in-patient admissions and about 200,000 out-patients per year. At the Frankfurt Medical School, which is organisationally within the Frankfurt University Hospital, there are approximately 3,300 medical and dental students, including 1,200 medical students who are in the clinical phase of their studies. A comprehensive influenza vaccination campaign, which included publicity (posters, leaflets), education (information sessions), and vaccination started in the influenza season 2003/04. Influenza vaccination as well as advice to HCWs is offered by the occupational health service of the university hospital. In the past seven years we achieved an improvement in seasonal influenza vaccination uptake from 3.2% in 2002/03 to 40.5% in 2009/10.

To address why higher vaccination uptakes were not met during the pandemic 2009/10, we developed a questionnaire for 2010/11, after reviewing published studies on reasons why HCWs accept or refuse influenza vaccination and after conducting a preliminary survey one week before the vaccination campaign with 20 HCWs. The final questionnaire comprised seven closed questions divided into three areas: demographic data (age, sex, profession group, field of work), acceptance of the pandemic influenza A(H1N1)2009 vaccination in 2009/10, and attitudes in response to the pandemic. HCWs and medical students who came to get the seasonal influenza vaccine between October 2010 and February 2011 were asked to complete this anonymous self-administered questionnaire and to return it in a locked box.

Ethical considerations

Participants were informed that all the information gathered would be anonymous and kept confidential. Participation was voluntary, completion of the questionnaire implied consent for study participation. Participants cannot be identified from the material presented.

Statistical analysis

The statistical analysis of the frequency distributions was done using a two-tailed Pearson's chi-square test. The threshold p-value for statistical significance was set to $p<0.05$. The questionnaire was not based on a priori hypotheses; nevertheless, an α-adjustment was made with 14 and five four-field tables, using the Bonferroni post-test which considered selective (local) p-values of

TABLE 1

Demographic characteristics of participants, healthcare workers and medical students at Frankfurt University Hospital, October 2010–February 2011 (n=1,645)

Age (years)	n	%
Up to 30	648	39.4
31–40	434	26.4
41–50	337	20.5
51–60	191	11.6
Over 60	35	2.1
Sex		
Male	663	40.3
Female	982	59.7
Job description		
Physicians	505	30.7
Medical students	322	19.6
Nurses	394	23.9
Medical technicians	104	6.3
Administrative personnel	164	10.0
Maintenance, catering, workshop, transport	77	4.7
Others	79	4.8
Field of work		
Anaesthesia	144	8.8
Ophthalmology	24	1.5
Surgery	118	7.2
Dermatology	48	2.9
Gynaecology	53	3.2
Ear, nose and throat	20	1.2
Internal Medicine	338	20.5
Psychiatry	53	3.2
Paediatrics	145	8.8
Radiology	74	4.5
Neurology	86	5.2
Other department or not specified	542	32.9

p≤0.0036 (Table 2) and p≤0.01 (Table 3) as statistically significant at the global overall significance level of α=0.05. The significance calculations were made using the program BiAS for Windows 9.04 (Epsilon Verlag, Hochheim Darmstadt 2009). Furthermore, 95% confidence intervals (CI) were calculated.

Results

From October 2010 to February 2011, 1,366 of 3,900 (35.0%) HCWs of the University Hospital Frankfurt were vaccinated with the seasonal trivalent influenza vaccine. In total, 1,323 vaccinated HCWs (response rate 96.9%) and 322 of 1,200 (26.8%) medical students in the clinical phase of their studies at the Frankfurt Medical School completed the anonymous questionnaire and were vaccinated against influenza. All 1,645 questionnaires could be analysed. Overall 982 of 1,645 (59.7%) participants were female, and 663 of 1,645 (40.3%) were male, in accordance with the sex distribution of employees and student body at the university. Demographic characteristics of the study population are shown in Table 1.

Table 2

Healthcare workers reasons for refusing the AS03 adjuvanted pandemic influenza vaccine in the 2009/10 influenza season, Frankfurt University Hospital, October 2010–February 2011 (n=1,645)

Reason	Total persons (n=712) number percentage (95% CI)	Physicians (n=100) number percentage (95% CI)	Nurses (n=202) number percentage (95% CI)	Physicians vs nurses p value	Students (n=192) number percentage (95% CI)	Others (n=218) number percentage (95% CI)
No personal risk of contracting influenza	238 33.4% (30.0–37.0)	27 27.0% (18.6–36.8)	47 23.3% (17.7–29.7)	0.478	89 46.4% (39.1–53.7)	75 34.4% (28.1–41.1)
No severity of influenza illness	96 13.5% (11.1–16.2)	12 12.0% (6.4–20.0)	21 10.4% (6.6–15.5)	0.674	33 17.2% (12.1–23.3)	30 13.8% (9.5–19.1)
Vaccine does not work	86 12.1% (9.3–14.7)	11 11.0% (5.6–18.8)	22 10.9% (7.0–16.0)	0.977	31 16.1% (11.2–22.1)	22 10.1% (6.4–14.9)
Fear of side effects	187 26.3% (23.0–29.7)	25 25.0% (16.9–34.7)	66 32.7% (26.3–39.6)	0.171	43 22.4% (16.7–29.0)	53 24.3% (18.8–30.6)
Fear of adjuvants	239 33.6% (30.1–37.2)	35 35.0% (25.7–45.2)	83 41.1% (34.2–48.2)	0.307	47 24.5% (18.6–31.2)	74 33.9% (27.7–40.6)
Fear of needles	11 1.5% (0.8–2.7)	1 1.0% (0.0–5.4)	6 3.0% (1.1–6.4)	0.284	0 0% (0.0–1.5)	4 1.8% (0.5–4.6)
Vaccine causes flu	28 3.9% (2.6–5.6)	3 3.0% (0.1–8.5)	15 7.4% (4.2–12.0)	0.126	3 1.5% (0.3–4.5)	7 3.2% (1.3–6.5)
No time – too busy	52 7.3% (5.5–9.5)	12 12.0% (6.4–20.0)	7 3.5% (1.4–7.0)	0.004	19 9.9% (6.1–15.0)	14 6.4% (3.6–10.5)
Forgotten	36 5.1% (3.6–6.9)	6 6.0% (2.2–12.6)	8 4.0% (1.7–7.7)	0.428	12 6.3% (3.3–10.7)	10 4.6% (2.2–8.3)
Missed vaccination days at the hospital	31 4.4% (3.0–6.1)	7 7.0% (2.9–13.9)	7 3.5% (1.4–7.0)	0.169	10 5.2% (2.5–9.4)	7 3.2% (1.3–6.5)
Media hype alienated me	104 14.6% (12.1–17.4)	7 7.0% (2.9–13.9)	32 15.8% (11.1–21.6)	0.031	21 10.9% (6.9–16.2)	44 20.2% (15.1–26.1)
Insufficient information about vaccine	38 5.3% (3.8–7.3)	5 5.0% (1.6–11.3)	10 5.0% (2.4–8.9)	0.985	14 7.3% (4.0–11.9)	9 4.1% (1.9–7.7)
GP advised against pandemic vaccine	46 6.5% (4.8–8.5)	2 2.0% (0.2–7.0)	13 6.4% (3.5–10.8)	0.095	10 5.2% (2.5–9.4)	21 9.6% (6.1–14.3)
Got no appointment with GP	3 0.4% (0.1–1.2)	0 0% (0.0–2.9)	1 0.5% (0.0–2.7)	0.481	2 1.0% (0.1–3.7)	0 0% (0.0–1.4)

CI: confidence interval; GP: general practitioner.

Multiple answers were possible and 1,195 answers were provided. Overall 43.3% (712 of 1,645) of the participants of the study were not vaccinated with the pandemic vaccine.

When asked how much time the participants provided care to immunocompromised patients (i.e. haematology, oncology, intensive-care units), 576 (35%) of the respondents stated daily, 411 (25%) occasionally, and 658 (40%) never.

Of all respondents, 933 (56.7%) stated that they had been vaccinated with the AS03-adjuvanted pandemic vaccine in the 2009/10 influenza season. The 712 (43.3%) respondents who had not received this vaccine were asked to provide the reasons for this. The main reason for not getting vaccinated was the objection to the AS03 adjuvants (239/712, 33.6%), closely followed by the belief that they personally were unlikely to catch influenza (238/712, 33.4%) (Table 2). Regarding these two frequently mentioned reasons there was no significant difference between physicians and nurses ($p=0.352$) (Table 2) or between women and men ($p=0.426$). No significant differences ($p<0.05$) in answers to all 14 questions stated in Table 2 could be seen between HCWs who were in daily contact with immunocompromised patients (165/712, 23.2%) and HCWs with occasional or no contact with such patients. However, men (45/246, 18.3%) stated more often than women (51/466, 10.9%) that they did not get vaccinated with the pandemic vaccine because they did not perceive the influenza A(H1N1)2009 virus infection as a severe disease ($p=0.006$). On the other hand more women (137/466, 29.4%) than men (50/246, 20.3%) noted that they had refused the pandemic vaccine because they had feared side effects ($p=0.009$).

Of the 1,645 HCWs surveyed, 270 (16.4%) cited that the 2009 influenza A(H1N1) pandemic influenced their attitudes towards vaccination in general (Table 3). Nurses (59/87, 67.8%) stated more often than physicians (36/73, 49.3%) that due to the pandemic it became clear that influenza is a severe disease ($p=0.018$), and also more nurses (21/87, 24.1%) than physicians (8/73, 11.0%) noted that they were concerned owing to the media hype ($p=0.031$). Otherwise, physicians stated more often than nurses (43.8% versus 25.3%) that they had had a positive experience with reference to the influenza vaccination ($p=0.013$) (Table 3).

Discussion

Increasing the public's acceptance of the influenza vaccination might be more challenging than addressing the scientific challenges involved in producing a safe and effective influenza vaccine [14]. Because a large number of people refuse to be vaccinated, it is important to understand the attitudes of the public and HCWs towards influenza vaccination [14]. It is therefore not enough to provide a safe vaccine, one also needs to convince the public to accept it. We attempted to understand the reasons of HCWs for not accepting the pandemic influenza A(H1N1)2009 vaccine as well as the impact of the pandemic on attitudes toward influenza infection.

The study showed that many German HCWs were unconvinced of the safety of the pandemic influenza vaccine. Fear of adjuvants was the most common reason cited for refusal of the adjuvanted pandemic vaccine. Since the 18th century, fear and mistrust have arisen every time a new vaccine has been introduced [17]. For this reason, communication is an issue which requires constant improvement. The media plays an

Table 3

Changes in attitudes following the emergence of pandemic influenza A(H1N1)2009, healthcare workers at Frankfurt University Hospital, October 2010–February 2011 (n=270)

	Total persons (n=270) number percentage (95% CI)	Physicians (n=73) number percentage (95% CI)	Nurses (n=87) number percentage (95% CI)	Physicians vs nurses p value	Students (n=40) number percentage (95% CI)	Others (n=70) number percentage (95% CI)
Pandemic created awareness for immunisations and caused me to check my vaccination card	51 18.9% (14.4–24.1)	20 27.4% (17.6–39.1)	9 10.3% (4.8–18.7)	0.010	17 42.5% (27.4–59.1)	5 7.1% (23.6–15.9)
Due to the pandemic it became clear that influenza is a severe disease	148 54.8% (48.7–60.9)	36 49.3% (37.4–61.3)	59 67.8% (56.9–77.4)	0.018	17 42.5% (27.4–59.1)	36 51.4% (39.2–63.6)
I had a positive experience with the influenza vaccination, therefore I am going to get vaccinated every year	84 31.1% (25.6–37.0)	32 43.8% (32.2–55.9)	22 25.3% (16.6–35.7)	0.013	8 20.0% (9.1–35.6)	22 31.4% (20.9–43.6)
Media hype alienated me and lowered my confidence in vaccination policies	50 18.5% (14.1–23.7)	8 11.0% (4.8–20.5)	21 24.1% (15.6–34.5)	0.031	1 2.5% (0.1–13.2)	20 28.6% (18.4–40.6)
Having heard a lot about adjuvanted vaccines and side effects, I became sceptical towards vaccinations	61 22.6% (17.7–28.1)	13 17.8% (9.8–28.5)	19 21.8% (13.7–32.0)	0.526	7 17.5% (7.3–32.8)	22 31.4% (20.9–43.6)

CI: confidence interval.

Multiple answers were possible; 394 answers about risk perception were provided. Overall 16.4% (270 of 1,645) of the participants stated that the influenza A(H1N1)2009 pandemic influenced their attitudes towards vaccination in general.

important role in translating scientific information and in shaping the public's understanding of health issues and risk perception of infectious diseases [18]. Greater efforts in educating the public and HCWs about influenza vaccine safety and the benefits of vaccination are needed for an effective public health response [13].

To appreciate the results of our study, some potential limitations need to be addressed: Firstly, results from a single German academic institution may not be applicable to other institutions. Secondly, given that we only questioned HCWs who received the 2010/11 seasonal influenza vaccination, it is possible that HCWs who were not willing to get vaccinated may have had other reasons to decline the adjuvanted pandemic influenza vaccine. Thirdly, the social desirability bias, i.e. selecting a choice of answers considered as being socially most favourable may have lead to bias in our survey. Fourthly, it would have been interesting to compare the reasons to accept the seasonal influenza vaccination with the reasons for accepting or declining pandemic influenza immunisation. Unfortunately, we did not survey this in the present study.

For infectious diseases that potentially have a large impact on public health, risk communication is a particular challenge. Providing the public and HCWs with relevant information about an outbreak could decrease levels of concern by reducing levels of uncertainty about the nature, prevention or treatment of the infectious disease [19]. It is important to identify the most appropriate type of information which can be understood and trusted.

Problems along the way include the unacceptably low influenza vaccination rates amongst HCWs for more than three decades despite official vaccination recommendations [11,20], and the perception of the H1N1/2009 pandemic on behalf of the public that borders ignorance and hysteria [21,22]. It has to be communicated better that HCWs who do not get vaccinated are taking two risks: firstly, the risk of themselves contracting influenza, a potentially long and serious illness, and secondly, the risk of transmitting influenza to their patients. Patients have a right to expect that HCWs and the institutions in which they work will take all necessary and reasonable precautions to keep them safe and minimise harm. The healthcare system will have to define a strategy to reach a sufficient influenza vaccination coverage among HCWs [11,16].

In conclusion, many German HCWs were unconvinced of the safety of the adjuvanted influenza vaccine. Greater efforts to educate HCWs about influenza vaccine safety and the need to increase influenza vaccination rates to ensure patient safety are of the utmost importance.

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Conflict of interest

The views in this article are the personal views of the authors and do not necessarily represent the views of the professional organizations or institutions within which we are members.
Sabine Wicker is a member of the German Standing Committee on Vaccination (STIKO) at the Robert Koch Institute (RKI). She has been a member of an advisory board on nasal influenza vaccines for AstraZeneca Germany. She has received honoraria for non-product-related talks on influenza vaccination from GlaxoSmithKline, Sanofi Pasteur, and Novartis.

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Innovations in communication: the Internet and the psychology of vaccination decisions

C Betsch (cornelia.betsch@uni-erfurt.de)[1]
1. University of Erfurt, Erfurt, Germany

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This paper provides a psychological perspective on the possible effect of the Internet on the decision against vaccination. The reported importance of the Internet in health decisions is still low, but rising; especially the amount of interactive use of the Internet is increasing, e.g. due to the use of social media. It is argued that the fact that individuals do not report the Internet to be an important source of information does not necessarily mean that the information obtained in their Internet searches is not influential in their decisions. Evidence is summarised here regarding the (anti-)vaccination information on the Internet, and its influence on risk perceptions and on vaccination intentions and behaviour in relation to the encoded information. The conclusion suggests that scholars should strive to explain the underlying processes and potential mediators of vaccination decisions to increase the effectiveness of health communication. In reference to a definition of evidence-based medicine, a great future challenge lies in evidence-based public health communication based on interdisciplinary research involving public health, medical research, communication science and psychology.

Vaccine-preventable diseases are a great challenge to public health in the European Union (EU) [1]. Societies and public health profit from vaccinations. However, vaccination has become a victim of its success [2]: Many Europeans no longer perceive a threat from a number of vaccine-preventable diseases, while the risks of suffering from various side effects of vaccinations have become more central to their decision. Anti-vaccination arguments that question the safety of vaccines are disseminated through various channels, especially the Internet [3]. A recent example is the quick spread on the Internet of the idea that influenza (H1N1)2009 vaccines contain a substance that causes the Gulf War Syndrome [4]. As a result, Europeans might decide against receiving vaccinations for themselves or their children. Analyses show that the decrease in vaccination rates due to anti-vaccination movements has lead to epidemic outbreaks with severe health consequences and long-term damage to the trust in specific vaccinations, for instance the measles-mumps-rubella (MMR)-scare in the United Kingdom (UK) [5]. As a consequence of suboptimal vaccination coverage the World Health Organization (WHO) failed to reach the goal to eliminate measles until 2010; the new target is measles elimination by 2015.

This paper takes a first step in exploring the role of the Internet in influencing anti-vaccination decisions from a psychological perspective and examines how vaccination risk perception and decision process are affected by information on the Internet. The main points were also presented at the 2010 Eurovaccine conference [6]. From a psychological point of view it is assumed that during the pre-decisional phase of the decision process, the problem at hand (to vaccinate or not) is identified and the person making the decision acquires the necessary information, e.g. via an Internet search (see Figure 1) [7]. In the selectional phase, potential outcomes of the alternatives are evaluated (appraisal, e.g. the risk of suffering from side effects after vaccination). Finally the decision is made. In the post-decisional phase the decision needs to be implemented and the person making the decision receives feedback (e.g. about the actual occurrence of side effects). All information is stored in the memory and will influence future decision processes. This paper focuses mainly on information search, its influence on risk perceptions, vaccination intention and finally behaviour.

The Internet as a source of health information

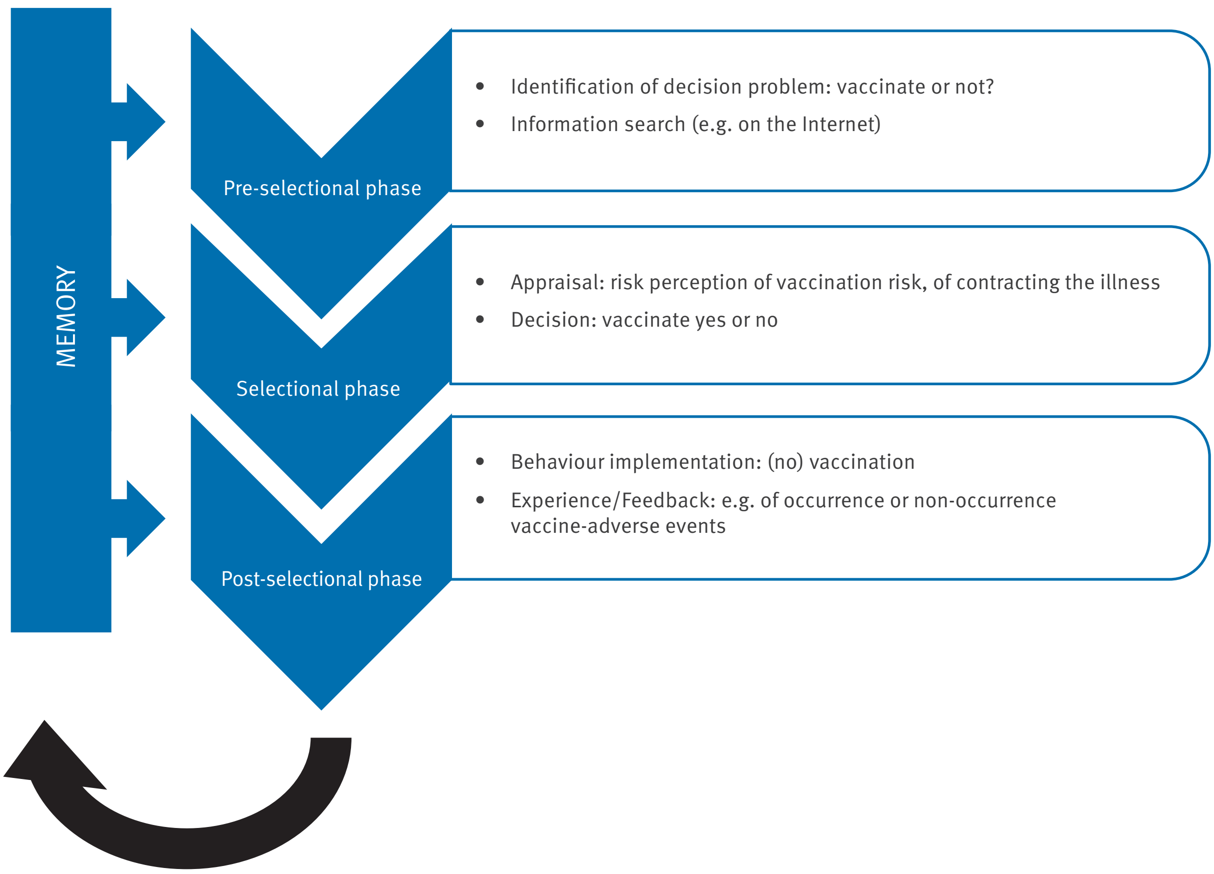
The study 'e-health Trends in Europe' investigated who searches the Internet for health-related information, how often and how. Two independent surveys, separated by an interval of 18 months, were conducted in 2005 and 2007 with representative samples (N=14,956) from seven European countries: Denmark, Germany, Greece, Latvia, Norway, Poland, and Portugal. The results revealed an increase in this time period from 42% to 52% of the population who surf the Internet for health information [8]. There is a tendency towards a more interactive use of information especially among 'digital natives' (i.e. those who grew up with the Internet). However, it is also striking that in comparison to other available information the Internet is perceived to have a very low importance for health decisions; the most important source are health professionals, followed by conventional media [8]. The fact that individuals report that they do not consider the Internet to be an important source does not necessarily mean that the information obtained in their frequent Internet searches does not influence their decisions. Internet information may still have an influence, if rather subtle. Psychological research underlines that informational influence on perceptions and behaviour is not always conscious, consider for example accessibility effects, the influence of affect, automatic information processing, implicit learning, etc. [9]. Thus, in order to assess the potential influence of the Internet we need to consider (i) the information obtained on the Internet, (ii) its influence on risk perceptions as predictors of vaccination behaviour [10,11] and (iii) vaccination intentions and behaviour in relation to the processed information.

(Anti-)vaccination information on the Internet

In general, the probability with which correct information about infectious disease prevention can be found on the Internet varies dramatically: In a study concentrating on Australia, Canada, the UK and the United States (US), Internet searches for the term 'hand cleaning' during the pandemic in 2009 led to the WHO recommendations on preventive actions in 75–80% of the hits [12]. Thus, the probability to find reliable information was relatively high. In contrast, in a different analysis only 51% of the information sources that were found regarding the relation between the MMR vaccine and autism gave the correct answer [13]. Moreover, in a study in the US in 2009 analysing the first 10 hits that parents received on Google.com for either of the three search terms 'vaccination', 'vaccine', and 'immunization OR immunisation', 21 of the total 30 results were immunisation sites, of which five were classified as anti-vaccination; a combined sample with hits from the Canadian Google.ca returned a total of eight anti-vaccination websites from the first 30 hits [3]. The number of anti-vaccination websites obtained varied depending on the search term: 71% of sites returned for the term 'vaccination' but none of the sites found with the term 'immunisation' were classified anti-vaccination. The less specific the search term, the more anti-vaccination web-sites can be found [14]. Recent work suggests that the parents' knowledge about vaccination determines the complexity of a search term [14]: the more complete (in reference to an integrated expert model) their knowledge was, the more complex were the search terms that were proposed for an online information search (e.g. MMR vaccine as opposed to vaccination). This means that the people with less knowledge on the topic, who are more likely to conduct searches [14], will do so using less complex search terms which lead to more anti-vaccination websites.

Figure 1

Psychological view on a vaccination decision



In terms of page content, all eight vaccine-critical Internet sites analysed by [3] were concerned with vaccine safety and claim a causal relationship between vaccinations and illnesses of unknown origin, e.g. multiple sclerosis, autism, asthma and sudden infant death syndrome. Arguments are continually repeated, for example: vaccines erode immunity (seven of eight), create only temporary or ineffective immunity (seven of eight), contain many ingredients and preservatives that will make you sick (eight of eight), overwhelm children's immune systems, especially when administered in combination (three of eight). At the same time, treatments superior to vaccination are promoted, e.g. homeopathy (seven of eight). In addition, anti-vaccination websites are very well connected, as they all provide links to similar sites [3].

A key feature on seven of the eight examined websites was the inclusion of emotive appeals, such as pictures and stories of children who were supposedly harmed by vaccinations. An example for such descriptions of personal experiences, posted on a German website, reads as follows: 'My four year-old daughter received the five-in-one combination vaccine at nine months, she then had a fever for two weeks, was apathetic and had screaming fits, since then she has suffered from atopic dermatitis and many allergies. My son is now four months old and I don't know if I should get him vaccinated or not (...)'. Parents appear to have a preference for personal information when searching on health related topics, i.e. information from parent to parent: even parents-to-be already search for such information, mainly through internet forums (bulletin boards) where they can post questions that are then answered by other parents [15]. In this way, a communication tree is created documenting all posted questions and their subsequent answers. The information that was found in a German content analysis of a baby forum in 2008 revealed that only 19% of the postings contained scientific information while 68% had personal and emotional content [15]. The above-mentioned analysis of anti-vaccination web-sites [3] explicitly excluded sources that contain large amounts of personal narrative information, e.g. news groups, forums, and social media such as Facebook or Twitter. There is, for example, an anti-vaccination profile from New Zealand on Facebook with nearly 14,500 people 'liking' the page in April 2011, which implies that 14,500 users receive anti-vaccination updates, often several times a day. Moreover, during the influenza A(H1N1) pandemic 22.5% of tweets contained personal experiences about the illness or the vaccination [16]. Thus, past analyses probably largely underestimate the availability of (anti-)vaccination narratives on the Internet.

In summary, a Google search leads to vaccine-critical sites in about one of five hits on immunisation; these sites provide an abundance of critical arguments as well as emotive appeals against vaccination. Additionally, participation in social media or online forums grants access to a plethora of personal narrative information.

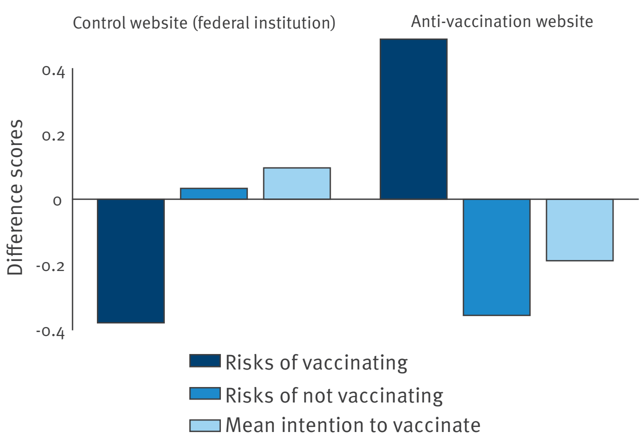
In the following, I will outline how this kind of information influences risk perceptions and vaccination intentions.

Effects of the Internet on the perception of vaccination risks

In psychological theories of preventive behaviour the perception of risk (e.g. of a vaccine-preventable illness) is related to the omission and commission of preventive behaviour (e.g. vaccinations [11]). Numerous studies show that risk represents a general predictor of preventive health behaviour [10]. However, beliefs about the risk of the preventive action, e.g. the risk of suffering from vaccine adverse events, are rarely in the focus of psychological research [10] and have only recently attracted notice. An online study demonstrated that anti-vaccination information on the Internet has a particular impact on the perceived risk of vaccinating [17]: Participants were randomly assigned to real Internet sites, either a Swiss vaccine-critical or a neutral control site (of the German Federal Centre for Health Education, BZgA). The effect of vaccine-criticism was examined by assessing (via self-report measures) the perceived risks of vaccinating and not vaccinating as well as vaccination intentions before and after the information search. The results of this study show that even a short search on vaccine-critical Internet sites can lead to considerable changes in risk perceptions. After viewing the vaccine-critical site, risks of vaccinating were perceived to be greater than before, while the perceived risks of not vaccinating had decreased (Figure 2, [17]). Assessments of these parents' intentions to have their own children receive four of the vaccinations recommended by the German Standing

Figure 2

Changes in risk perceptions and vaccination intentions dependent on search environment, Germany, September 2008



The 223 participants who searched 5–10 minutes on an anti-vaccination website (right panel) perceived a higher risk of vaccination, a lower risk of not vaccinating, and their vaccination intentions for four recommended vaccinations decreased compared with their answers before the Internet search. The risk perception regarding vaccination was lower among participants who searched a control site from a federal institution; None of the other answers in this group changed after viewing of the control site [17].

Committee on Vaccination (STIKO) also indicated an effect of viewing the vaccine-critical site, as the mean intention to accept the four vaccinations decreased significantly. A reduction in the perceived risks of vaccinating after viewing the control site indicated that the displayed information apparently induced trust in the safety of the procedure. This group did not change their perception of the risks of not vaccinating.

To assess long-term effects of the vaccine-critical information, participants were contacted again five months after the initial study [18]: Participants (both groups) who had perceived higher vaccination risks after the initial study still perceived potential vaccination injuries to be more likely and more severe than participants who had perceived lower vaccination risks. In addition, participants who had perceived greater vaccination risks had repeatedly searched for vaccine-critical information during the five months (e.g. in discussions with their paediatricians or additional Internet searches with a focus on narratives and statistics). Moreover, parents who perceived the risks of vaccinating to be high after the information search had their children vaccinated with fewer vaccines than recommended or not at all in the five-month period. Conversely, children of parents who gained the impression during the information search that not vaccinating leads to considerable risk had received more vaccinations during the five-month period.

The anti-vaccination websites analysed in this study [17] contained significantly more narrative information than the control website. Reading narratives about vaccine-adverse events has been shown to be a critical factor of the effects of Internet anti-vaccination information. But what makes narratives so powerful? Study results show that personal and emotional descriptions of adverse events have an effect on readers' emotions – they cause the reader to feel threatened [17,19]. This emotion then influences perceptions of risks, which, in turn, affect vaccination intentions. The more narratives of vaccine-adverse events a person reads, and the more emotional these are, the greater the person perceives potential risks of vaccinating to be. Through this effect on risk perceptions, such narratives can negatively influence vaccination intentions [19].

Promoting vaccination on the Internet by successful communication strategies

When designing e-health websites and promoting messages for preventive behaviour, the core-message of vaccine-prevention appeals - 'Have your child vaccinated!' – can be formulated by using either a fear appeal ('Measles can lead to brain damage!') or a prevention appeal ('Prevent measles!'). Given that some parents fear vaccinations, should fear be fought with fear? Or are campaigns more successful when they build upon prevention appeals? Campaigns that are very successful when used on community billboards (e.g. 'Daniel, 10, brain-damaged after a measles infection', a successful campaign in a German federal state in 2009), may have a less positive or even negative impact when used on the Internet, where they are likely to appear in the context of vaccine critical information. Thus, the effects of campaigns and appeals must be evaluated in the context in which they are used. A recent study assessed the effect of prevention and fear appeals on people who were exposed to a vaccine-critical Internet forum [20]: Vaccination intentions were lower when a fear appeal referred to the negative consequences of not vaccinating than when a prevention appeal encouraged protection against measles. Instead of increasing awareness about the risks associated with the illness and thereby positively affecting the intention to vaccinate, fear appeals had the opposite effect. Apparently, study participants were unable to identify the source of their negative emotions, resulting in decreased vaccination intentions. The findings raise the question of which campaign method is appropriate in the context of vaccine-critical information on the Internet: perceptions of illness-related risks could be increased or perceptions of vaccinations risks decreased. It is necessary to learn more about how perceptions of both of these types of risk influence vaccination intentions to make an informed campaign decision [20].

When focusing on the aim of decreasing the perceptions of vaccination risks, one possible means could be to inform the public about why the typical objections of anti-vaccination activists are false. This was done by a collaborative Internet publication of two German federal institutes (Robert Koch Institute, Paul Ehrlich Institute [21). In this publication, vaccination risks are largely negated by explaining relationships in a generally understandable manner, empirical studies are quoted and the critical arguments invalidated to the greatest possible extent. The Internet allows fast and easy dissemination of the contents and everyone is free to adapt the phrasing to their needs – e.g. by placing particular emphasis on the negation of a risk (e.g. to persuade consumers of the safety of a vaccine). To analyse the effect of different degrees of risk negations, two experiments used variations of the same risk negations as used in the above publication [21], where single sentences within longer scientific explanations were negating risk either in a strong or in a weak manner (e.g. 'Specific vaccines can indeed produce illness-like symptoms; however, the complete illness will never appear (strong) / will appear extremely rarely (weak)'). Both studies showed that stronger risk negations paradoxically led to higher risk perceptions, while weaker negations led to lower risk perceptions (unpublished data). This effect also depends on how trustworthy the source of the information is. The Internet publication that negates typical objections of anti-vaccination activists [21] can also be found on the Internet sites of pharmaceutical companies. Pharmaceutical companies and public organisations are trusted to different degrees where vaccine-related questions are concerned: governmental institutions are considered to be the most and pharmaceutical companies the least trustworthy (unpublished data).

Trust in the information source has been shown repeatedly to be a relevant factor of the effect of risk communication [22]. Especially strong denials by a source that is not trustworthy increased the risk perception (unpublished data). The results imply that only minimal changes in risk negations might have noticeable effects on outcome variables. Decisions against vaccination might thus not only be influenced by anti-vaccination information, but also result from suboptimal risk communication.

Future perspectives

The omnipresence of easily accessible social media applications challenges prior approaches to aided decision making. Computerised decision aids are available that aim at 'presenting evidence on options, benefits and harms, helping patients to clarify which outcomes are important' [23]. The Internet is increasingly used to provide decision aids online. One future goal might be to develop e-health decision aids that merge an innovative social media system and a classical decision aid approach. Until such technological possibilities can be fruitfully applied, several basic questions have to be answered, such as how interactivity can be used to improve risk judgments [24] and whether changes in knowledge relate to changes in Internet information search and risk perception at all [14]. Such questions call for structured interdisciplinary research.

Scholars from the public health sector, medical research, communication science and psychology are concerned with the role of the Internet and its impact on health decision making. Each discipline works on a different level of resolution and with different intentions (e.g. examining the mere frequency of use of the Internet versus assessing processes behind decisions based on the obtained information). The need for more interdisciplinary research has been mentioned repeatedly [25] with a focus on communication science and public health. This perspective paper aimed at highlighting the value of psychology in this context. Public health communication will profit from more research on the actual influence of the obtained information instead of gathering self-reports about the relative importance of the Internet. If we strive for effectively using the Internet for public health, we need academic exchange and evidence-based interventions. We must cautiously evaluate new technical developments and innovative tools. Only if we consider the underlying processes and potential mediators can effective health communication take place. In reference to a definition of evidence-based medicine [26], a great future challenge exists in installing evidence-based public health communication as the 'conscientious, explicit and judicious use of current best evidence in making decisions' about the use of public health messages.

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European institutes for disease prevention and control collaborate to improve public health surveillance

A Hulth (anette.hulth@smi.se)[1], A C Viso[2]
1. Smittskyddsinstitutet (Swedish Institute for Communicable Disease Control, SMI), Stockholm, Sweden
2. Institut de Veille Sanitaire (French Institute for Public Health Surveillance, INVS), Saint Maurice, France

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A new Public Health Action Programme called Triple-S (Syndromic Surveillance Survey, Assessment towards Guidelines for Europe) started in September 2010 and will end in August 2013. The aim of the Triple-S project is to increase the European capacity for real time or near real time surveillance and monitoring of the health burden of expected and unexpected health-related events. During the period mentioned, the project will review and analyse European syndromic surveillance systems for both human and animal health. The project, which is co-financed by the European Commission through the Executive Agency for Health and Consumers, involves 24 organisations from 13 countries.

Syndromic surveillance monitors in near real time the spread and impact of health-related events in a population. These events range from infectious diseases to environmental hazards and the surveillance is based on the presence of signs and symptoms. Examples of sources used are data from emergency departments, pharmacy sales, telephone helplines, web queries and data that may reveal animal production collapse.

A core activity for the project is the creation of an inventory of syndromic surveillance systems in Europe (planned, pilot, existing and expired). To this end, a network of contact persons will be created and a questionnaire will be developed and sent to this network. The information collected will be analysed and stored in a specifically designed database, which will be updated during the entire duration of the project. A review of syndromic surveillance systems in the veterinary agencies in the European Union (EU) Member States will also be conducted. A specific questionnaire for this review will be adapted from the questionnaire on human health syndromic surveillance systems. Individuals who have information related to human or animal syndromic surveillance systems in a particular country are encouraged to visit the Triple-S website and read more on possibilities to participate in the surveys.

To facilitate knowledge exchange between representatives of syndromic surveillance systems in different EU Member States, eight visits will be organised for project partners and external participants between June 2011 and May 2012. During the visits, detailed information on the syndromic surveillance systems, strengths and weaknesses, experiences and lessons learnt, and the importance of different determinants of syndromic surveillance will be discussed. Institutions interested in visiting syndromic surveillance systems for knowledge exchange can find more information on the Triple-S website.

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