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Defining contagion literacy: a Delphi study

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ABSTRACT

Against the background of climate change, which enables infectious diseases to move their frontiers and the increasing global mobility, which make people more exposed to contagion, we as citizens need to relate to this new scenario. A greater number of infectious diseases may also potentially lead to an increased need to use antibiotics and anti-parasitic substances. In view of this, the aim of this study was to identify the health literacy needed in the contemporary world and specify what should be taught in compulsory school. We present the findings of a Delphi study, performed in Sweden, regarding the opinions on contagion among experts in the field. We used Nutbeam's framework of health literacy and related it to Bloom's taxonomy of educational objectives in order to analyse and categorise the experts' responses, which were categorised into six main content themes: *contagions, transmission routes, sexually transmitted diseases, hygiene, vaccinations and use of antibiotics and antibiotic resistance*. These themes were then divided into the three levels of Nutbeam's framework: *functional health literacy,* which is about knowledge and understanding, *interactive health literacy,* which is about developing personal qualities and skills that promote health, and *critical health literacy,* which is about social and cognitive skills related to analysis and critical reflection. The implications for communication and education are then discussed and what should be taught in compulsory school is identified.

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Antibiotic resistance; contagion; Delphi study; health literacy; learning progression; science education; scientific literacy

Rationale and introduction

The climate is changing all over our planet. Some impacts of climate change on health have already been observed (Watts et al., 2015). Climate change is expected to have an impact on the spread of already domestic diseases, but also to introduce and/or establish new infectious diseases in many places of the world (Smittskyddsinstitutet, Socialstyrelsen, & Statens veterinärmedicinska anstalt, 2011). Not long ago we have actually seen the spread of rift valley fever, swine flu, Ebola and lately the Zika virus. In a report from 2014, the Swedish Meteorological and Hydrological Institute states that the health of humans and animals can be affected due to a warmer climate (Sveriges meteorologiska och hydrologiska institut, 2014). These climate-sensitive diseases are commonly using a vector for their distribution, and according to an inventory of mosquito species in

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Europe, we already have vectors that can carry some of the diseases we find in the warmer climate (Sveriges meteorologiska och hydrologiska institut, 2014). The links between climate change and vector populations may become significant in areas where the temperature is currently the most limiting factor (Watts et al., 2015).

Increasing globalisation also leads to increased spread of vectors and diseases, through the movement of both people and animals between countries (Sveriges meteorologiska och hydrologiska institut, 2014). A greater number of incidences of infectious diseases may potentially lead to an increased need to use antibiotics and anti-parasitic substances. This can lead to further increased development of resistance in microorganisms and parasites (Smittskyddsinstitutet, Socialstyrelsen, & Statens veterinärmedicinska anstalt, 2011), which is already a major problem. According to André et al., the Swedish public is to a large extent aware of the problem of antibiotic resistance, but lacks important knowledge about how resistance develops (Andre, Vernby, Berg, & Lundborg, 2010).

We need to be prepared for these scenarios regarding the spread of contagions. There is a need for new and continuous updating of risk information, vaccination recommendations and the like to the public as a consequence of these changes. Because of the increased spread of contagions all around the world, we must reconsider what we need to know about these questions as responsible citizens, so we can meet future challenges. This study aims to address that gap and identify what we need to know about contagions so that this information can be included in the school curriculum of the compulsory school.

Against the background sketched above, we performed a Delphi study of professionals in a variety of relevant fields, such as medical researchers, physicians, nurses, as well as experts working with public health issues at relevant institutions. There are some general recommendations about important aspects of contagions issued by the Public Health Agencies and in different national curricula about the concepts to teach. However, these documents are often old and not very specific, and to our knowledge there has not been any systematic empirical study looking into this issue from a broad research and practice-based perspective, which is urgently needed now in view of the increasing threats to public health.

Background

Scientific literacy and health literacy

SL is needed to participate in the modern society where so many things are based on science. We need to comprehend events of daily life, and often these events are governed by the laws of science although they might take place in nature or society (Roberts, 2007). Therefore the public needs some kind of SL (Rundgren, Rundgren, Tseng, Lin, & Chang, 2012).

The concept of SL has been used since the late 50s, but has not always had the same meaning. Often these different meanings of SL have been related to how we make use of SL. One of the most commonly used definitions includes two visions of SL, which Roberts has termed Vision I and Vision II (Roberts, Abell, & Lederman, 2007). The goal of Vision I is to introduce us to science itself, its products and processes. It prepares us for further studies and professional practice. The goal of Vision II, on the other hand, is to make every citizen able to use the scientific knowledge and skills we learn in everyday

situations. It approaches SL by looking at situations where there are components of science and situations that people are likely to encounter as adult citizens. Historically, Vision I has been the starting point for Vision II by looking at processes in situations where science has a role. However, this view has been challenged as some researchers in science communication and education think that it is more important to start from a Vision II perspective, that is, start with a situation and then add the relevant science (Roberts, 2007). In this study, we have taken such an approach in order to identify the kind of knowledge a citizen needs regarding contagious diseases, and thus should be taught in compulsory school.

Different levels of SL

In the literature, SL is said to exist at two levels, a macro level and a micro level (Roberts et al., 2007). A macro-level perspective of SL is about collective well-being, democracy and social coherence. The better people understand science and how they might benefit from it, the more likely they are to support scientific progress in society (Laugksch, 2000). The micro level is more about SL for the individual. What do I as a citizen need to know about science in my daily life? This may involve better health decisions, greater confidence in science and reduced personal risk (Dillon, 2009). By understanding health information better, for example, and relying on the information provided, individuals may conceivably take greater responsibility for their own lives.

Despite the different definitions of SL, most researchers see the need to relate SL to the ability to function as a citizen in a community (home, work). Not only at the level of knowledge, but also in order to make decisions and act as a responsible person (Holbrook & Rannikmae, 2009). Hence, both levels are important for a literate person, and we include both of these levels in our study.

Framework of health literacy

The definition of health literacy (HL), given by the World Health Organisation in a health promotion glossary written by Don Nutbeam (1998, p. 357), states that 'health literacy represents the cognitive and social skills that are needed for individuals to gain access to, understand and use information about good health.' Being able to have access to health information and capacity to use it effectively will lead to empowerment (Nutbeam, 1998). Ratzan and Parker (2006) add that HL skills are needed for dialogue and discussion, reading health information and interpreting charts. It also includes using a thermometer or calculating timing or dosage of medicine (Ratzan & Parker, 2006). A commonly used definition of HL is 'the capacity to acquire, understand and use information in ways which promote and maintain good health' (Nutbeam, 2009, p. 304). In that way HL can be understood as specific knowledge about an individuals' health situation and how to improve it. Accordingly HL can be viewed as a subset of SL, and contagion literacy a subset of HL that relates to the body of knowledge needed by a citizen to be informed about issues related to infectious diseases and to improve health related to contagions.

There are only a few conceptual models of HL that can be used to identify and categorise HL, and Don Nutbeam's prototypical model is the most recognised one (Sørensen et al., 2012). This model is a three-level hierarchy (Nutbeam, 2000), which is a suitable construct for our analytical purposes since we want to structure the body of knowledge

needed for contagion literacy for a possible learning progression. It has been used, among others, in studies about patients' understanding of their disease.

The different levels of HL are distinguished by the different levels of knowledge and skills that relate to the acquisition, understanding and application of context-specific knowledge (Ratzan & Parker, 2006).

- The first level is *functional health literacy*, which refers to the ability to understand information about health risks, health conditions and how the health system can be used (Chinn, 2011). With basic knowledge at this level, the individual can participate fully in society. The individual benefits are improved knowledge of risks and health services and ability to follow prescribed actions (Nutbeam, 2000).
- The second level is *interactive health literacy*. Here, the focus is on developing personal qualities and skills that promote health. It involves improved capacity to act independently on knowledge about health issues. It also means improved self-confidence and motivation (Nutbeam, 2000). On this level, one should be able to use that knowledge from the first level to acquire new skills, like applying new information in a new context and combining different channels for communication.
- The third level is *critical health literacy*. It includes more advanced cognitive and social skills to actively participate and evaluate health activities. The individual should be able to critically review and analyse the information provided through television, newspapers, websites, etc. and to be able to extract information from different forms of communication. On this level, one has the knowledge needed for improving lifestyle choices and changing lifestyle if necessary (Nutbeam, 2000). Health status is influenced by individual characteristics and lifestyle, but it is also determined by social, economic and environmental circumstances of individuals and populations (Nutbeam, 2000). The individual should at this level be able to critically analyse these circumstances, which can help to better understand and use information in ways which promote and maintain good health for the individual and for the community in general.

Although Nutbeam's framework for HL is widely renowned in health education, it has its limitations as an analytical tool since it only involves three steps based on quite open-ended definitions. Therefore, in this study, we have operationalised Nutbeam's framework further by relating it to Bloom's taxonomy of learning objectives. Bloom's taxonomy is one of the most recognised and used instruments in educational sciences. In this study, we draw mostly on the cognitive domain in which the objectives for learning are classified and the categories lie along a continuum. We take our starting point in Anderson and Krathwohls' (Airasian, Anderson, Krathwohl, & Bloom, 2001) development of Bloom's taxonomy. It all starts with remembering and understanding something new, which is then applied in analysing, evaluating and creating something based on what has been learned.

A statement of a learning objective (which in our study constitutes the knowledge a health literate individual should have regarding contagions) contains a verb and a noun describing the intended cognitive process and the knowledge the individual is expected to acquire or construct. Hence, the taxonomy can help to classify what constitutes common content knowledge in a specific subject. The framework consists of six major hierarchical categories: *knowledge, comprehension, application, analysis, synthesis* and

evaluation. Each of the categories has 'action words' that describe the cognitive processes that relate to that category. These are the words we used when analysing the experts' answers in relation to Nutbeam's three levels of HL, see also Method section.

Teaching and learning about contagious diseases

Learning about microorganisms appears to occur in a range of contexts, both at home and in school. Common life experiences influence children's ideas about being ill and why (Byrne, 2011). Before beginning school, children have conceptions about phenomena that are not scientifically correct (Carey, 1985). They begin developing early conceptions prior to formal instruction and every individual has their own understanding about different phenomena when they start school (Driver, 1989). Young children's understanding of the cause of illness is believed to evolve from something simple to something more complex. According to Piaget's framework of learning, children younger than seven do not have the cognitive skills yet to reason about the cause of disease. However, in multiple studies by Kalish, preschool children see germs as the cause of certain diseases. He proposes that children understand germs as the biological link between having symptoms, like a running nose, and to give the disease to a friend (Kalish, 1997). But the understanding seems to be limited. Children see every disease as contagious and the cause is germs. They do not make the distinction between contagious and noncontagious diseases (Nagy, 1953), and that not all germs are pathogenic (Byrne, 2011). Children do often not see germs as living things, and germs are not important for their understanding of disease or the spread of disease. Children also see 'a germ', not that every disease has its special microorganism (Nagy, 1953).

In a study conducted by Jones and Rua (2006) with teachers and children in 5th, 8th and 11th grade, a lack of knowledge about microorganisms that can cause disease was found. Weather conditions were stated as a possible cause of getting sick and a common misconception was the belief that antibiotics can cure viral infections. The greatest gap of knowledge seems to be to understand the difference between bacteria and viruses. How bacteria can be beneficial to humans was not clear and bacteria were thought to cause more serious diseases than viruses. But students at all grade levels viewed germs as a general cause of disease without being able to distinguish between different 'germs' (Jones & Rua, 2006). The study also included teachers. They tended to hold similar understandings of microbes as their students. In order to increase students' understanding there is a need to assist teachers in developing their knowledge and understanding of microbial infections (Jones & Rua, 2008).

Based on these studies we can see a need for developing a learning progression for teaching contagions. Learning progressions (LP) are models of how student learning develops over a period of several years (Lehrer & Schauble, 2015). It also describes paths by which students might develop more sophisticated ways of reasoning. LPs begin with consideration of students' prior knowledge and are built toward the goals set by the curriculum for the subject in mind (Duncan & Rivet, 2013). In this study, we provide the curricular aspect of a learning progression of contagions and relate those to the literature of student understanding in the Implications section. The central questions for the teacher when teaching LPs are what content is to be taught, how and why (Wickman, 2014), and these are questions that are addressed in this study.

Contagion in the curricula

What then can be found in the policy documents regarding what should be learnt about contagion in compulsory school (which can be seen as a benchmark for HL since it is thought to provide a basic citizen literacy)? When looking into the steering documents of compulsory schooling in Sweden (www.skolverket.se), and some neighbouring countries that language wise was accessible to us; Norway (www.udir.no) and UK (www.gov.uk/goverment/organisations/department-for-education), we can see that contagions are not regarded as a subject domain of its own.

Both the Norwegian and Swedish national curriculum contains a section called 'Body and health'. The Swedish curriculum for years 4–6 states that the pupils should learn about some common diseases and how they are prevented. The curriculum for years 7–9 states that knowledge about viruses, bacteria, infections and the spread of infections should be taught. The Norwegian curriculum is more precise compared with the Swedish curriculum. After the fourth year of compulsory school, the pupils in Norway should be able to explain the reason for vaccinations, and be able to read texts in different media about common diseases and how they can be prevented. After the seventh year the pupil should know about the immune system and how to prevent and cure contagious diseases. After year 10, the pupils in Norway should know about sexually transmitted diseases (STDs), and be able to explain how the lifestyle can affect health. The curriculum in the UK includes a section called 'Health, disease and the development of medicines' in which it is stated what a pupil should know after the last year of compulsory school. The pupil should be taught about the relationship between health and disease and contagious diseases (including STDs), and that bacteria, viruses and fungi can act as pathogens. Reducing and preventing the spread of contagious diseases are also taught, and the impact of lifestyle factors.

When comparing the three curricula we can see that recognised and important aspects of contagion are: the most common contagions, common diseases, how to protect oneself from diseases and the relation between contagions and life style. However, these documents give somewhat different suggestions and do not provide any coherent framework for teaching about contagions. Instead, contagions are included under the overriding umbrella of 'health', leaving out any more precise and coherent suggestions of what a citizen should know about these issues, which is the aim of this study. Moreover, no reflections about the rapid change in the surrounding world regarding these issues could be found in the curricula. This lack justifies conducting a Delphi study investigating what HL in relation to contagion should include in a time of climate change and globalisation.

Aim of the study

The aim of this study is to identify the knowledge that constitutes HL in the area of contagious diseases according to professional experts in the field of healthcare and public health who work preventively with these issues. The underlying questions specifically address what is important to know and why regarding these issues from an HL perspective. Our study and the Delphi panel questions are based on reports written by medical and communication experts on infectious diseases (Andre et al., 2010; Smittskyddsinstitutet, Socialstyrelsen, & Statens veterinärmedicinska anstalt, 2011; Sveriges meteorologiska och hydrologiska institute, 2014). The research questions guiding this study are:

- What does a health literate individual need to know (and be able to do) regarding contagious diseases?
- Why does a health literate person need to know this?
- In what way can the knowledge of contagious diseases be hierarchically structured to usefully serve a learning progression?

Method

The Delphi method

The Delphi method (Nworie, 2011) is a research method that is used to gather opinions from a group of chosen participants, who can be considered as experts in the given area, extract common opinions and on the basis of the result predict or make decisions (Grisham, 2009; Nworie, 2011).

Participant selection

First, we identified the experts who would form the panel. Participants in a Delphi study are chosen on the basis of their field of expertise (Nworie, 2011). It is not a randomly chosen selection of participants, because every person is chosen according to the criteria of the investigators (Hasson, Keeney, & McKenna, 2000). The criteria we used were that the members of the expert panel should include medical and communicative expertise on contagious diseases, and have experience of working with personal communication or, on a higher systematic level, with the communication and prevention of contagious diseases from a public health perspective. Here, we used the framework of a micro and a macro level of SL to make our choices (Holbrook & Rannikmae, 2009). For the micro level, we selected medical researchers, physicians and nurses working with infectious diseases as their specialty and encountering patients with contagious diseases on a daily basis, and for the macro level, experts working at institutions that in different ways address prevention, education and communication related to contagious diseases (see Table 1).

The selection of the participants started with the identification of suitable experts. These were identified individually based on personal contacts or through institutions in Sweden in which appropriate expertise could be found. E-mails were sent to the individually selected participants, and to contact persons at the institutions from which we wanted

Table 1. Professional categories and organisations from which we selected the participants in the study.

Micro level	Macro level
• Nurses in three different schools • Nurse, lecturer at a university in Sweden • Specialist nurse, lecturer at a university in Sweden • Physician of general medicine, lecturer at a university in Sweden • Professor, public health sciences • Professor, medical microbiology	• Investigator at The National Board of Health and Welfare • Communicator at Swedish Institute for Communicable Disease Control • Hygiene nurse at Swedish Institute for Communicable Disease Control • Infectious disease physician, lecturer • Infectious disease physician, the Swedish strategic programme against antibiotic resistance (STRAMA) • Writer/educator of infectious diseases

to recruit a suitable expert to the panel. A criterion for selecting participants for the study was long personal experience in their field of expertise, and all experts had more than 10 years of experience. Fourteen individuals, who had knowledge and interest in the subject, agreed to participate as experts in our panel (see Table 1).

Procedure

The number of rounds when the experts are asked to give their opinion varies in the classical Delphi method, with two to four rounds normally reported in the literature, of which two or three rounds are normally preferred (Hasson et al., 2000). Commonly, there is a dropout between the rounds (Hasson et al., 2000). In this study, there are three rounds, because after the third round the panel reached consensus.

We formulated three questions based on current literature that pinpoints relevant and changing issues in this field of public health (see also our Background section). Among other documents, reports and science articles, the national research report 'Infectious Diseases in a Changing Climate' (Smittskyddsinstitutet, Socialstyrelsen, & Statens veterinärmedicinska anstalt, 2011) was used in particular as a starting point. In this report, the Swedish Institute for Communicable Disease Control, The National Board of Health and Welfare and The National Veterinary Institute in Sweden give an account of their opinions about how new and known contagious diseases will influence us due to the climate change. The main purpose of the first round in a Delphi study is to identify issues to be used in later rounds (Hasson et al., 2000). So, in the first round, the panel participants were presented with three open questions.

In the e-mail we sent to the experts there was a short introduction to the project and the reason why the respective expert had been chosen. Then we expressed our wish to hear the experts' opinions about what a health literate citizen should know about contagious diseases in the present day world. The more specific questions asked were:

- What is relevant common knowledge regarding contagious diseases?
- Can you think of any lack of knowledge among 'common' people that education and information can or should remedy?
- What do you think is important to teach in compulsory school regarding contagious diseases?

In Delphi surveys, there is no consistent method for reporting findings (Hasson et al., 2000). In this study the written data generated from the panelists were analysed with the method 'thematic coding analysis' (Robson, 2011, p. 474) after each round. In the analysis we first familiarised ourselves with the written material and then generated initial codes, which were grouped into themes, and finally interpreted the data. After the Delphi study we further analysed the generated themes by using Nutbeam's (2000) framework of HL in combination with Blooms' taxonomy of learning objectives (Airasian et al., 2001).

The three rounds of the Delphi study

The Delphi study started with the initial e-mails questions, described above, to the participants of the panel. In the first round, 10 of the experts responded by e-mail, but 4 preferred

telephone contact. During the telephone conversation, notes were taken and the conversation was transcribed instantly. Data collected from this initial round (written e-mail responses and telephone interview transcripts) were analysed in an iterative process using thematic coding analysis (Robson, 2011). When reading the answers, we looked for concepts in each expert's answer related to contagion. These concepts were then coded according to the scientific terms used (e.g. virus) and the meaning the experts attributed to the concepts (e.g. infectious particle that replicates only inside the living cells of other organisms). Based on this coding we classified the coded concepts into overriding themes of content. A compilation was made, first for each expert, then we compared each expert with the others, and finally we had a categorisation of themes in contagious diseases that the different statements of the experts could be related to.

Since the experts were aware of the meaning of a Delphi study, they most often structured their answers well. However, sometimes we found overlap in their categorisation, for example, when an expert put the different contagious agents (e.g. bacteria and viruses) in different bullet points. In the creation of the themes, we used the wordings of the panelists as much as we could, but in order to make coherent and understandable categories, their texts needed to be reduced and structured. The categorisation was made by the first author and thereafter discussed and validated with the second author. In order to include a theme for the second round, at least 6 out of 14 experts had to emphasise its importance. We chose this response rate because it amounts to almost 50%, and by deciding the limit to be 6 out of 14 experts, we included all the major themes in the second round. Other themes mentioned, we ignored after the first round because there was only one or two proponents of each, for example a theme coded as: *the body's own defense against infections*.

After our compilation and grouping in themes of content, this material was sent to the expert panel by e-mail for the second round. They were asked for opinions on the themes and if there was anything they wanted to add. After the second round the additional suggestions from the experts were analysed in the same way as the first way, i.e. by using thematic coding analysis, as above. After the second round, one additional theme of content was added: *the use of antibiotics and antibiotic resistance*.

In the third round, the panel members were once again asked to respond by e-mail if they agreed to these themes, i.e. to validate the categorisation now including the theme of *use of antibiotics and antibiotic resistance*. The experts were also asked to give additional thoughts and comments and to identify *what* is important to know in each theme and to motivate *why* it is important to be known about this theme. All participants from the first round, except one, responded in the second and the third rounds. After the third round, they all agreed that the six HL themes include what is needed to be a health literate citizen regarding contagion. Therefore, we decided that three rounds were enough. Based on the third round we generated the expert panel's arguments for the selection of themes, and the reasons why a theme is important for HL. Many of these statements are given in the Results section and the further analyses of those are presented in the next section.

Data analysis after the Delphi study

The Delphi study as described above generated the *health literacy themes of contagious diseases*. These themes represent the content knowledge dimension. In addition, we wanted

to structure this content knowledge according to the cognitive process dimension in order to suggest a learning progression within these HL themes of contagious diseases. Therefore, we used the framework of HL by Nutbeam (2000) to further analyse and differentiate the data into hierarchical cognitive levels. However, since Nutbeam's framework is not adopted to be used as a research tool, the framework was operationalised further according to Bloom's taxonomy (Airasian et al., 2001), i.e. the levels of Nutbeam's framework were related to the educational goals of Bloom's Taxonomy, as follows:

- Functional health literacy is about knowledge and understanding (Nutbeam, 2000), which is similar to the two first levels of Bloom's taxonomy: *knowledge* and *comprehension*. These levels centres on action words such as: *recognising, recalling, interpreting, exemplifying classifying* and *explaining*. Hence in our analysis we have categorised the experts' statements relating to the mentioned action words as Functional health literacy.
- Interactive health literacy is about developing personal qualities and skills that promote health, i.e. to act according to new insights (Nutbeam, 2000). This is similar to the third level of Bloom's taxonomy: *application*. Here it becomes important to use and apply knowledge by relating different bodies of knowledge. Procedural knowledge, i.e. how to do something becomes important. This level centres on action words such as: *doing, relating, executing, applying* and *implementing*. Hence, in our analysis, we have categorised the experts' statements relating to these mentioned action words as Interactive health literacy.
- Critical health literacy is about social and cognitive skills related to analysis and critical reflection of different sources, as well as managing these skills in order to use them to change the lifestyle. This is similar to the fourth, fifth and sixth level of Bloom's taxonomy: *analysis*, *synthesis* and *evaluation*. These levels centre on action words such as: *differentiating, organising, checking, analysing, evaluating* and *critiquing*. Hence, in our analysis, we have categorised the experts' statements relating to these mentioned action words as critical health literacy.

In the analysis of the data generated from the third round, we coded the experts' arguments and reasoning of the relationship between the what and why, i.e. what content knowledge within a theme that was important to be knowledgeable about (i.e. be literate about), and why this was argued for. This was conducted by searching the answers for the action words (i.e. verbs) the experts used for motivating a specific content. Depending on what action words (see bullet list above) they used, the content knowledge was classified as belonging to functional, interactive or critical HL. For example, 'it is of extreme importance that children and youth *recognize* the fact that the way we live affects the risk of exposure to infection' was categorised at the functional level and '*implementing* that antibiotic only must be used when there is no other alternative' at the interactive level, while 'a citizen needs to be able to *evaluate* their own behavior' was categorised at the critical level.

The Delphi process relies on the anonymity of the participants (Nworie, 2011). Therefore, we devised a personal coding system to track respondents and their responses from the first to the third round (Hasson et al., 2000). We have used this coding when presenting the results.

Results

From the open responses in round one, we identified five themes of content regarding contagious diseases that the experts found essential for a health literate person to know. After the second round, we identified one more theme (Antibiotics and antibiotic resistance) making up six themes in all (see Table 2).

The health literacy themes of contagious diseases

We will start with the experts' thoughts and comments on each HL theme in order to address the two first research questions of what and why a health literate person needs to know about contagious diseases.

Contagions

Almost all of the experts thought that it is important to be aware of the different types of microorganisms that can cause an infection. They talked about bacteria and viruses, but also about other parasites, such as fungus.

> First of all, it is important to communicate a basic understanding of bacteria, viruses, parasites and fungus. (Expert 3)

They particularly emphasised that it is important to know the difference between bacteria and viruses given the fact that antibiotics do not work against viruses.

> With regard to infection and transmission, it is important to understand the difference between viruses and bacteria. (Expert 8)

Several of the experts thought that it is important to know that we coexist with microorganisms, especially bacteria. They are a part of our body (our normal flora) and we are dependent on them.

> Bacteria are something we are surrounded with on and in our bodies and largely depended upon. (Expert 8)

This viewpoint should, according to the experts, be accompanied by the argument that our normal flora is part of our defense against more invasive microorganisms.

> Humans have always lived, and will continue to live in balance, often peaceful coexistence with an enormous amount of microorganisms. We must learn about the conditions for this coexistence. (Expert 9)

Table 2. Themes and number of experts mentioning the specific theme after completing the second round of the study.

Themes of content	Number of experts mentioning the theme (out of 14 experts)
Contagions	7
Transmission routes	6
Sexually transmitted diseases (STD)	6
Hygiene	9
Vaccinations	6
Use of antibiotics and antibiotic resistance	9

The main argument in this theme is that knowing that microorganisms can infect us and make us ill is necessary knowledge for a health literate citizen to act on in order to avoid becoming infected.

Transmission routes

Together with the knowledge of the different microorganisms that can cause infections, the experts pointed out that it is also crucial to know about different ways to get infected.

> Give information about some of the existing transmission routes such as airborne, drop, contact, sexual and blood contagion. (Expert 3)

The basic argument is that knowing about the transmission routes means knowing how to prevent the spread.

> You cannot protect yourself against everything, but there are certain things you absolutely have to protect yourself from. (Expert 2)

Interestingly, the experts emphasised that it is not just important to inform about traditional transmission routes between humans, but also between humans and other animals (i.e. zoonosis). They claimed that it is important to raise awareness about these 'new' diseases that are spread to us from animals, which are becoming increasingly important due to globalisation and changing travel habits as well as the more intense utilisation of nature by humans.

> Increased knowledge of infection between animals and humans is needed because more than half of all 'new' infections among humans are zoonosis. (Expert 3)

With this information, the experts claimed, we cannot only better protect ourselves, but also avoid the unnecessary fears that media reporting regarding, for example, the bird flu, swine flu, etc. can cause.

> We need knowledge in order to assess the content of the rich flow of messages we are all exposed to. (Expert 1)

In addition, the experts pointed out that there are social aspects of lifestyle that need attention. It is not only a matter of science, but also about how we live our lives in a society that matters, and once again they referred to the globalisation aspect and changing travelling habits as important.

> It is of extreme importance to give children and youth a basic understanding of the fact that the way we live affects the risk of exposure to infection. We live in a time and a country where the risks of infection in many respects have become very much smaller but the world is bigger than our country. (Expert 3)

Yet another aspect of transmission routes and how to avoid getting infected is knowing about the life cycles or progression of some common contagious diseases and the concept of incubation. The contagion is not infectious, or as infectious, during the different stages of the progression of the disease.

> Knowing how common cold viruses are transmitted, when you are the most contagious and when infection is no longer possible is important. (Expert 2)

Sexually transmitted diseases

Several of the experts highlighted STDs and that it should be a theme in its own right. They see STD as a contagion that is extra important to be literate about, especially for young people because of its connection to fertility and the social stigma associated with them. Here the experts talked the need for information about the different STDs, how they are spread and the best ways to protect yourself.

> How sexually transmitted infection occurs, when one can be especially sensitive to be infected, and how to protect oneself … (Expert 2)

The experts also highlighted the importance of lifestyle and habits. As the STDs are spread via direct contact between persons, there are more ways to avoid being infected than there are for other contagions, e.g. not to have unprotected sex.

> If you have deliberately tried to avoid, for instance, sexually transmitted disease/blood infection, it can save a lot of concern after the 'contact' with a potentially infected person. (Expert 10)

Since this theme of content is associated with social stigmatisation, the experts also pointed to the importance of eliminating misconceptions about STDs, such as HIV, among the public.

> It is important to dispel myths about, for instance, HIV. (Expert 8)

Hygiene

One important aspect of protecting oneself from contagious diseases is good hygiene, according to the experts. The importance of hygiene is something that almost all of the experts talked about as a means to avoid being infected and to infect others. Especially the importance of maintaining good hand hygiene was mentioned by many in the panel together with other behavioural aspects such as cough etiquette and how to handle food.

> There is a low level of knowledge among patients today about the importance of good hand hygiene and the importance of being out in the fresh air. (Expert 6)

Good hygiene is important in order to prevent getting infected, but it is equally important to understand that good hygiene means that you can prevent the contagion from spreading to others. This is especially important among people who are particularly sensitive to infection. A recurring theme among the experts is that hindering the spread of contagions should not only be seen as an act of individual protection, but an act of solidarity with others too.

> It is not primarily a matter of ourselves avoiding infections, but about solidarity with others – by washing our hands we avoid spreading infection. (Expert 4)

Some of the experts also mentioned that young people should know a little about what it was like before we knew about the importance of hygiene. With such historical knowledge, the experts argued, the public is more likely to develop respect for contagious diseases, which many today lack.

> For young people today deadly infections are something completely abstract. (Expert 4)

In line with the previous discussion, the experts emphasised that a balanced view on hygiene is important, because also an exaggerated focus on hygiene can lead to psychological problems, such as phobias and compulsive behaviour. Moreover, a more balanced ecological understanding of contagion is important for understanding that contact with contagions is also important to us as this triggers the immune system, and possibly also helps to avoid developing allergies.

> It's important to note that excessive hygiene levels are not good. Contact with contagions is beneficial for us. (Expert 9)

Finally, our lifestyle was mentioned again also in relation to hygiene. The experts emphasised a sensible lifestyle, which includes exercising, being outdoors, sleeping well, etc.

> Infections are prevented not only by hygiene and vaccinations, but just as much by a sensible lifestyle: diet, exercise, sleep etc. (Expert 9)

Vaccinations

Vaccinations was singled out as a theme in its own right since it is such an important tool in hindering the spread of contagion both at a personal level and from a public health perspective. The experts claimed that it is important that we understand how vaccination works, and why it is important to be vaccinated, not only to protect yourself but also to protect others.

> What vaccinations are good for, how they work and how few side effects they have. (Expert 2)

On the topic of vaccines, the experts said that it is important for people nowadays to know all the good that vaccinations have done in saving lives and suffering. Information about how it was before we started to use vaccinations could be a way to get people to understand the importance of taking vaccinations and what might happen if we stop taking them. Regarding this theme, the experts also mentioned the problem of 'scientific myth conceptions' regarding the relation between vaccines and disorders such as autism.

> Emphasizing the enormous success vaccinations have had and the risk involved with failure to vaccination, for instance, against measles. (Expert 3)

Also here, the experts mentioned the solidarity aspect. When we take a vaccination, we do not just protect ourselves, but we also prevent additional spread of the contagion. It is both about protecting oneself and about preventing an epidemic from spreading through the population.

> Vaccination as a protection mechanism for the individual and the population. (Expert 8)

Use of antibiotics and antibiotic resistance

The last theme that, according to the expert panel, should form the basis of a health literate citizen is knowledge of antibiotics and antibiotic resistance. This theme was first pointed out by the experts in the second round and might at a first glance seem to be a bit out of scope. However, the experts pointed out that the extensive use of antibiotics, or the misuse to be precise, is the cause of the evolving problem of bacterial resistance to antibiotics. Therefore, understanding that antibiotics do not work against all contagious organisms,

especially viruses which can cause infections, is crucial in order to influence people to reduce their antibiotic intake. Here the experts highlighted that antibiotics are ineffective against many infections and there is therefore no point in taking antibiotics 'just in case', which is a common misconception, according to many of the experts.

> The false belief that antibiotics can fix everything. (Expert 12)

The experts also pointed out that a literate citizen should also know that taking antibiotics can lead to bacteria becoming resistant. Soon, this may mean that we do not have any functioning antibiotics left. Moreover, the experts agreed that a common misconception to rectify is who becomes resistant: the individual or the bacteria.

> A major gap in knowledge among 'ordinary' people is who actually becomes resistant. It is confused with immunity and believed that the person in question becomes resistant, and they miss the fact that it's the bacteria that become resistant. (Expert 8)

Yet another aspect that the panel emphasised was that the use of antibiotics not only causes resistance but also kills the 'friendly' bacteria of our normal flora. This can make way for more infectious bacteria. Once again, the experts referred to the importance of having a notion of the ecology of our microflora.

> The use of antibiotics knocks out even the 'friendly' bacteria, thus paving the road for the resistant ones. (Expert 7)

Finally, the experts also observed that many infections heal by themselves, and that we can help the body recover through rest, good night sleep and so on. Often, it comes back to our choice of lifestyle where there is no room for patience or recovery. From a societal perspective, this is a very complex issue involving many problems that the experts also addressed as important to know about.

> The problem of resistance is multi-sectorial and global and affects, besides human medicine, also veterinary medicine, agriculture/food and spread in the environment. (Expert 3)

Analysis according to the integrated model of Nutbeam and Bloom

In this section, we will use our newly developed three-level HL framework, based on Nutbeam, in order to classify and arrange the experts' answers according to Functional health literacy, Interactive health literacy and Critical health literacy. In each of the six themes, we will take the experts' answers and arguments and relate them to the three levels. The results are summarised in Table 3.

Functional health literacy

When it comes to functional health literacy, we found that there are some basic concepts a literate citizen should recognise and explain that form the basis on which to build further understanding. These basic concepts more or less represent the six themes identified by the experts*: contagions, transmission routes, STD, hygiene, vaccinations, use of antibiotics and antibiotic resistance* (see Table 3). Of these, *contagions* and *transmission routes* could be seen as the most central. If the basic groups of contagion are known and discernible (bacteria, viruses, fungus and parasites) as well as their transmission routes (airborne,

Table 3. A summary of the analysis of the experts' answers in relation to our developed framework of HL based on Nutbeam and Bloom.

Themes/level of HL	Functional health literacy	Interactive health literacy	Critical health literacy
Contagions	• Recognising different contagions (bacteria, fungus, parasites and virus) • Explaining the difference between bacteria and viruses • Recognising that we have a normal flora of microorganisms • Exemplifying common contagious diseases	• Implementing correct medical treatment in response to the contagion/ disease in question	• Differentiating between contagious microorganisms and the normal flora within the microbial ecosystem of the human body • Critically reflecting on our attitude to microorganisms in order to coexist with them
Transmission routes	• Recognising different transmission routes (airborne, blood contagion, contact, drop, sexual and zoonosis)	• Applying adequate protective behaviour in response to the different transmission routes	• Analysing and critically evaluating information about transmission routes and contagions reported in the media • Differentiating the lifecycles of different contagions
STDs	• Recognising the most common STDs (chlamydia, genital warts, gonorrhoea, genital herpes, HIV) • Classifying the different STDs according to their transmission routes	• Applying an adequate protective behaviour in each case of the mentioned STDs	• Analysing lifestyle choices in order to avoid STD infections • Critiquing information in order to dispel myths about STDs
Hygiene	• Recognising the importance of hygiene (especially in relation to: cleaning, cough etiquette, food handling and hand hygiene) • Recalling how bad hygiene historically has influenced the spread of contagious diseases	• Applying good hygiene actions in accordance with those recognised areas	• Analysing the issue of hygiene also from a solidarity point of view, protecting others • Differentiating between a sound hygiene and a destructive excessive behaviour
Vaccinations	• Recognising how a vaccination works • Recalling how life was before we had vaccinations	• Relating information about vaccinations to actions of taking them	• Differentiating the importance of protection for the population and not only the individual • Critiquing the spread of scientific myths about side effects of vaccinations
Use of antibiotics and antibiotic resistance	• Recognising that antibiotics are only effective against bacteria- induced infections • Recognising that extensive use of antibiotics lead to the evolution of resistance among bacteria (and not for the human taking the antibiotics)	• Implementing the knowledge about antibiotic resistance into a restrictive antibiotic taking behaviour	• Critiquing different information sources in order to dispel myths about antibiotics curing all infectious diseases • Evaluating the potential consequences to taking antibiotics on the normal flora of bacteria Analysing what the spread of antibiotic resistance can lead to at the personal as well as societal level

blood contagion, contact, drop, sexual and zoonosis), it is possible to build all further information or learning about common STDs and the protection from these on that understanding. The same can be said about different hygiene techniques, recognition of

vaccines, use of antibiotics and antibiotic resistance that all relate to a specific contagion and how each one is transferred (see Table 3).

Interactive health literacy

In terms of Interactive health literacy, the health literate citizen should be able to use and transform functional health literacy into actions. If these actions are based on functional health literacy, it is assumed that the decisions will be more informed, leading to: (1) that actions are taken in the first place (which is a common problem regarding health issues), and (2) that more accurate actions are taken. Hence, it is both about taking preventive actions to avoid getting infected by, for example, practicing safe sex, taking appropriate vaccinations and applying appropriate hygiene standards, as well as carrying out instructions given by health care personnel such as completing a course of treatment of antibiotics (see Table 3).

Critical health literacy

Finally, the level of Critical health literacy involves putting issues about contagious diseases into the broader picture of how we live our lives. These issues are interrelated and our lifestyle at large also influences our risk of being infected by various diseases. Moreover, the experts also emphasised that it also involves stepping out of ourselves and viewing these issues in terms of the benefits to the common good and to the well-being of many. Moreover, it is important to recognise that in accomplishing this there might be a conflict of interest; for example, treatment with antibiotics might cure the disease and the person can go back to work more quickly, but at the same time that person's normal flora might get damaged and antibiotic wastes will be spread in the sewers. In a Critical health literacy perspective of contagious diseases, these issues need to be addressed (see Table 3).

Discussion

Based on the result, we might conclude that the experts' ideas of what should constitute HL would be consistent with the curriculum for compulsory school addressed in this study (i.e. Norway, Sweden and UK) in several ways. The themes include *the most common contagions, hygiene, STD* and *vaccines* that are mentioned in most curricula. However, there are also some surprising results. First, the specification of transmission routes as a theme of its own is not mentioned in the curricula. Second, the last theme about the use of antibiotics and antibiotic resistance is not previously linked to contagious diseases. In education, this is brought up in other subject matter contexts, such as the evolution of microorganisms and their ability to become resistant to antibiotics (Bohlin & Höst, 2015). Due to the rising problem of antibiotic resistance, the experts of this study thought that antibiotic resistance should be dealt with in the context of contagions in order to make its consequences more visible. This is in line with research in communication about medical treatment where a lack of knowledge about the importance of completing a treatment with antibiotics has been identified (Pechere, 2001; You et al., 2008).

These new suggestions could be seen as a response to a recent development of changed climate that may lead to an increased use of antibiotics due to increased spread of infectious diseases and the globalisation of society with an increasing mobility of people and

goods with fast spreading of new diseases (McMichael, 2013). Related to this was also the experts' strong emphasis on the need to inform about zoonosis, i.e. contagions transmitted from animals. Traditionally, this transmission route has been neglected in textbooks, but in view of globalisation with changing travel behaviour and new patterns of contagious spread, the experts argue that a literate citizen needs to know more about these matters.

In addition to the themes, the experts addressed some aspects of contagion that they believe are important to inform and instruct about. One aspect is the general lack of a historical perspective among the public regarding contagions. In previous decades, there was a 'collective memory' about how it was before we had antibiotics and vaccines. Now the experts feel that this 'collective memory' has been lost and as a consequence people's awareness of hygiene and vaccinations has dropped and people take for granted that there are always cures for infectious diseases, which leads to a lack of understanding of the gravity of the issue of antibiotic resistance. To counter this development, several of the experts advocate that a historical perspective should be adopted in education to make students more aware of living conditions prior to antibiotics and vaccines.

Another cross-sectional aspect is the impact of media. The experts pointed out that epidemic diseases often hit the headlines of media in very drastic ways, which can be exemplified by MERS, SARS, Swine flu, Ebola or Zika. This dramatic reporting tends to produce fear of epidemic diseases, which spreads panic and influences people to take irrational non-scientific decisions. Much of this irrational fear is, according to the experts, a consequence of the lack of HL among the public. Hence, much would be gained if the basics of contagions, their transmission routes, life cycles, hygiene and possible treatments (antibiotics and vaccines), were common knowledge. However, the experts claimed that this is not enough and a more critical reflection among the public is necessary. Critical reflection would also counteract the myth conceptions claimed to exist on issues related to contagious diseases, e.g. that antibiotics can cure all diseases, and that HIV is very contagious and lethal, etc.

There is a fairly new concept in medicine and science that the experts referred to, which is 'the normal flora of microorganisms' living on and within our bodies, and that these microorganisms are our friends protecting us. Traditionally in education and communication, microorganisms are mostly associated with dangerous contagions (Tomes, 2000) and students have difficulties discerning that not all germs are pathogenic (Byrne, 2011). The experts clearly expressed a wish that this conception should be taught because it is more preferable to look at the human body as an 'ecosystem' in which many organisms coexist. Then it is easier to explain why actions that destroy this ecosystem (antibiotics, excessive hygiene) might also be harmful to our health since they also wipe out the microorganisms protecting us. This perspective is also missing in the curricula for compulsory school.

By relating Nutbeam's framework of HL (Nutbeam, 2000) to Bloom's taxonomy of learning objectives (Airasian et al., 2001), we were able to systemise the categorisation of the HL themes of contagions into three cognitive levels: Functional Health Literacy, Interactive Health Literacy and Critical Health Literacy (see Table 3). The functional level involves understanding some basic facts and concepts related to the six themes. Although this would seem to be within reach for a literate citizen, the experts' experiences are that this knowledge is lacking to a great degree among the public. At the interactive level, the literate person turns this knowledge into action. However, as clear-cut as this

might be, we know from psychological research that knowledge is only one of many factors influencing behaviour (Ajzen, 2005). Therefore, communicators and educators that might want to use these results should be aware that an understanding of functional health literacy might not be enough to develop interactive health literacy; the importance of motivation, pre-conceptions, attitudes, self-efficacy and values might also be of importance (Ajzen, 2005). The same might be said about the critical level, but most of all this level is about higher cognitive skills such as metacognition and critical thinking. This means that to be able to reach this level, an individual needs to be able to mobilise higher cognitive skills that cannot be taken for granted even though he or she has reached the two preceding levels. In addition, in order to have knowledge acquired at the two preceding levels, and to engage in the critical health literacy of contagions, as suggested by the experts, formal training in metacognition and critical thinking is also a prerequisite. These are circumstances that need to be considered if this framework is to be implemented.

If we view our results through the lenses of a micro/macro perspective, we can see that both the functional and the interactive levels are dominated by a micro perspective where the aim is to understand and interpret knowledge in order to take certain actions in personal lives. The basis of HL regarding contagious diseases in this study is to inform citizens to make good decisions in their personal lives. This is a goal that could easily be linked to education. A macro perspective (Dillon, 2009) is introduced at the critical level of the framework. Here, societal and population perspectives are included where the well-being of others is also of concern.

Implications

In conclusion, we think that the results of this study could be useful in many different contexts, such as education, health communication and science communication. The defined health contagion literacy in this study should be made available to the public in general and be viewed as a benchmark of knowledge a citizen needs to master in order to cope with the health system and navigate in society. Therefore, we believe that teaching about contagions based on the learning progression of the three levels of HL could start in preschool and continue through primary school, middle school and lower secondary school.

From a learning progression perspective, it is possible to start with the functional level. Young children (4–5 years of age) have an almost intuitive understanding of what is, and what is not contagious (Kalish, 1997), and with proper education the children can understand the concept contagion already from the first grades of elementary school (Sigelman, Alfeld-Liro, Lewin, Derenowski, & Woods, 1997). As shown by Jones and Rua (2008) as well as Byrne (2011), it is crucial to teach students to distinguish between different germs. Siegelman and colleagues (1997) claim that without basic knowledge about germs and viruses as agents of disease, children do not have an opinion about how infectious diseases are obtained. The experts of this study pointed to the importance of learning about different transmission routes that have not been so accentuated in previous studies. The knowledge we need to develop is not just about the different contagions and their transmission routes but also some kind of action competence in protecting ourselves from contagious. A teaching perspective including the interactive level of HL needs to start early in schooling.

The critical level should probably be included in the latter part of schooling such as middle school and lower secondary school. The results of this Delphi study could be used as a basis for further development of learning progression models by relating the results to local curricular goals and studies of student understanding and alternative understandings at different ages.

Acquiring and learning a behaviour that hinders the spread of contagious diseases is not based on cognitive understanding alone, but also involves establishing good routines, which need to be established early in life (Siegal, 1988). Hence, in a teaching or communication situation, the levels of HL cannot be viewed as totally separate and talked about disjointedly. Instead, they should be viewed as corresponding vessels always informing each other, although with a stronger emphasis on the higher levels as the child gets older. However, more nuanced suggestions of how to further develop a learning progression need to be based on empirical studies. We need more knowledge about children's understanding and alternative understanding related to the six themes. At what ages is it possible to include functional, interactive and critical HL perspectives? What is the relationship between cognitive and affective dimensions related to action competence in avoiding contagious diseases? These are questions that need to be addressed in future research. Another problem is that we lack knowledge of what is actually taught in schools. What is the relationship between intended and enacted curriculum? Future research is therefore called for.

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