SISSA – International School for Advanced Studies
ISSN 1824 – 2049

Journal of Science Communication
http://jcom.sissa.it/

RECEIVED: December 23, 2013
PUBLISHED: June 6, 2014

Article

Is it my responsibility or theirs? Risk communication about antibiotic resistance in the Swedish daily press

Gustav Bohlin and Gunnar E. Höst

ABSTRACT: *Antibiotic resistance is an increasing global threat involving many actors, including the general public. We present findings from a content analysis of the coverage of antibiotic resistance in the Swedish print media with respect to the risk communication factors cause, magnitude and counter measures. The most commonly reported cause of development and spread of resistance was unnecessary prescription of antibiotics. Risk magnitudes were mostly reported qualitatively rather than using quantitative figures. Risk-reduction measures were analyzed using a framework that distinguishes between personal and societal efficacy. Measures at the societal level were more commonly reported compared to the individual level.*

KEYWORDS: *Health communication, Risk communication, Science and media*

Context

Antibiotic resistance

The threat from bacterial resistance to antibiotics is increasing. It has been estimated to cause 25 000 deaths annually in Europe [1], and increase societal costs by as much as 1.5 billion Euro [2]. Apart from rendering severe infectious diseases untreatable, antibiotic resistance poses a wider danger to the entire advanced medical health care system, since other treatments requiring antibiotics (e.g. transplantations, chemotherapy and premature care) may be hindered [3, 4]. While existing drugs lose their effects, new alternatives seem distant [3]. Any solution to the multi-faceted societal problem of antibiotic resistance will involve complex interactions between health care providers, public health agencies, policy makers, and the pharmaceutical industry.

Public citizens also play important roles, as emphasized by several scholars [e.g. 5]. A clear relationship exists between patient expectations and the degree of prescribing by general practitioners [6, 7]. Reducing consumer demand may be the strongest driving force for change, provided that compelling incentives are presented [3]. The degree of compliance in completing treatments and an increased awareness during international travel are also important factors. High prevalence of antibiotic resistance tends to correlate with low levels of public awareness [8]. Gonzales, Ackerman and Handley [9] posit that the lack of immediate benefit to patients or clinicians from avoiding antibiotics may impede translation of evidence into practice. Therefore, successful interventions typically

include patient education [e.g. 10]. A well-developed risk communication to the public is likely to be important in this regard.

Risk communication

Communication of risks that are of high concern involve mechanisms that are studied through risk communication theories [11]. According to Covello et al. [12], risk communication is based on four theoretical models: risk perception, mental noise, negative dominance and trust determination. Together, these models offer descriptions of the processing of risk information, the formation of risk perceptions and the basis for making risk decisions [11, 12].

The risk perception model deals with different factors affecting how a particular risk is perceived. These are not directly related to the absolute risk, but rather concern moral and emotional responses in the individual [13, 14]. Some of the identified risk perception factors of specific relevance to antibiotic resistance are: controllability, understanding, uncertainty, trust in institutions and human origin [12]. Taken together, the risk perception model implies that risks that are perceived to be under the control of others, are poorly understood, have uncertain dimensions, associated with institutions lacking in trust and those generated by human actions will be perceived as greater than risks that do not have these characteristics.

The mental noise and the negative dominance models concern how individuals perceive risk information while being in a condition of stress or anger. According to the mental noise model, these conditions will impair individuals' ability to process information effectively [15]. This indicates a need for visualized risk communication material that is easy to comprehend and which builds on what the individuals already know [12]. Negative dominance implies that individuals will focus on losses and negative information when they are in a state of anger, emphasizing the importance of positive or solution-oriented messages [11, 12].

The trust determination model concerns the need to establish public trust to make risk communication efforts more readily acceptable. Critical for this theory is that individuals tend to trust authorities less when they are upset. Therefore, trust must be established before the occurrence of an actual crisis event [11].

There has also been a move toward theories stating that risks and threats are socio-cultural processes rather than objective factors [16]. Such theories often emphasize the importance of public trust in the messenger of a risk for how the risk is perceived and acted upon [11].

Studying risk communication concerning antibiotic resistance in printed news reports

Newspapers have a significant influence on readers' behaviors concerning health risks [17], as well as on public trust in local health care actors [18]. Media coverage thus reflects aspects of the risk communication processes that shape public perceptions

of antibiotic resistance. Nisbet et al. [19] have reported a positive relationship between factual and procedural scientific knowledge and media use. In fact, media and the press is the primary source of science information for most people upon completing formal education [e.g. 20].

News reports about antibiotic resistance have primarily been studied by scholars in an English language context. Desilva, Muskavitch and Roche [21] investigated how newspapers in Canada and the United States described the magnitude of the antibiotic resistance problem, its underlying causes and measures to reduce further expansion. Chan and co-workers [22] found that U.K. newspapers often described "dirty hospitals" as the source of resistance. Boyce, Murray and Holmes [23] found that the British press often based antibiotic resistance reporting on governmental agency press releases rather than research reports.

While print media is an important actor in science and risk communication processes, a changing media landscape gives citizens increased access to online information. Print newspapers cannot be assumed to be the only channel of information. In addition, readers may be exposed to different thematic content depending on whether information is accessed online or through print newspapers [24]. Consequently, caution should be taken toward a printed news bias in science communication studies [25]. Analyzing a single media clearly precludes conclusions regarding the relative impact of newspapers compared to other forms of media. Nevertheless, studies of print newspapers benefit from the accessible and permanent nature of print news as a data source, compared to online news stories that may be continuously edited and often lack permanent archives. Studying printed newspapers also makes it possible to contrast the results to previous research on print media.

In Sweden, the context of the present study, printed news is still an important source of news for citizens. Although there is a decrease in newspaper reading, still 61% of the Swedish population read printed newspapers at least five days a week in 2011, compared to 81% in 1990. According to the same study, only 12% read newspapers online [26]. 59% of the respondents accessed newspapers through subscription. Nevertheless, the limitations of print media studies discussed above were carefully considered during the execution of the present study. In addition, since Swedish citizens rank the credibility of national quality press higher than news on the Internet [26], these may be important vehicles for conveying relevant risk information, according to the trust determination model.

Efficacy measures concerning antibiotic resistance

According to the risk perception model, knowing how to handle a particular disease is crucial for a person's conception of risk [14, 27]. This knowledge may be described in terms of self-efficacy or personal efficacy, usually including both symptom information and possible individual actions to decrease the risk of contracting the disease [28, 29]. Analysis of self-efficacy information has provided valuable insights into the reporting on emerging infectious diseases [e.g. 28, 29]. Results from Dahlstrom and collaborators indicate that

reporting of self-efficacy information, in contrast to risk magnitude and sensational information, is associated with behavioral change [30]. The reporting of self-efficacy may also be compared to efficacy measures above individual control. Goodall et al. [31], explored press coverage of the H1N1 virus using fear appeal message processing models to examine the degree of efficacy measures that individuals or organizations/communities could undertake. The term 'societal efficacy' was introduced by Evensen and Clarke [32] by elaborating on the concepts proxy and collective efficacy [33]. Proxy efficacy handles risk at a level beyond the direct control of individuals, who must rely on actors with more power or expertise to act on behalf of the community. Collective efficacy refers to the collective power of many individuals sharing the same belief or desire in achieving a goal [32, 33].

In the context of antibiotic resistance, personal efficacy information may be defined as measures that individuals can undertake to decrease the risk of being infected by resistant bacteria as well as to lower the risk of enabling new resistant bacteria to evolve. Symptom information is not as relevant, since this depends on the pathogen and not on whether it is resistant to antibiotics. Desilva et al. [21] reported that only 6% of the examined articles in the North American press included the two self-efficacy measures that the authors considered to be the most important. Societal efficacy information may be defined as measures that could be performed by health care professionals (e.g. prescribing doctors), governing bodies, and other entities. The risk of immediate personal disaster from bacterial resistance is low compared to for example malaria infections or avian influenza. Therefore, a larger focus on societal efficacy information may be expected in press coverage of antibiotic resistance compared to more direct threats, such as the West Nile Virus. However, the reporting of societal efficacy measures against antibiotic resistance has not been investigated previously.

Swedish perspectives on antibiotic resistance

As a small European country, the Swedish context has many characteristics that may affect the reporting of causes as well as personal versus societal efficacy information. For example, Sweden's size could make international factors (e.g. an inflow of resistant strains from other countries) more prominent than in larger countries, such as the U.S.A. [see 21]. In addition, self-medication with antibiotics in Sweden is very low compared to other countries, probably because antibiotics are only available on prescription [34]. In a reported European comparison, Swedish citizens possess favorable attitudes and behavior toward antibiotic resistance [8]. The authors of the report suggest the governmentally financed organization Strama (Swedish Strategic Programme against Antibiotic Resistance) as a possible explanation for this. Strama is a collaborative network for preserving the effectiveness of existing antibiotics that has worked with prescribers, pharmacists and the public since 1995 [e.g. see 35].

In terms of background knowledge about antibiotic resistance, Sweden is more similar to other European countries [8]. Widespread misconceptions include the belief that

humans become resistant to antibiotics and that antibiotics are effective against viral infections [36, 37]. The misconception that humans, rather than the infecting bacteria, carry resistance may support the view that it is an individual rather than a community problem, with potential implications on risk awareness and willingness to take measures against spread [38].

Objective

Motivated by the background given above, the aim of the present study was to explore and analyze the information concerning bacterial resistance to antibiotics reported in Swedish newspapers. In particular, the study investigates the distinction between personal and societal efficacy in the reporting of antibiotic resistance. The following three research questions were posed:

1. To what degree is bacterial resistance to antibiotics reported in Swedish newspapers?
2. To what extent and through which examples is antibiotic resistance presented in light of its (a) magnitude, (b) causes and (c) risk-reduction measures?
3. Are suggested risk-reduction measures aimed at societal institutions or individuals?

Methods

Data source

A quantitative content analysis [39, 40] was conducted on the seven largest daily newspapers[1] in Sweden. Four of these are distributed mainly through subscription, two are tabloids and one is a freely distributed paper funded by advertising. The chosen newspapers have a total circulation of about 1.5 million copies per day. Articles from a period of 36 months, from 1 June 2008 until 1 June 2011, were accessed through the database *Mediearkivet* using the Swedish words for "antibiotic resistance" ("antibiotikaresistens"), "resistant bacteria" ("resistenta bakterier") and "MRSA" (short for methicillin-resistant *Staphylococcus aureus*) as keywords. The resulting list of articles was refined in two steps prior to analysis. First, articles that fulfilled any of the following three exclusion criteria were removed: 1) The article was an identical copy of another article, mostly due to preprinted versions provided by a national news agency, 2) The article was a short story comprising less than 35 words, 3) The story of the article was unrelated to antibiotic resistance and the keywords were only mentioned in passing. Second, in cases where subsections for an article were stored as separate articles in the database, these were combined into single articles for the analysis, further reducing the total number of articles. The first author handled the refinement process, and the second author reviewed an excluded subset to ensure that the third exclusion criterion was applied without excluding

[1] Newspapers examined were Aftonbladet, Dagens Nyheter, Expressen, Göteborgsposten, Svenska Dagbladet, Sydsvenskan, Metro — Riks.

relevant articles. Data from a three-year period were collected to reduce the risk that specific reporting in response to isolated events biased the overall pattern.

Development of a code sheet

The content analysis employed a code system developed with respect to risk-magnitude descriptions, causes for the development and spread of antibiotic resistance, and possible risk-reduction measures [cf. 21]. Given the potential impact of magnitude information on individuals' risk perceptions [12, 28], three magnitude categories were included: qualitative descriptions using phrases such as "a rising problem", numerical descriptions of mortality (number of human deaths), and morbidity (number of discovered infections). The operationalization of variables for causes and risk-reduction measures consisted of inductively defining variables through a qualitative content analysis of the first five months of collected data. All mentions of causes and risk-reduction measures were noted in an open coding step [41]. Structuring the variables into categories of causes, personal efficacy or societal efficacy provided the basis to construct the code sheet for the main quantitative content analysis. In addition to the specific variables, a generic variable (e.g. "other causes") within each category provided information on less frequent alternatives. The resulting code sheet included the following variables for causes: *unnecessary prescription, impaired health care hygiene/logistics, tourism, livestock/agriculture, transport/groceries* and *other causes* (generic). Risk-reduction measures related to societal efficacy were captured using the following variables: *lowering prescription rates, improved health care hygiene/logistics, development of new antibiotics* and *other societal measures* (generic). Risk-reduction measures related to individual efficacy included the variables: *rational expectations on receiving antibiotics* and *other individual measures* (generic). Finally, a variable was added for information regarding the *lack of effect of antibiotics on viruses*, because antibiotics are commonly believed to treat viral infections with important implications for the over-use of antibiotics. The variables were formulated to be either present or absent for each article. Thus, the code sheet can capture several different responses for each main category (magnitude, causes, individual and societal risk-reduction measures), although it does not keep track of multiple occurrences of an individual variable within one article [cf. 21, 32].

Data analysis

The first author coded all articles, while the second author coded a reliability sample consisting of 16% of the data source [cf. 32] Intercoder reliability was assessed by calculating Krippendorff's alpha, using a cut-off value of 0.7 [42]. Calculations were performed using IBM SPSS Statistics (version 19) together with a macro called KALPHA (downloaded from http://www.afhayes.com/spss-sas-and-mplus-macros-and-code.html). The reliability score for two variables (*improved health care hygiene/logistics* and *other societal measures*) fell slightly below the agreed cut-off value. Discussions of the coding

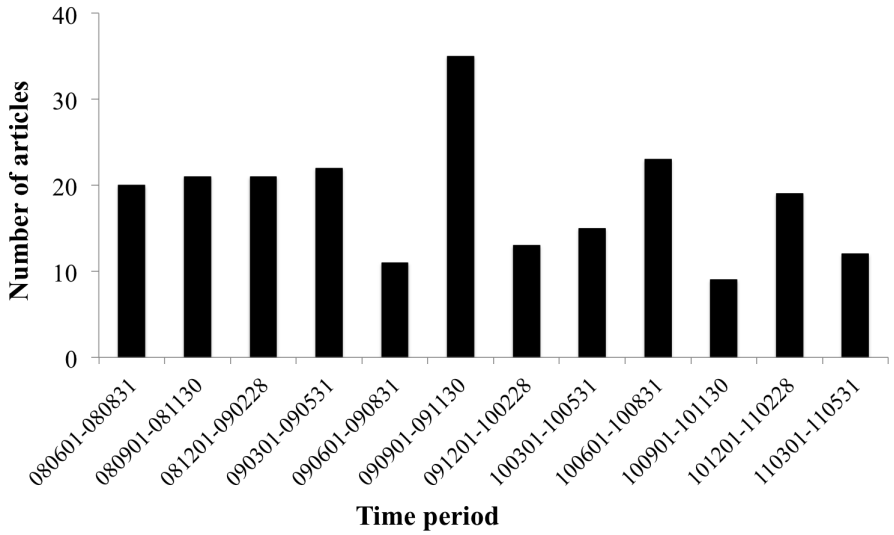

Figure 1. Distribution of articles over time (n=221).

discrepancies were followed by consensus decisions in the cases where either of the two coders had missed a statement. Following this, an additional set of articles was coded for these two variables to ensure a reliable coding procedure. A further reliability check of the code sheet compared the distribution of variables between the data subset used for inductive variable development and the complete data source. The similar proportions of articles with variables in the respective overall categories (i.e. cause, personal efficacy and societal efficacy) indicate that a satisfactory number of representative articles were included in the code sheet development sample.

Results

A database search retrieved 335 articles, of which 114 were excluded during a refinement process. The content analysis was conducted on the remaining 221 articles, of which 27 articles were also used for the inductive operationalization of variables. A peak in the reports concerning antibiotic resistance was observed during autumn 2009 (figure 1). This may be linked to the release of two reports from the European Centre for Disease Prevention and Control and an outbreak in a premature-child care unit in Sweden, which resulted in the death of three newborn children.

Figure 2 shows the frequency of articles that contained information for each of the four main categories. The majority of the analyzed articles provided some description or explanation related to magnitude, cause and/or societal efficacy measures. Less than a quarter of the articles (24%) reported personal efficacy measures.

A description of the magnitude of the problem was reported in 138 (62%) of the analyzed articles (table 1). *Non-numerical descriptions* that used expressions such as, for

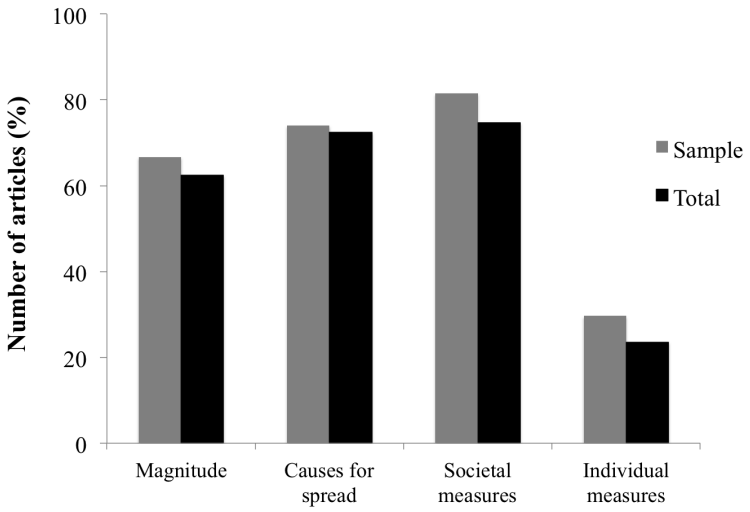

Figure 2. Frequency of articles reporting magnitude, causes and risk-reduction measures for the sample used in code sheet development (n=27) and the complete dataset (n=221).

example, "a rising problem" (Article No. 53) to describe the magnitude were found in 126 articles. Numerical accounts of the magnitude either described the *number of deaths* due to infections for some specified region and period (observed in 28 articles), or the *number of infections* per year (incidence) caused by one or more resistant strains (observed in 69 articles).

Causes underlying the development and spread of antibiotic resistance were mentioned 253 times in 160 of the analyzed articles, while 61 articles (28%) did not mention any cause. As presented in table 1, the cause that was most frequently reported was *unnecessary prescription*, observed in 44% of the analyzed articles, followed by *impaired health care hygiene and/or logistics* (e.g. failure to isolate infected patients or lack of staff hygiene routines). The third most frequently reported cause was increased *tourism*, which was often mentioned in the context of a comparison between Sweden and countries with a worse antibiotic resistance situation. The use of antibiotics in *livestock/agriculture* was described as an important cause in 13% of the articles in the study. Examples of quotations that describe causes for the spread of antibiotic resistant bacteria were:

> "Essentially, the development is driven by misuse of antibiotics. When the strains have developed resistance, they spread more easily in the hospital setting if the beds are close together, if infected patients are not isolated and if the staff do not follow adequate hygiene routines." (Article No. 116)

> "...a third of those who fell ill during 2009 have been infected abroad. Swedish efforts to reduce antibiotic use is not unimportant, but no matter how well we succeed, the problem still remains as long as the rest of the world does not follow the same route." (Article No. 79)

Topic	Specific action	Frequency[a]	Reliability[b]
Magnitude		*62.4*	
	Non-numerical descriptions	57.0	0.95
	Number of infections	31.2	0.87
	Number of deaths	12.7	0.79
Causes		*72.4*	
	Unnecessary prescription	43.9	0.72
	Impaired health care hygiene/logistics	26.7	0.93
	Tourism	14.0	0.72
	Livestock/agriculture	12.7	1
	Transport/groceries	8.6	0.88
	Other causes	8.6	0.84
Societal measures		*74.7*	
	Lower prescription rate	37.1	0.84
	Improved health care hygiene/logistics	32.6	0.74
	New antibiotics	19.0	0.88
	Other societal measures	21.7	0.80
Individual measures		*23.5*	
	Rational expectations on receiving antibiotics	13.6	0.80
	Other individual measures	10.9	0.88

[a] Percentage of articles in which an action was mentioned.

[b] Reliability scores are listed with Krippendorff's alpha coefficients.

Table 1. Frequency of reporting specific actions concerning magnitude, causes and risk-reduction measures (societal and individual) regarding antibiotic resistance (n=221).

As for possible actions to handle the resistance problem, a total of 298 risk-reduction measures were mentioned in 174 of the articles. Of these, 244 were categorized as societal measures and 54 as personal measures directed towards individual members of the public. At the societal level, the most commonly reported measures were a *lower prescription rate* and routines for *improved health care hygiene/logistics* in hospitals (table 1). Among the measures for logistical improvements, it was suggested that hospitals should isolate patients that are infected with resistant bacteria and that the number of patients hospitalized in the same room should be minimized. The most common individual measure was to foster *rational expectations on receiving antibiotics* so that patients refrain from simply demanding a prescription of antibiotics when visiting the doctor. Other reoccurring individual measures involved the importance of hand hygiene using disinfectants (9 articles) and advice regarding the handling of groceries (6 articles). The importance of completing a whole round of treatment once started was mentioned in 1 article. Some example quotations from articles that include measures to handle antibiotic resistance are given below:

> "In order to limit the consequences, we must further reduce the use of antibiotics and get more single rooms in health care to reduce the spread, says NN." (Article No. 110)

> "To counter the development it should be prohibited to use important human antibiotics in animals, it should be required to report all use and to try all other methods before antibiotics are used, says NN" (Article No. 32)

> "As long as successful visits to the doctor are held synonymous with a prescription, it will be difficult to achieve success: health care seekers, especially parents of snot-nosed children, must be persuaded to take more responsibility." (Article No. 178)

The inefficiency of treating viral infections, such as the common cold, with antibiotics, was reported in ten of the analyzed articles (frequency = 4.5%, reliability = 0.88).

Discussion

According to risk communication theory, hazard information such as mortality or morbidity statistics influences the perception of a particular risk. Depending on the number and character of the risk perception factors present, the perception may be significantly amplified [12, 14]. Thus, information on antibiotic resistance magnitudes may influence risk perception among newsreaders. In the Swedish press, the magnitude of the resistance problem is predominantly described qualitatively, stating for example that it "is a rising problem". Numerical descriptions of infections or their mortality are also present, but to a lesser degree. This pattern is similar to the press coverage of antibiotic resistance in North America, where 40% of the investigated articles included qualitative magnitude information [21].

Qualitative descriptions such as *rising*, *rare* or *frequent* provide lower contextual precision than specific quantitative frequencies, and may have different connotations for different readers [43]. The low contextual precision may promote a less efficient risk communication process for antibiotic resistance compared to news reports concerning other risks. For example, news reports on avian influenza included a higher degree of numerical risk estimates [28]. However, West Nile virus magnitude information was reported mostly qualitatively [29], and a majority of articles on contamination in farmed salmon also provided qualitative magnitude information [44]. Clearly, the type of risk magnitude information reported in the news may differ between different risks. Direct and understandable hazard information is important, given that the risk of bacterial resistance to antibiotics incorporate many of the identified risk perception factors. These include for example that antibiotic resistance is generated by human action, under the control of others than the individual and not greatly understood.

Causal explanations for antibiotic resistance may include both causes that underlie the development of resistance among a certain bacterium, and the causes for the spread of a resistant strain of bacteria among humans. The most commonly reported cause of the increasing antibiotic resistance problem was unnecessary prescription of antibiotics. The same primary cause was found in the North American press by Desilva et al. [21]. This factor is important in national initiatives for countering the threat of antibiotic resistance [3, 9], since higher prescription rates increase the antibiotic load and hence the

selection pressure for resistance. It is likely that the relatively high frequency of reporting of this cause is due to it being well established in the health care organizations of the respective countries. In addition to forming the basis for relevant measures reducing the antibiotic load, sound reporting of causes affects several of the factors shaping risk perception. In particular, it increases understanding of the mechanisms involved in the origin of resistant bacteria. Self-explanatory risks are perceived as smaller than those that are poorly understood [12].

In the Swedish press, the second most common cause was deficits in health care hygiene or logistics. Although not a causal factor in the development of antibiotic resistance, it is likely to be important for the spread of resistant strains. No information on this factor is available for the North American press, where agricultural antibiotic use was reported as the second most common cause [21]. Use of antibiotics in agricultural livestock handling was also reported in the Swedish press, but to a lower degree. Chan et al. [22] found that U.K. newspapers had a tendency to focus on a simplified conception of health care hygiene (i.e. "dirty hospitals") as the primary cause for antibiotic resistance development. It seems likely that North American press would also report on the connection between health care hygiene and antibiotic resistance. However, the predefined code system used by Desilva et al. [21] did not include this as a potential cause, precluding discovery of any such reporting. The inductive coding procedure employed in the present study allowed patterns to be discerned that a predefined code system might have missed, in particular since some reported causes reflect the Swedish context. For example, tourism was reported more frequently than the livestock industry, possibly because Sweden is a relatively small country where inflow of resistant strains is perceived as a more significant contributor than in larger countries.

The three most commonly reported risk-reduction measures emphasize societal efficacy [32]. No previous studies have investigated the reporting of societal efficacy measures against antibiotic resistance. The causes of antibiotic resistance and the measures to reduce its prevalence and to prevent further spread are often reported together as a problem and a solution, and therefore many reported causes are directly reflected in the suggested counter-measures. Consequently, the two most frequent measures are lowering prescription rates and implementing stricter hygiene and isolation routines in health care. In contrast to this, the third most commonly reported measure, the need for development of new antibiotics, does not address the actual causes of resistance development and spread although it is nevertheless considered a necessary strategy [e.g. 4].

The reporting of individual level risk-reduction measures was less frequent than societal measures. For people to have rational expectations regarding prescriptions of antibiotics when visiting the doctor was the only measure found on multiple occasions. Patients' expectations are indeed important factors in prescription outcomes [6, 45]. The personal risk of infection by resistant bacteria is quite small, at least in Sweden where resistance levels are relatively low. In this regard, solidarity with others is often used to argue for using less antibiotics, rather than appealing to individuals' self-interest. In the short term, the individual may actually be worse off given the potentially longer recovery

time from untreated bacterial infections. Thus, the personal efficacy measures raised may be motivated by its perceived societal benefits rather than individual.

In comparison with North America [21], Swedish newspapers less frequently report measures that individual readers can employ. Desilva et al. [21] analyzed two key individual measures, namely recognizing that antibiotics are ineffective for viral diseases (reported in 22% of the articles) and completing the entire course of antibiotics (10%). The two aspects were mentioned together in 6% of the North American articles, a frequency that the authors considered far too low [21]. In comparison, the Swedish press reported that antibiotics are only effective against bacteria in less than 5% of the articles, while a single article (less than 1%) mentioned the importance of completing a course of treatment.

The low representation of specific individual measures is problematic for at least two reasons. Firstly, information on proper use of antibiotics is often not provided by prescribing doctors in Sweden [36]. People thus seem unlikely to encounter the relevant information through the press and direct interactions with the health care system. Investigating whether or not the information is communicated through other media channels, such as online resources, or through specific social contexts, such as schools, may further clarify the state of antibiotic resistance risk communication in Sweden. Secondly, knowing that antibiotics are ineffective against viruses is critical for understanding doctors' decisions on prescription. Surveys indicate that a quarter of the Swedish population may be unaware of this limitation in antibiotics [e.g. 36]. However, such knowledge is actually a prerequisite for patients' rational expectations on prescriptions, which was the main personal efficacy measure reported in Sweden. Thus, the problem of little reporting of personal efficacy measures in the Swedish press may be further compounded by the lack of information inherent in simple suggestions that patients should be 'rational'.

Revisiting one of the identified factors shaping risk perception opens up another line of reasoning. The degree of controllability involves to what extent a risk is perceived to be under the control of others rather than under individual control. This is directly related to personal efficacy and it implies that a risk recognized as under the control of others is perceived as larger [12, 27]. In this regard, it is possible that Swedish newspapers' distinct pattern of reporting societal efficacy to a larger extent than individual measures not only leaves the public with less ability to act against resistance levels, but it also increases levels of worry, fear and the appearance of antibiotic resistance as a threat.

The question of whether the information presented is sufficient for the public to make sense of suggested measures can be extended further. Understanding "hard facts" regarding antibiotic resistance (e.g. no effect against viruses, and that persons do not become resistant to antibiotics) requires knowledge of basic microbiology concepts. Furthermore, the argument that interrupting an antibiotic treatment increases the risk of survival and spread of bacterial cells that have become resistant is an application of evolutionary theory. Thus, an evolutionary framework is necessary for explaining *why* proposed measures would be effective, as well as why other actions support the growth of resistant bacteria [46]. It has previously been shown that a more precise risk magnitude information

leads to an increased risk perception and that greater self-efficacy information is associated with greater intention to change behavior [30]. It is possible that the behavior change promoted by reported personal efficacy information would be even more efficient when combined with an explanation rather than relying on people's belief in the authority of the information. The risk perception model also brings some support to this argument since both a lack of understanding and uncertainty are recognized factors contributing to a greater perception of risk [12]. Examining the inclusion of these aspects in public information presents an intriguing possible future research undertaking.

The distinction between risk-reduction measures that support personal efficacy, which are possible for an individual to undertake, and societal efficacy, which are directed toward other actors [32], allows a broader perspective on how the press reports on risk reduction measures compared to the focus on personal efficacy in previous studies. Evensen and Clarke [32] suggest that the balance of reporting information that support efficacy at the personal or societal level may be determined by journalistic norms that are sometimes in conflict. In this view, personal efficacy reflect an obligation to empower the public by informing about possible actions, while societal efficacy is motivated by a journalistic "watchdog" role, where officials are held accountable in times of crisis.

Studying the reporting of avian influenza and West Nile virus infections, Evensen and Clarke [32] found that information related to societal efficacy was more prominent than personal efficacy information. They suggest that news media focus on the role of official institutions because of the "potentially broad health, economic, and social impacts" of the zoonotic diseases they investigated. A similar argument could be made regarding the reporting on antibiotic resistance, although the "outbreak" scenarios involving avian influenza and West Nile virus differ from antibiotic resistance in important ways. For example, the former diseases constitute acute threats to individuals, while antibiotic resistance is more of a looming threat to the entire society, with potentially catastrophic long-term consequences. Such differences might have been expected to result in differences in the focus of press reports, for example with more emphasis on personal efficacy in keeping safe during a potential avian influenza epidemic. The similar pattern for the different types of diseases strengthens the notion that the broad consequences are indeed important in encouraging the focus on societal efficacy [32].

The similar pattern of personal/societal efficacy information observed for antibiotic resistance and two zoonotic viruses [32] raises the question about what, if any, kind of disease would be reported primarily from the perspective of personal efficacy? The hypothesis that press reporting of personal and societal efficacy information varies depending on disease/risk characteristics could be investigated by explicitly comparing diseases that vary across a range of social and medical factors. The characteristics of the reporting might also reflect the national context, and it would be interesting to study the press in regions with a larger antibiotic resistance problem than Sweden and North America (e.g. in southern Europe or Southeast Asia). Together, such investigations may shed further light on the significance of the distinction between personal and societal efficacy.

Limitations

The present study has several limitations. Since newspapers were the only data source, no conclusions can be drawn regarding the relative impact of newspapers compared to other forms of media. Other channels of risk communication (e.g. online resources, broadcast media, outreach campaigns) and social settings (e.g. schools and direct interactions with the health care system) are likely to also convey information about antibiotic resistance. Investigating the communication of risk information concerning antibiotic resistance through such channels would be a valuable future research direction.

Conclusions

The present study contributes to research on media reports about infectious diseases [e.g. 21, 28, 29, 32] by providing empirical results regarding risk communication concepts such as magnitude, causes, and countermeasures for antibiotic resistance in Swedish newspapers. Issues such as trust, understanding and controllability bring theoretical context to the results. In particular, the risk perception model identifies important factors that may shape public risk perception of antibiotic resistance. For example, the risk might be perceived differently depending on whether the report includes an evolutionary explanation to antibiotic resistance or not. The study applies the concepts of personal and societal efficacy [32] to news reports about antibiotic resistance. Similar to previous findings for zoonotic virus diseases, societal efficacy measures are reported more frequently than personal efficacy. The results motivate further research exploring conditions potentially associated with differences in the reporting of risk reduction measures for different diseases and other risks, as well as the consequences on readers' risk perception.

Acknowledgments

The authors thank Professor Lena Tibell for valuable discussions.

Funding

The research described in this paper was funded through the Swedish Research Council (grant numbers: 2008-5077 and 2012-5344).

References

[1] WHO (2011), *Director-General Statement. World Health Day 2011*, http://www.who.int/mediacentre/news/statements/2011/whd_20110407/en/index.html.

[2] ECDC/EMEA (2009), *Joint technical report: the bacterial challenge - time to react*, European Medicines Agency, European Centre for Disease Prevention and Control.

[3] O. Cars et al. (2008), "Meeting the challenge of antibiotic resistance", *BMJ* **337**: a1438.

[4] S.B. Levy and B. Marshall (2004), "Antibacterial resistance worldwide: causes, challenges and responses", *Nat. Med.* **10**(12): S122–S129.

[5] C.A. McNulty et al. (2007), "Don't wear me out — the public's knowledge of and attitudes to antibiotic use", *J. Antimicrob. Chemoth.* **59**(4):727–738.

[6] P. Davey, C. Pagliari and A. Hayes (2002), The patient's role in the spread and control of bacterial resistance to antibiotics, *Clin. Microbiol. Infect.* **8**: 43–68.

[7] J.G. Scott et al. (2001), "Antibiotic use in acute respiratory infections and the ways patients pressure physicians for a prescription", *J. Fam. Practice* **50**(10): 853–858.

[8] L. Grigoryan et al. (2007), "Attitudes, beliefs and knowledge concerning antibiotic use and self-medication: a comparative European study", *Pharmacoepidemiology and drug safety* **16**(11): 1234–1243.

[9] R. Gonzales, S. Ackerman and M. Handley (2012), "Can implementation science help to overcome challenges in translating judicious antibiotic use into practice?", *Arch. Intern. Med.* **172**(19): 1471–1473.

[10] R. Gonzales et al. (2013), "A cluster randomized trial of decision support strategies for reducing antibiotic use in acute bronchitis", *JAMA Intern. Med.* **173**(4): 267–273.

[11] J. Infanti, J. Sixsmith, M.M. Barry, J. Núñez-Córdoba, C. Oroviogoicoechea-Ortega and F. Guillén-Grima (2013), *A literature review on effective risk communication for the prevention and control of communicable diseases in Europe*, ECDC — European Centre for Disease Prevention and Control, Stockholm, Sweden.

[12] V.T. Covello et al. (2001), "Risk communication, the West Nile virus epidemic, and bioterrorism: Responding to the communication challenges posed by the intentional or unintentional release of a pathogen in an urban setting", *J. of Urban Health — Bulletin of the New York Academy of Medicine* **78**(2): 382–391.

[13] P. Slovic (1987), "Perception of Risk", *Science* **236**(4799): 280–285.

[14] V.T. Covello and P.M. Sandman (2001), "Risk communication: evolution and revolution", in A. Wolbarst, *Solutions to an Environment in Peril*, Johns Hopkins University Press, Baltimore, MD, U.S.A., pp. 164–178.

[15] J. Baron, J.C. Hershey and H. Kunreuther (2000), "Determinants of priority for risk reduction: the role of worry", *Risk Analysis* **20**(4): 413–28.

[16] H. Joffe (2003), "Risk: from perception to social representation", *Brit. J. Soc. Psychol.* **42**(1): 55–73.

[17] C.W. Trumbo (2012), "The Effect of Newspaper Coverage of Influenza on the Rate of Physician Visits for Influenza 2002–2008", *Mass Commun. Soc.* **15**(5): 718–738.

[18] E. van der Schee., J.D. de Jong and P.P. Groenewegen (2012), "The influence of a local, media covered hospital incident on public trust in health care", *Eur. J. Public Health* **22**(4): 459–464.

[19] M.C. et al.Nisbet (2002), "Knowledge, reservations, or promise? A media effects model for public perceptions of science and technology", *Commun. Res.*, **29**: 584–608.

[20] S. Dunwoody (2008), "Science Journalism", in M. Bucchi and B. Trench ed., *Handbook of Public Communication of Science and Technology*, Routledge, New York, U.S.A. .

[21] M. Desilva (2004), "Print Media Coverage of Antibiotic Resistance", *Sci. Commun.* **26**(1): 31–43.

[22] P. Chan et al. (2010), "Newspaper reporting of meticillin-resistant Staphylococcus aureus and 'the dirty hospital"', *J. Hosp. Infect.* **75**(4): 318–22.

[23] T. Boyce, E. Murray and A. Holmes (2009), "What are the drivers of the U.K. media coverage of meticillin-resistant Staphylococcus aureus, the inter-relationships and relative influences?", *J. Hosp. Infect.* **73**(4): 400–407.

[24] M.A. Cacciatore et al. (2012), "Coverage of emerging technologies: A comparison between print and online media", *New Media & Society* **14**(6): 1039–1059.

[25] M.S. Schäfer (2012), "Taking stock: A meta-analysis of studies on the media's coverage on science", *Pub. Underst. Sci.* **21**(6): p. 650–663.

[26] L. Weibull, H. Oscarsson and A. Bergström (2012), "Swedish trends 1986–2011", in *SOM-rapport 2012* **27**, Göteborg, Sweden.

[27] C. McInnes (2005), *Health, security and the risk society*, The Nuffield Trust and the U.K. Global Health Programme, London, U.K. .

[28] A.D. Dudo, M.F. Dahlstrom and D. Brossard (2007), "Reporting a potential pandemic - A risk-related assessment of avian influenza coverage in US newspapers", *Sci. Commun.* **28**(4): 429–454.

[29] J.P. Roche and M.A.T. Muskavitch (2003), "Limited precision in print media communication of West Nile virus risks", *Sci. Commun.* **24**(3): 353–365.

[30] M.F. Dahlstrom, A. Dudo and D. Brossard (2012), "Precision of Information, Sensational Information, and Self-Efficacy Information as Message-Level Variables Affecting Risk Perceptions", *Risk Analysis* **32**(1): 155–166.

[31] C. Goodall et al. (2012), "Threat, Efficacy, and Uncertainty in the First 5 Months of National Print and Electronic News Coverage of the H1N1 Virus", *J. Health Commun.* **17**(3): 338–355.

[32] D.T. Evensen and C.E. Clarke (2012), "Efficacy Information in Media Coverage of Infectious Disease Risks: An Ill Predicament?", *Sci. Commun.* **34**(3): 392–418.

[33] A. Bandura (2000), "Exercise of human agency through collective efficacy", *Curr. Dir. Psychol. Sci.* **9**(3): 75–78.

[34] E. Svensson, F.M. Haaijer-ruskamp and C.S. Lundborg (2004), "Self-Medication with Antibiotics in a Swedish General Population", *Scand. J. Infect. Dis.* **36**(6–7): 450–452.

[35] S. Molstad et al. (2008), "Sustained reduction of antibiotic use and low bacterial resistance: 10-year follow-up of the Swedish Strama programme", *Lancet Infect. Dis.* **8**(2): 125–132.

[36] M. Andre et al. (2010), "A survey of public knowledge and awareness related to antibiotic use and resistance in Sweden", *J. Antimicrob. Chemoth.* **65**(6): 1292–1296.

[37] European Commission (2012), *Eurobarometer 72.5 (2009)*, ZA4999 data file version 5.0.0, TNS Opinion & Social, Brussels (Producer), GESIS Data Archive, Cologne, Germany.

[38] L. Brookes-Howell et al. (2012), "'The Body Gets Used to Them': Patients' Interpretations of Antibiotic Resistance and the Implications for Containment Strategies", *J. Gen. Inter. Med.* **27**(7): 766–772.

[39] K. Krippendorff (2004), *Content Analysis: An Introduction to its Methodology*, 2 ed., Sage, Thousand Oaks, London & New Delhi.

[40] C. Robson (2011), *Real World Research*, 3rd ed., Wiley Ltd., Cornwall, U.K. .

[41] S. Elo and H. Kyngas (2008), "The qualitative content analysis process", *J. Adv. Nurs.* **62**(1): 107–115.

[42] A.F. Hayes and K. Krippendorff (2007), "Answering the call for a Standard Reliability Measure for Coding Data", *Communication Methods and Measures* **1**(1): 77–89.

[43] S.T. Bogardus, E. Holmboe and J.F. Jekel (1999), "Perils, pitfalls, and possibilities in talking about medical risk", *JAMA-J. Am. Med. Assoc.* **281**(11): 1037–1041.

[44] S.M. Amberg and T.E. Hall (2010), "Precision and Rhetoric in Media Reporting About Contamination in Farmed Salmon", *Sci. Commun.* **32**(4): 489–513.

[45] J. Macfarlane et al. (1997), "Influence of patients' expectations on antibiotic management of acute lower respiratory tract illness in general practice: questionnaire study", *Brit. Med. J.* **315**(7117): 1211–1214.

[46] P.D. Gluckman et al. (2011), "How evolutionary principles improve the understanding of human health and disease", *Evol. Appl.* **4**(2): 249–263.

Authors

Gustav Bohlin is a Ph.D. student in the Department of Science and Technology at Linköping University. His research interests encompass communication of scientific concepts in a public understanding perspective, including the role that visual representations play in this process. Two central linked themes in his doctoral work are evolution education and antibiotic resistance. E-mail: gustav.bohlin@liu.se.

Gunnar E. Höst, Ph.D., is a researcher at Linköping University, Department of Science and Technology. His research focuses on learning with visual representations and language aspects of communication and meaning-making of biological and molecular phenomena. E-mail: gunnar.host@liu.se.

HOW TO CITE: G. Bohlin and G.E. Höst, "Is it my responsibility or theirs? Risk communication about antibiotic resistance in the Swedish daily press", *JCOM* **13**(03)(2014)A02.