



Controversy over antibacterial silver: implications for environmental and sustainability assessments



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ABSTRACT

The potential risks and benefits of using silver, especially nanosilver, as an antibacterial agent in consumer and healthcare products are under debate globally. Using content analysis of texts from newspaper and TV, government agencies, municipalities, government and parliament, non-governmental organizations, and companies, we analyze the argumentation in the Swedish public controversy over antibacterial silver and relate the findings to environmental and sustainability assessments. We conclude that silver is regarded as either beneficial or harmful in relation to four main values: the environment, health, sewage treatment, and product effectiveness. Various arguments are used to support positive and negative evaluations of silver, revealing several contradictory reasons for considering silver beneficial or harmful. Current environmental and sustainability assessments (i.e. substance flow analysis, risk analysis, multi-criteria analysis, and lifecycle assessment) cover many of the concerns raised in the public controversy over antibacterial silver and can therefore inform the debate regarding its toxicity, emissions, and environmental impact. However, not all concerns raised in the public controversy are covered by current environmental and sustainability assessments, most notably, concerns over public health and bacterial resistance issues are not paid full attention. For future environmental and sustainability assessments to make an even more significant societal contribution and to inform consumers and decision-makers about concerns articulated in the public debate, a wider range of issues concerning antibacterial silver needs to be considered through a unified framework.

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1. Introduction

Silver is increasingly being used in consumer and healthcare products as an antibacterial agent. Data on the production and use of antibacterial silver in consumer products indicate distinct growth in its use over time. The use of antibacterial silver in Europe was estimated to total 30 tonnes per year in 2004, increasing to 110–230 tonnes per year as of 2010 (Blaser et al., 2008). Antibacterial silver sometimes occurs in the form of silver nanomaterials, or “nanosilver.” Nanomaterials are often defined as materials with at least one dimension in the size range of 1–100 nm, and there is an ongoing discussion among regulators and scientists, regarding risks and sustainability of nanotechnology (Ellenbecker and Tsai, 2011; Helland and Kastenholz, 2008). Regarding nanosilver more specifically, the question is whether it poses a higher, lower, or

similar risk compared with that of ordinary, non-nanomaterial silver (Luoma, 2008). According to the most comprehensive database on nanomaterials in consumer products, nanosilver is by far the most common nanomaterial present, used in about a quarter of all products included in the database. The number of products containing nanosilver increased tenfold from 2006 to 2012 (Project on Emerging Nanotechnologies, 2012).

The increase in antibacterial silver and nanosilver in consumer products has led to lively global debate about potential risks. For example, the global non-governmental organization (NGO) Friends of the Earth (2009, 2011) has demanded a ban on antibacterial silver until proven safe for both humans and other organisms. The controversy has led to lively public debate in Sweden over whether or not consumers should buy silver-containing products and whether regulatory action is needed in relation to different forms and applications of silver. In this controversy, a number of arguments have been made by a variety of actors to support divergent standpoints about antibacterial silver.

This article has two aims: first, to analyze the public controversy over antibacterial silver in Sweden with regard to the supportive

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and critical evaluations made and the arguments used to support these evaluations and, second, to discuss the findings of this analysis in relation to the methods and results of environmental and sustainability assessments (E&SA) of antibacterial silver. An umbrella term, E&SAs include several approaches and methods, such as lifecycle assessment, risk analysis, material and substance flow analysis, cost–benefit analysis, strategic environmental assessment, ecological footprint analysis, and multi-criteria analysis (see Finnveden and Moberg, 2005; Ness et al., 2007). In pursuing the second aim of this study, with regard to the arguments and evaluations advanced in the public controversy, we address which of these approaches and methods have been applied in assessments of antibacterial silver, as well as the results of these assessments. This overview, in turn, indicates potential venues where E&SAs can inform the public debate. However, comparing the arguments made in the public controversy with these current assessments reveals challenges and limitations when it comes to informing the public debate over antibacterial silver.

Although this study focuses on the case of Sweden, similar communicative patterns to those identified here can be expected in other national contexts. Silver is internationally produced and used for antibacterial purposes. This use of silver for antibacterial purposes has been criticized internationally by, for example, the NGO Friends of the Earth (2009, 2011) as mentioned above. Both risks and benefits of antibacterial silver products have captured the attention of news media internationally.

2. Methods and materials

2.1. Analytical concepts

We understand a controversy to be a situation involving two or more actors who advance incompatible standpoints (e.g. beliefs, attitudes, and goals) regarding an issue. When questioned by an opponent, actors involved in a controversy are motivated to provide reasons for their standpoints (Toulmin, 1958/2003). We understand an argument to constitute the reasons that support or weaken a standpoint or another argument (Blair, 2012; Næss, 1961; Walton, 1990). The standpoints of the controversy examined here concern the evaluation of antibacterial silver as a “good” or “bad” thing, which in turn motivates consumer and regulatory action. Inspired by the argumentative schemes of *association* and *dissociation* suggested by Perelman and Olbrechts-Tyteca (1958/1969) and applied to risk communication by Corvellec and Boholm (2008), we suggest that a verbal argumentative controversy centered on incompatible evaluations of a certain phenomenon *x*, for example, antibacterial silver, can be analyzed in terms of a set of basic theoretical elements. These elements are: (1) *evaluations*, i.e. verbal acts of (a) *association* or (b) *dissociation* (i.e. separation) between *x* and (a) *positive value* or (b) *negative value* (see Table 1), and (2) *arguments*, i.e. verbally articulated reasons (a) supporting or (b) weakening the

Table 1
Combinations of the dichotomies of association–dissociation and negative value–positive value.

	Positive value	Negative value
Association	Silver is associated with positive value, i.e. a <i>positive evaluation</i> by association (e.g. “silver is eco-friendly”)	Silver is associated with negative value, i.e. a <i>negative evaluation</i> by association (e.g. “silver is a risk”)
Dissociation	Silver is separated from positive value, i.e. a <i>negative evaluation</i> by dissociation (e.g. “silver is not eco-friendly”)	Silver is separated from negative value, i.e. a <i>positive evaluation</i> by dissociation (e.g. “silver is not a risk”)

Table 2
Analyzed texts.

Source	Specification
Newspapers	Eighty-eight articles, from 1991 to June 2012, from twelve newspapers: first, the top ten (in terms of circulation) paid-for Swedish newspapers: the three major metropolitan morning papers <i>Dagens Nyheter</i> , <i>Svenska Dagbladet</i> , and <i>Göteborgs Posten</i> ; the local regional morning papers <i>Sydsvenska Dagbladet</i> and <i>Helsingborgs Dagblad</i> ; the evening tabloids <i>Aftonbladet</i> , <i>Expressen</i> , <i>Göteborgs-Tidningen</i> , and <i>Kvällsposten</i> ; and the daily morning financial newspaper <i>Dagens Industri</i> ; second, the two strategic additions of (i) the local regional morning paper <i>Borås tidning</i> , because Borås is the location of the Swedish School of Textiles at the University of Borås and silver is increasingly used in textiles, and (ii) the weekly newspaper <i>Ny Teknik</i> because of its focus on technology, engineering, and innovation.
TV news	TV4 (http://www.tv4play.se/): two TV news features (from December 2011 and May 2012; in total 2 min and 49 s)
Government agencies	SVT's website (http://www.svt.se/): four web pages Swedish Chemicals Agency (http://www.kemi.se/): 16 reports or web pages Medical Products Agency (http://www.lakemedelsverket.se/): three documents/reports National Food Agency (http://www.slv.se/): five reports or web pages Swedish Environmental Protection Agency (http://www.naturvardsverket.se/): four documents/reports
Swedish parliament and government	Two private members' motions, two opinion reports from parliamentary committees, and one record of the proceedings in the chamber (2 May 2011) (see http://www.riksdagen.se/) An open letter from the Minister for the Environment to the county councils (see http://www.regeringen.se/)
Municipalities	Municipality of Gothenburg (http://www.goteborg.se/): six reports or web pages Municipality of Stockholm (http://www.stockholm.se/): seven documents/reports Municipality of Malmö (http://www.malmo.se/): two documents/reports
Non-governmental organizations	Swedish Society for Nature Conservation (http://www.naturskyddsforeningen.se/): four web pages Swedish Water and Wastewater Association (http://www.svenskvatten.se/): 17 reports/documents or web pages Federation of Swedish Farmers (http://www.lrf.se/): two web pages
Companies	Polygiene (http://www.polygiene.com/): complete website (approximately 9000 words) Gryaab (http://www.gryaab.se/): two web pages Addnature (see http://www.addnature.com/ ; http://www.facebook.com/addnature ; and http://addnature.wordpress.com/): two Facebook posts including comments and a blog entry

associations or dissociations in (1). For example, the claim that “silver is toxic” is a negative evaluation that associates silver with the negative value of toxicity. The claim that “scientific studies demonstrate that silver is toxic to marine organisms” serves as an argument supporting this negative evaluation.

2.2. Textual material

In this study, we analyze texts from the following sources: news media, government agencies, parliament and government, municipalities, NGOs, and companies (see Table 2 for a detailed list of these sources). The keywords “silver” together with “bacteria” and/or “smell” (in Swedish) were used in retrieving information from the websites of government agencies, NGOs, municipalities, companies, and the Swedish parliament and government. The choice of

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