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Waste generation as a side impact of COVID-19 pandemic:

Communication on correct disposal of single-use face masks

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Abstract

The rapid global spread of SARS-CoV-2 and the resulting Coronavirus disease (COVID-19) pandemic has led to urgent efforts to contain and mitigate transmission. The use of face masks became a primary measure to limit the spread, which increased the production and consequent waste generation. It is estimated that globally 129 billion single-use face masks are discharged into the environment every month. Besides to add to already great concerns over plastic pollution, contaminated face masks not properly handled also poses a health risk. The health and environmental consequences caused by the inadequate disposal of single-use face masks are treated in this study as an eminent risk to be properly communicated. This study framed the waste generation as a side impact of the COVID-19 pandemic and analysed how the communication has been made regarding the correct disposal of single-use masks, with focus in users of public transport in Stockholm region. National and regional authorities are recognized as the main responsables for the communication about correct disposal, together with manufacturers and suppliers of single-use face masks. Disclosure and informative material of four government authorities and instruction manuals of eight brands of single-use face masks are analysed according to: i) presence / absence of information (about the disposal); ii) type of communication (visual or written); iii) message transmitted and; ix) availability in other languages. It was found guidance about correct disposal of face mask in two thirds of the existing communication, that is mainly written and with few visual aids. Half of communication is made only in Swedish and with no sufficient focus on the importance of correct disposal neither with reference to trash bins with lid. It suggests that the current communication about how to dispose single-use masks safely may not be enough, which is affecting the perception of risk by the population and worsening the health and environmental consequences caused by the inadequate disposal.

Sammanfattning

Den globala spridningen av SARS-CoV-2 virus krävde omedelbara åtgärder för att begränsa COVID-19 pandemi. Användningen av munskydd blev en primär åtgärd och idag cirka 129 miljoner engångsmunskydd släpps ut i miljön globalt varje månad. Förutom att lägga till problem över plastföroreningar, använda och kontaminerade munskydd som inte hanteras ordentligt betyder också en hälsorisk. De hälso- och miljökonsekvenser orsakad av fel bortskaffande av engångsmunskydd visas som en framträdande risk som behöver att kommuniceras ordentligt. Denna studie ramade ökningen av avfallsproduktion som en sidoeffekt av COVID-19-pandemin och analyserade hur kommunikation om bortskaffande av engångsmunskydd har gjorts till kollektivtrafikanvändarna i Stockholms region. Nationella och regionala myndigheter är de huvudansvariga för kommunikationen, tillsammans med tillverkare och leverantörer av engångsmunskydd. Reklam och informativt material från fyra myndigheter och instruktionsmanualer från åtta märken engångsmunskydd analyseras enligt: i) närvaro / frånvaro av information (om bortskaffande); ii) typ av kommunikation (visuell eller skriftlig); iii) meddelande och; ix) tillgänglighet på andra språk. Man hittade vägledning om korrekt bortskaffande av munskydd i två tredjedelar av den befintliga kommunikationen, som huvudsakligen är skriftlig och utan visuella hjälpmedel. Hälften av kommunikationen sker endast på svenska och utan tillräckligt fokus på korrekt bortskaffande. Den nuvarande kommunikationen verkar inte räcka, vilket påverkar riskuppfattning och försämrar de hälso- och miljökonsekvenser orsakad av det fel bortskaffandet.

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1. Introduction

The rapid global spread of SARS-CoV-2 and the resulting Coronavirus disease (COVID-19) pandemic has led to urgent efforts to contain and mitigate transmission. In 28 January 2021 more than 100 million cases have been confirmed and more than 2.17 million deaths attributed to COVID-19 (CSSE, 2021). Most nations shut borders, introduced quarantine and restricted mobility to decrease the infection rate. Alongside, governments and international organizations have released guidelines to reduce the spread of the virus, such as frequent handwashing and social-distancing, as well as actively encouraged citizens to use face masks on certain occasions (Saberian et al., 2021). The virus can be transmitted through the air when a person coughs, sneezes, breathes heavily or talks. Wear masks and face coverings acts in this sense as a barrier from inhaling and spreading aerosol particles which may contain the virus, playing so a crucial role to control the spread of COVID-19. Because of that, the use of face masks became part of a comprehensive package of the prevention and control measures to limit the spread of COVID-19 (Howard et al, 2021).

Saberian et al. (2021) estimate that globally 129 billion face masks were discharged into the environment every month, however little guidance has been given on how to dispose them safely. Dharmaraj et al. (2021) point out that governments are facing great challenges to impose strict regulations about proper disposal of face masks. Used face masks can be seen abandoned elsewhere, from city streets, empty shopping trolleys, hedges, onto the pavement and even in rivers and mountainous areas (Saberian et al., 2021, Greenpeace, 2020; Desert, 2020). Although essential for preventing the spread of Coronavirus, single-use face masks are adding to already great concerns over plastic pollution and, without better disposal practices, a significant environmental risk is looming (Roberts et al., 2020).

Face masks are made of polypropylene, a petroleum-based, non-renewable and non-biodegradable polymer. This type of plastic takes a long time to degrade and releases toxic substances during the process, being hazardous to the environment (Dharmaraj et al., 2021; Greenpeace, 2020). Wildlife can be directly impacted through choking on pieces of litter (when animal cannot differentiate food from plastic), malnutrition (plastic materials fill up stomachs but provide no nutrients) and entanglement (with the elastic of the masks). Discarded face masks can become floating marine debris and also impact the marine ecosystems, once plastics break down into micro-plastics that contains toxins and contaminants and may be absorbed or ingested. Over the medium to long term, plastic waste can smother environments and break up ecosystems (Roberts et al, 2020).

There are also health concerns over the disposal of contaminated face masks, since coronaviruses can remain on surfaces and, if not properly handled or disposed, single-use face masks may still carry traces of viral contaminants (Dharmaraj et al., 2021). It poses a risk of contamination to waste collectors, litter pickers or even other people who first come across trash bins (Roberts et al, 2020).

An influence diagram (Figure 1) was drawn up to clarify the factors in the problematic. Oval shapes represent uncertain circumstances or states of the world, while rectangular ones represent choices that can be made by a decision maker. The arrows demonstrate the influence that one factor has to another.

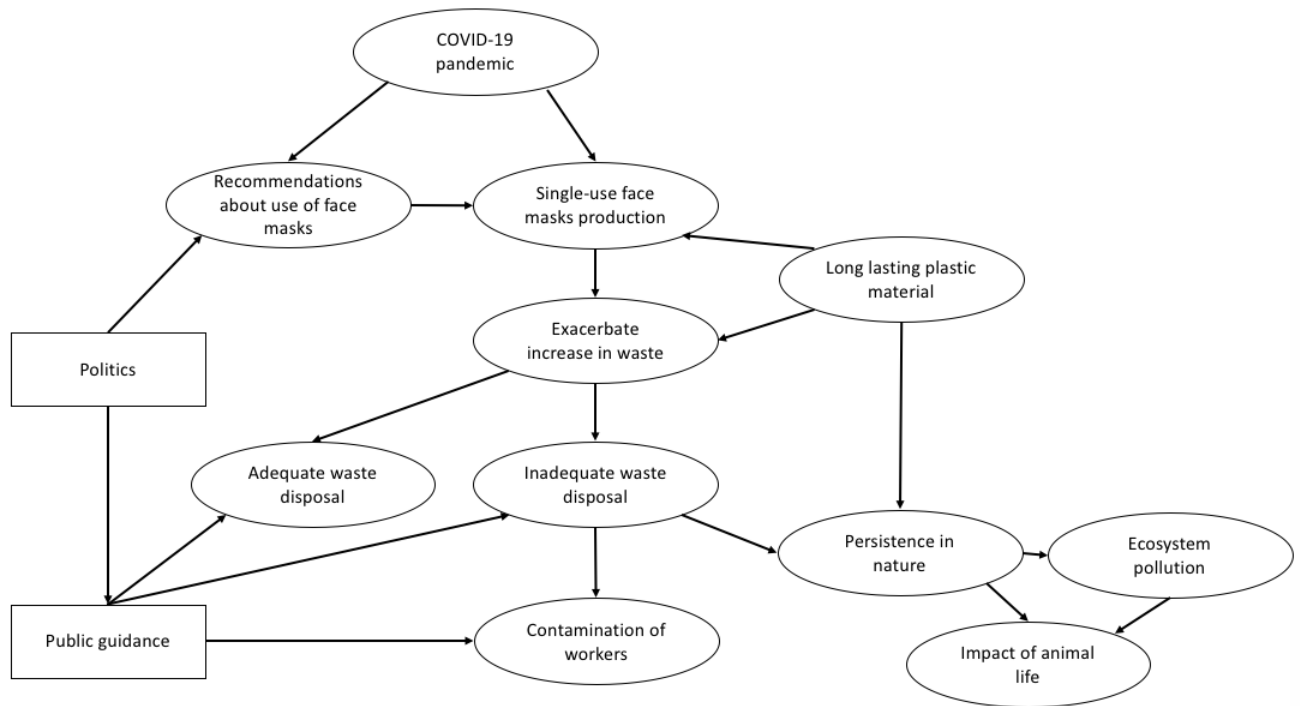


Figure 1. COVID-19 pandemic and waste generation influence diagram

To avoid the spread of COVID-19, wearing a face mask is considered a primary solution. Governments took measures to decrease the infection rate, encouraging citizens to use single-use face masks, what created a great increase in production. It led to an increase in waste generation, both due to production of face masks and because of the use itself. The inadequate waste disposal appears as a consequence of the increase of waste that may led to contamination of workers / waste collectors and population in general. If not properly discarded, long last plastic material of single-use face masks persists in the environment and causes pollution of ecosystems and impacts in animal life.

1.1 Aim and research question

This study aims to analyse how communication has been made regarding the disposal of single-use face masks, with focus on users of public transport in Stockholm region. One main and two secondary research questions are formulated:

Main research question:

How have users of public transport in Stockholm region been informed about the correct disposal of single-use face masks?

Secondary questions:

- The instructions for use of single-use face masks include information about their correct disposal?
- Governmental authorities inform about the correct disposal of single-use face masks?

1.2 Risk communication

The health and environmental consequences caused by the inadequate disposal of single-use face masks are treated in this study as an eminent risk to be properly communicated. Risk communication is a field with contributions from several others. Environmental and social sciences can, for example, provide correct information and enhance a democratic process, while sociology and psychology offer support to determine an appropriate approach to communicate with different audiences and to refine the message to be transmitted (Lundgren & McMakin, 2013).

The communication of a risk is basically an exchange of information between the person/institution who makes the risk assessment and the interested group. However, how the risk is conceived and perceived is a topic open to debate, with several theoretical perspectives and paradigms related. According to Williamsson & Weyman (2005), there are diverse factors linked about how the risk is valued, such as culture, gender, education, age and family constitution, between others. Risk perception depends of other aspects that relies also on qualitative characteristics of that hazard itself, for example if the exposure is voluntary or not, the risk source (natural or artificial), the extent of the consequences (geographically and across time), reversibility, whether it affects future generations, etc. At the individual level, the risk perception is a result of many other factors, such as familiarity and experience of the risk, degree of control, sympathy / dislike towards the source of the risks, among others. The perception of risk is also influenced by societal factors, such as ethics and equity and the role of media and advertising, for example (Lundgren & McMakin, 2013).

Last but not least, an important aspect that influences the risk perception is its management and the trust or distrust related to the perceived institutional control. Hedquist (2002) suggested a "trust ladder", in which the concepts of trust are hierarchized with a gradual qualification:

- Reliability (tillförlitlighet): when the receiver feels that what the transmitter is saying is true. It refers only about the content, that has correct and reasonable factual information, as well as recognized sources;
- Credibility (trovärdighet): when the receiver feels that the transmitter is understanding. It includes also emotional aspects and communication skills from the transmitter/spokesperson;
- Trust: translated from Swedish in two different ways. "Ha förtroende" is when the receiver has a positive valuation of the sender (an institution, in this case) and feels that it means what says and keeps what is promised, but receiver still have full decision-making power. "Känna tillit" refers more to personal relations and means to trust "others", when the receiver is ready to let the transmitter take control and decide.

It is up to the recipient (and not the sender) to decide how the relationship should be valued and whether there is reason to perceive a speaker/actor as trustworthy. In order to communicate the health and environmental consequences caused by the inadequate disposal of single-use face masks, a chain of communication is required. The actors those expected to have responsibility in relation to this risk communication are identified and valued according the trust ladder in Figure 2 below:



Figure 2. Tillitstegen of communication about inadequate disposal of single-use face masks

National and regional authorities are recognized as the main responsables for the communication regarding the disposal of single-use masks, since they are the ones who are recommending the use as a prevention and control measure to limit the spread of COVID-19. They are on the top of the stair because they have a national mandate from the government and have built a relationship with the public for a long time. Medieakademin publish every year an annual confidence barometer, a survey that measures trust in social institutions, individual companies and mass media in Sweden. In 2020 healthcare is in position number 5, with 62% and state in general has 42%.

Down in the ladder there are three different groups. The research community is recognized with credibility (in confidence barometer 69%) since are the ones who can attest the impacts of plastic pollution on the environment and health risks through research and publication of scientific articles. Environmental organizations also have credibility since they are seen as experts on the subject, with the best interest and good will in communicating about risks via, for example, advertising campaigns. Greenpeace has, for example, 35% in confidence barometer. Mass media generally has also credibility (confidence barometer 49%) and can play an important role to reach out the great audience. Finally, down in the ladder there are manufacturers and suppliers of single-use face masks. They play an essential role in communicating about its proper disposal, for example by including this kind of information in the instructions for use. However, they are not recognized as authorities in the matter and neither have a close relationship with the public.

This study has the hypothesis that little guidance has been given on how to dispose single-use masks safely, which reduces the perception of risk by the population and worsens the health and environmental consequences caused by the inadequate disposal. A target group was chosen to analyse how the communication of this risk is being made. Getting to know the audience is one of the first steps in the risk communication process and an analysis of the audience is carried out in the next section.

1.3 Target group

This study aims to analyse how communication has been made regarding the disposal of single-use face masks. The focus is on residents of Stockholm, in special users of public transport. It justifies due to new recommendations given by Folkhälsomyndigheten from 7 January 2021: people travelling on public transport during rushing hours are advised to wear face masks in order to minimize the risk of spreading infection. From that date companies operating public transport started to provide single-use face masks for travellers and the sale of them was stimulated in supermarkets, convenience stores and even in fast machines at train stations. It is assumed that inappropriate disposal tends to occur in the surroundings of train stations and bus stops, where single-use face masks are discarded after the end of the journey. In this sense, the target group for the risk communication is users of public transport in Stockholm.

This is the case of care communication, in which the risk and the way to manage it have already been determined through scientific research that is accepted by most of the audience. There are no doubts that single-use face masks should be properly disposed in order to avoid environmental and health impacts. The communication aims so to increase the awareness about the topic.

In order to develop a message better adapted to the target group, an audience analysis was carried out. A midline-comprehensive level of analysis is pursued, with characterization of audience's ability to comprehend the communication, information available about demographics, age and gender, as well as some assumptions regarding psychological factors, such motivations and mental models of risk. Due to time and resources limitations, the data is basically secondary collected from official statistics (SL rapport and Stockholm årsbok). It is acknowledged also that some degree of assumptions was taken, but it is considered that some audience information is better than none.

Table 1. Audience analysis - adult users of public transport in Stockholm

Analysis level	Characteristic		Source
Baseline	Group size	865.000 travellers per day in Storstockholms lokaltrafik (SL). It is not possible to estimate how many wear single-use face masks	SL rapport
	Education level	60% of population has secondary and 28% post-secondary education (Stockholm)	Statistisk årsbok Stockholm
	Communication method	Train and subway: messages and recommendations on posters, digital displays in the stations, announcements on speakers. Busses: posters on bust stops and bus windows	
	Experience /background about the risk	Plastic pollution is not a new risk, but the health consequences of inadequate disposal of face masks is	
Midline	Age	When travelling, take public transportation: - 16-24 years: 53% - 25-39 years: 35% - 40-64 years: 28% - 65+ years: 24%	Calculated based on SL rapport

	Gender	36% of female travellers take public transportation, versus 43% male	Calculated based on SL rapport
	Language / culture	25% of population is foreign-born	Statistisk årsbok Stockholm
Comprehensive	Exposure to news media or other coverage	Recommendations to use face mask are on focus, but little or no emphasis about the importance of their correct disposal	
	Effects of the risk on them	Low direct effect on daily life	
	Control over risk	High and easy control: proper disposal of single-use face masks or change to reusable ones	

Table 1 summarizes the information collected and serves as basis for the development of the communication process. From there, it is possible to point out the daily travellers in SL system and although it is not possible to estimate how many wear single-use masks, the communication as whole will reach a large number of people. It also points out that adults and young people constitute the largest number of travellers, with a slight predominance of men. It is important to clarify that the data collected for those aspects does not indicate absolute numbers or percentages and only serves to draw some assumptions.

The high level of education of the population also demonstrates the type of message that the communication can provide, with special importance to the use other languages and/or visual aids due to considerable percentage of foreign-born people. It is assumed that plastic pollution is an already familiar/known risk for the audience, but the health consequences of inadequate disposal of face masks can be considered a new risk. Both have, however, low direct impact on daily life. In turn, the control over risk is high and easy: proper disposal of single-use face masks or change to reusable ones.

Finally, it is acknowledged that recommendations to use face mask are on focus on media, but little or no emphasis about the importance of their correct disposal. It also indicates a possible path for communication: include/reinforce the information about proper disposal in the existing communication about the use of face masks. The main communication methods already in place to reach audience are messages and recommendations on posters and digital displays in the stations, as well posters on bus stops and bus windows.

2. Method

In order to analyse how users of public transport in Stockholm have been informed about the correct disposal of single-use face masks during January-March/2021, two main methods are chosen:

1. Analysis of the recommendations about disposal on package and/or instruction manual of single-use face masks

Manufacturers and suppliers of single-use face masks share responsibility about its correct disposal. It is assumed that the information about disposal should be clear for buyers when purchasing the product. In the case of single-use face masks, packages contain and/or are followed by use instructions. It is expected so that they also contain some type of guidance regarding the disposal.

The products to be analysed will be collected from several physical sale points, such as supermarkets, pharmacies and convenience stores in the vicinities of train/busses stations. The largest possible number of different brands will have their communication about disposal (on package or instruction manual) analysed according to the following criteria:

- i) presence / absence of information (about the disposal);
- ii) type of communication (visual or written);
- iii) message transmitted;
- ix) availability in other languages.

2. Analysis of the content of COVID-19 disclosure and informative material of government authorities

Recommendations to use of face masks is one of prevention and control measures to limit the spread of COVID-19. In Sweden, new disclosure materials have been released after 7 January 2021 along with the new recommendations about wearing face masks when travelling on public transport. It is expected also that the authorities have prepared informative materials about issues related to the pandemic.

The following government authorities will have their disclosure and informative material analysed:

- a) Region Stockholm: public organ of the county;
- b) 1177 Vårdguiden: Sweden's gathering place for information and services in health and care;
- c) Folkhälsomyndigheten: Public Health agency that issues national level recommendations;
- d) Storstockholms Lokaltrafik (SL): responsible for public transport in Stockholm.

It will be analysed disclosure material and informative pages available on official websites. Specific page sections that refer to the COVID-19 and use of face masks will be observed, as well as a results of search engines in the websites with the term “munskydd”. Social media accounts will also be observed (Facebook, Instagram, Twitter). The same criteria for analys will apply:

- i) presence / absence of information (about the disposal);
- ii) type of communication (visual or written);
- iii) message transmitted;
- ix) availability in other languages.

3. Results

3.1 Communication from manufacturers and suppliers

It was analysed 8 different brands of single-use face masks. They all were collected from supermarkets, pharmacies and convenience stores in the vicinities of the train stations of Tullinge, Sundbyberg and Stockholm C. In order to facilitate the discussion, each brand was named after a letter, from a) to h). Photographs of the packages and instruction manuals can be found in the appendix.

Table 2 summarizes the results:

Table 2. Recommendations about disposal on package and/or instruction manual of single-use face masks

	Brand	Type of communication	Information about disposal	Message	Other languages
A	Adder care	Written	No	-	No
B	Graid	Written	Yes	"Dispose used mask in a closed bin"	Yes
C	Nords medical	Written	Yes	"Förstör och återvinn efter användning"	No
D	Gibson medical	Written	Yes	"Kassera munskyddet i en avfallsbehållare med lock"	Yes
E	Deltrian	Visual	Yes	"Kasteras efter användning"	Yes
F	One Care	Written	Yes	"Efter användning skall masken slängas enligt riktlinjer som gäller för medicinskt avfall"	Yes
G	Aidelai	Written	No	-	No
H	Add pharma care	Written	Yes	"Kassera i papperskorg med lock"	No

3.2 Communication from governmental authorities

3.2.1 Region Stockholm

Region Stockholm is responsible for overall issues within the county, such as public transport, healthcare, regional planning and public transport. The official website <<https://www.sll.se>> was visited on 23 February 2021, as well as the official account @regionstockholm on social media (Instagram, Facebook and Twitter).

Website

A special section about COVID-19 was highlighted in the home page, with the name "Samlad information om Region Stockholms arbete med covid-19". The information presented in this section were well organized and visual, with pictures and specific sub-sections for each particular related issue (for example about vaccination, statistics, news, how to seek medical help, etc.). When it refers to updated general advices, the sub-section has a link that redirects to the official website of the Public Health agency. When it refers to use of face masks in public transportation, the section has a link that redirects to the official website of Storstockholms

Lokaltrafik (SL) and a short orientation video about it (detailed below). There is any direct text about the use of face masks or disposal. Through the search engine it was not found any new information about the use of face masks, neither any specific focus about their disposal.

Disclosure material

Region Stockholm produced two short videos (1-1:30 minutes duration) giving orientation about the use of face masks. Both were posted in social media official accounts.

1. "Så använder du munskydd smittsäkert". The video gives instructions (spoken and written) about the use of face-masks and includes orientations about the proper disposal "kasta engångsmunskydd direkt efter användning", followed by a picture showing a trash bin.
2. "Undvik kollektivtrafiken om du kan". The video has a doctor talking about the recommendations about public transport and showing in practice how to use a face mask. The video does not contain any information about the disposal of the face masks after use.

Other languages

There is no specific content about face masks in other languages than Swedish. There is only a sub-section that redirects to the official website of 1177 Vårdguiden.

3.2.2 1177 Vårdguiden

Healthcare Guide online, 1177.se, is the Swedish national hub for advice, information and e-services about for health and healthcare. It provides quality-assured and user-friendly information about diseases, treatments, rules and rights. The website <<https://www.1177.se/Stockholm/>> was visited on 23 February 2021, as well as social media account @1177vardguidenstockholm (Facebook only).

Website

Information about COVID-19 are on focus, with several sub-sections displayed directly on the main page. The information regarding the use of face masks are easily found within the special section of COVID-19, in an exclusive page is dedicated for it "Så använder du munskydd". It presents visual communication (a short video, detailed below) and written recommendation about the use of face masks. The text includes one step about the disposal: "Så tar du av och slänger munskydd för engångsbruk: (...) Steg 3: Kasta munskyddet i en papperskorg".

Disclosure material

Vårdguiden produced one short-video about the use of face-mask: "Så använder du munskydd". It has a woman showing in practice how to use it, followed by spoken instructions (no subtitles in Swedish). It includes recommendations about the disposal, "kasta munskyddet i en papperskorg", followed by a picture of a trash bin. Informative posters about official recommendations are also found, but none of them aim the use of face masks.

The results of the search engine pointed out for a news published in the beginning of the year "Munskydd i kollektivtrafiken från den 7 januari". In that page, along with links to other pages regarding the correct use of face-masks, it was available a written message about correct disposal: "Kasta ditt munskydd i en papperskorg direkt efter användning". The other results from search engine did not present any additional information or specific focus on the disposal of face masks.

Other languages

Vårdguiden displays information about COVID-19 in 36 languages. The material can be accessed in the sub-section “Om covid-19” and for every language there is 8 posters in .pdf format with information translated about vaccination, social gatherings, mental health, new recommendations, testing, etc. There is any information about the use of face masks neither about its disposal in the posters. For 9 languages, however, the page contains also the video “Så använder du munskydd” with translated subtitles.

3.2.3 Folkhälsomyndigheten

The Public Health Agency of Sweden (Folkhälsomyndigheten) has the national responsibility for public health issues. They work to safeguard good public health and ensure that the population is protected against communicable diseases and other health threats. The website < <https://www.folkhalsomyndigheten.se> > was visited on 1 March 2021, as well as social media account @folkhalsomyn (Facebook and Twitter).

Website

Information about COVID-19 are on focus on the homepage, with a sub-section displayed directly on the main page. Under the section “Skydda dig och andra” there is a special page about face masks in general “Munskyddsanvändning i samhället utanför vård- och omsorg”, with instructions for use and message (written) about the correct disposal: “Ta av munskydd (...) 3. Kasta engångsmunskyddet i en papperskorg”. It is stressed by them that the “right type” of face mask is a single-use one with CE-label, a mark that indicates the product meets the European legal requirements.

There is also a page aimed at companies operating public transport “Rekommendation avseende munskydd till företag som bedriver kollektivtrafik” with recommendations about the waste management of single-use face masks. Operating companies are advised to review routines, so travellers can dispose their used face masks properly, and not on the ground, in vehicles or seats. However, it did not present any focus about the potential risks to public health and pollution.

The search engine showed diverse results for the term “munskydd”, and most of them are news or updated about the recommendations, redirecting to the main pages described below.

Disclosure material

Folkhälsomyndigheten has a special section to disclosure materials produced by them. They have posters in 8 different languages about the use of single-use face masks and in the step 3 the message is “Dispose of the single-use mask”, followed by an image of a face-mask being discarded. There are also available several of videos about COVID-19, but any of the them are about the use of face masks neither has any recommendations about its disposal.

On social media there was also a publication on the update about the use of face masks, however it not included instructions about the use neither disposal, only redirected to the pages already listed.

Other languages

Folkhälsomyndigheten has COVID-19 information in 29 languages, but for only in 8 of them there is information about the use and disposal of single-use face masks (visually only, on the posters).

3.2.4 Storstockholms Lokaltrafik

Stockholm Lokaltrafik (SL) has the overall responsibility for ensuring a well-developed, easily accessible and reliable public transport in Stockholm County. Because of the focus in this study, they were considered an essential actor in communicating guidelines about use and disposal of face masks. The website <<https://sl.se>> and their social media accounts @KanalSL and @ we_are_sl (Facebook and Instagram) were visited on 2 March 2021.

Website

Information about the use of face masks has a great focus on the main page of the website, leading to the page “Använd munskydd i kollektivtrafiken”. There is general information about the new recommendations from Folkhälsomyndigheten and also indications about where single-use faces masks can be purchased. There is written information about the use and a complete message about the proper disposal, asking to travellers do not trash the face masks if not in bins and stating that staff will empty the bins trash more often in some places. They also recommend that if there is no trash bin available, the travellers should take the face masks and throw them home. The message is followed also by the video and link of 1177 Vårdguiden disclosure material” “Så använder du munskydd”.

The results from the search engine pointed out mainly to information and pages already discussed, with the exception of the page “Trängsel i kollektivtrafiken” that summarizes the recommendations (written only), but do not inform about face masks or its disposal. In that page is available also the same information in other 7 languages.

Disclosure material

SL has not disclosed specific material (poster or videos) regarding the use of masks itself, but used the ones produced by other government authorities. Social media accounts have posts with information about the new recommendations on use of face masks in public transportation, but do not communication about how to use them or discard properly. Instead, posts and videos from other government agencies were used.

Other languages

SL do not provide much information in other languages directly on the main menu. There is a section of the website in English only, with guidance about use and disposal of face mask provided through the English version of the 1177 Vårdguiden video “Så använder du munskydd”. No written recommendation neither information in other languages were found in this section. However, the engine search showed pages in 7 different languages, with the same 1177 Vårdguiden videos in the respective languages with translated subtitles.

Table 3. Analysis of disclosure and informative material of government

Authority	Type	Page/material	Type of communication	Information about disposal	Message	Other languages
Region Stockholm	Website	"Samlad information om Region Stockholms arbete med covid-19" ¹	Written	No	-	No
	Disclosure material	"Så använder du munskydd smittsäkert" ²	Short video, spoken and written information	Yes	"Kasta engångsmunskydd direkt efter användning". Shows picture of a trash bin	No
		"Undvik kollektivtrafiken om du kan" ¹	Short video, spoken and written information	No	-	No
1177 Vårdguiden	Website	"Så använder du munskydd" ³	Written recommendation and short video	Yes	"Så tar du av och slänger munskydd för engångsbruk: (...) Steg 3: Kasta munskyddet i en papperskorg"	Yes
		"Munskydd i kollektivtrafiken från den 7 januari" ⁴	Written	Yes	"Kasta ditt munskydd i en papperskorg direkt efter användning".	No
	Disclosure material	"Så använder du munskydd" ⁴	Short video. In Swedish version, only spoken information. Other languages have subtitles.	Yes	"Kasta munskyddet i en papperskorg". Shows picture of a trash bin	Yes
Folkhälso myndighet	Website	"Munskyddsanvändning i samhället utanför vård- och omsorg" ⁵	Written	Yes	"Ta av munskydd (...) 3. Kasta engångsmunskyddet i en papperskorg".	No
	Disclosure material	"Så använder du engångsmunskydd" ⁶	Visual (poster)	Yes	"Dispose of the single-use mask", Shows image of a face-mask being discarded.	Yes
SL	Website	"Använd munskydd i kollektivtrafiken" ⁷	Written and short video	Yes	"Kasta det använda munskyddet i papperskorg för att inte skräpa ned. Vår personal ser över om vi behöver tömma papperskorgar oftare på vissa platser. Finns det ingen papperskorg kan du ta med det hem och slänga i hushållssoporna"	No
	Website	"Trängsel i kollektivtrafiken" ⁸	Written	No	-	Yes

4. Discussion

4.1 Communicating about disposal of single-use face masks

The health and environmental consequences caused by the inadequate disposal of single-use face masks are treated in this study as an eminent risk to be properly communicated. It is recognized that the way a risk is conceived and perceived depends of different theoretical perspectives and paradigms. In order to frame the incorrect disposal of face masks as an important risk, for example, contributions from environmental sciences showing the impacts in ecosystem and wildlife are required. Sociology and psychology can also contribute in choosing the appropriate approaches to communicate with different audiences and refining the message to be transmitted. The audience analysis (Table 1) serves as basis for the development of the communication process in this case.

Risk perception depends of other aspects that relies on qualitative characteristics of that hazard itself, as pointed out by Lundgren & McMakin (2013). The environmental and health risks caused by the inadequate disposal of single-use face masks can be considered artificial ones (cause by man), with non-voluntary exposure, low reversibility and great extent both geographically and across time. At the individual level, it is considered that there is certain degree of familiarity in relation to the risks related to plastic pollution for example, but little experience / knowledge about the health risks. The control over risk is considered high and easy, with certain dislike towards the source: no one really likes to wear face masks, but properly dispose them does not require a lot of effort. The perception of risk is also influenced by other factors and, although it seems interesting to analyse how gender, age, family constitution, education and culture play a role in influencing the proper disposal of face masks, it is not the focus of this study.

The role of media and advertising and the trust or distrust related to the perceived institutional control over risk are also aspects that influence the risk perception. The trust ladder (Figure 2) shows that the importance of understating the chain of communication. For the risk to be communicated widely, everyone has to talk about it: Governmental authorities have to give guidance about the disposal in their informative and disclosure material; Manufacturers and suppliers of single-use face masks must have include disposal information in the instructions for use; Research community have to produce and publish studies showing the environmental and health effects of improper disposal; Environmental organizations have to produce advertising campaigns about the subject; Mass media have to inform and encourage their great audience over the proper disposal.

4.2 What is being communicated now may not be enough

A total of 8 different brands of single-use face masks were collected from supermarkets, pharmacies and convenience stores, mostly in the vicinities of train/busses stations. Two of them did not have any guidance about the disposal and only one had a visual communication (drawing of a face mask being thrown out). Among those with information on disposal, half (3 of 6) included recommendations about trash bins with lid. Half of the total (4 of 8) presented information in other languages and the other half has information only in Swedish.

The communication of four governmental authorities were analysed, amid informative pages of official websites, social media accounts and disclosure materials. All authorities have information about the use of face masks on their official websites and the majority of the informative pages (4 of 6) included guidance about disposal, however mainly in written form. Only two informative pages used a visual aid to reinforce the message (video).

Stockholm Lokaltrafik was the only authority who do not produced their own disclosure material. Among the 3 videos and 1 poster analysed, the majority (3 of 4) presented a picture

or drawing of a face mask being discarded in a trash bin and one does not presented information about the disposal et al. None of informative pages/materials with guidance about disposal make reference to trash bins with lid in their written messages and only one emphasized the importance of correct disposal. Half of the pages/material have available recommendation in other languages and half of them only in Swedish.

Some reflections can be made based on the short analysis performed. Guidance on the correct disposal of face mask is present in two thirds of the existing communication, both from manufacturers/suppliers and governmental authorities. Half of all existing communication is made only in Swedish and, given that 25% of Stockholm's population is foreign-born, it may mean a significant exclusion. The type of communication, which is mostly written and not visual, also indicates a possible point to discussion and improvement. Finally, it is considered that there has not been a sufficient focus on the importance of correct disposal.

Based on that, the following points for improvement are suggested:

- Inclusion of information about proper disposal in the existing informative and disclosure material from authorities (official websites, informative posters, promotional videos, etc.), preferably with visual aids;
- Recommend / require manufacturers and suppliers of single-use face masks to provide information about disposal on packaging and instructions for use;
- Expansion / production of disclosure material in languages other than Swedish;
- Incentive for advertising campaigns about the subject, with the involvement of the scientific community and mass media.

4.3 Study limitations

This report carried out a short and limited analysis of the communication on disposal of single-use face masks in Stockholm. It is recognized that this is a time-framed analysis, once the information used as a basis for discussion was collected during the months of January and March 2021 and both the informative pages and disclosure materials are constantly changing. Thus, the results should be read as if they presented a kind of snapshot of the current moment. Further, because it is a very recent research topic, not much specialized literature on the subject was found, nor research and statistics specific to the region.

The scale of analysis was also limited to Stockholm region, with focus on public transport users. It was difficult to detail exactly the target audience of the communication, since such information was not available and no field study was carried out. The rationale behind the scope for analysis was to assume the habits / routine of an ordinary citizen, based on the audience analysis (Table 1), and suppose to which sources of information and disclosure materials a common user of public transport who uses a single-use face mask would be exposed to. After the announcement of the new recommendations about the use of face masks in public transportation, an ordinary citizen would look for more information on the official websites or social media of government authorities. He/she would then purchase a single-use face mask near the train or bus stations and read the instructions on the package. During the trip, he/she would pay attention to posters around the stations. It is assumed that if information about the disposal were present in all these phases, the citizen would be more aware of the issue and more likely to perform the correct disposal, thus reducing the environmental and health risks associated with inadequate disposal.

Regarding the methodology, it is also acknowledged that time and resource limitations may have caused biases in the analysis. The brands of single-use face masks collected for analysis were those available in the surroundings of the author. If the study were carried out for example with brands collected in another neighbourhood in Stockholm, it is possible that different results

would be obtained. A possible improvement for this issue would be expand the analysis by collecting more brands from other locations.

This study is basically based on the observation and discussion of a secondary data sources. In this sense, it would be beneficial to carry more studies about the adherence of the existing communication, as well as out more in-depth studies of the communication strategies of the authorities, for example through interviews with the managers and officers of government authorities. It could reveal issues not seen in the current analysis and also points to future directions.

Finally, it would be interesting to deepen the discussion about the use of reusable masks as a replacement of the single-use ones. This is indeed a very fresh topic for debate in which technical and public health issues must be balanced with environmental issues.

5. Conclusion

The use of face masks became an important prevention and control measure to limit the spread of COVID-19, but also meant a huge increase in their production and a great challenge regarding the correct disposal. It is estimated that globally 129 billion single-use face masks are discharged into the environment every month and, because of the properties of the material, significant environmental and health risks are looming. This study investigated how have users of public transport in Stockholm been informed about the correct disposal of single-use masks, with two main questions: 1. The instructions for use of single-use face masks include information about their correct disposal? and, 2. Government authorities inform about the correct disposal of single-use face masks?

It was found that two thirds of the existing communication have recommendations about the correct disposal, however half of them is made only in Swedish, mostly with written information and any visual aid, and with no sufficient focus on the importance of correct disposal. It concluded that the current guidance on the correct disposal of single-use face mask both from government authorities and suppliers of face mask may not be enough in communicating the health and environmental risks caused by the inadequate disposal.

It is suggested the inclusion of guidance about proper disposal in the all existing informative and disclosure material and in packages and instructions for use of single-use face masks as necessary measure to government authorities and suppliers and manufacturers. Expansion / production of informative and disclosure material in languages other than Swedish appears also as an important issue to be considered in order to not exclude a significant part of the foreign-born population of Stockholm. Finally, it seems beneficial to incentive advertising campaigns about the subject, with the involvement of the scientific community and mass media.

Although essential for preventing the spread of the virus, single-use face masks add to already great concerns over plastic pollution and poses significant environmental and health risk. Waste generation is so framed as a side impact of the COVID-19 and the inadequate disposal of single-use face masks as an eminent risk to be properly communicated.

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Annex

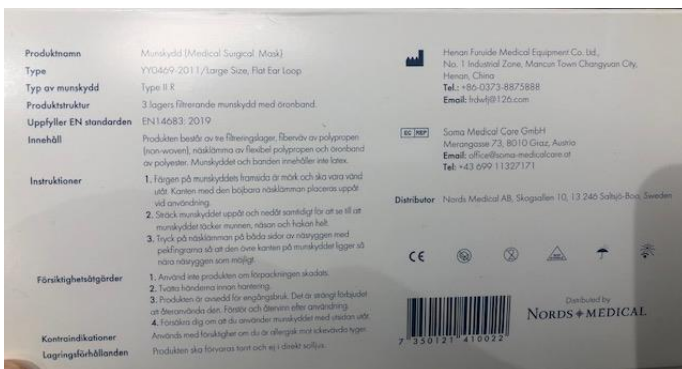
Packages / instruction manuals of manufacturers and suppliers of single-use face masks:



Brand A



Brand B



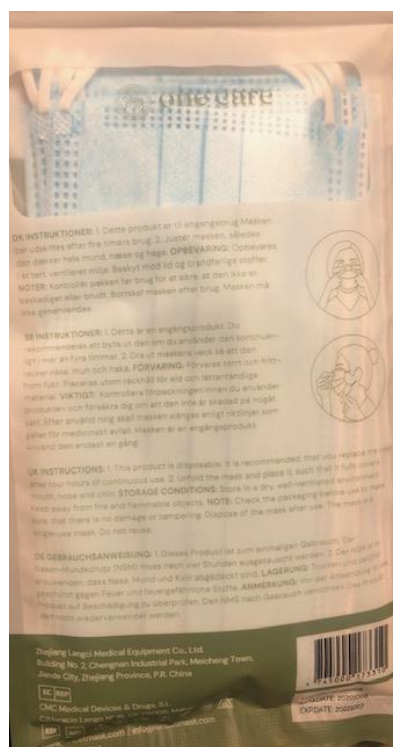
Brand C



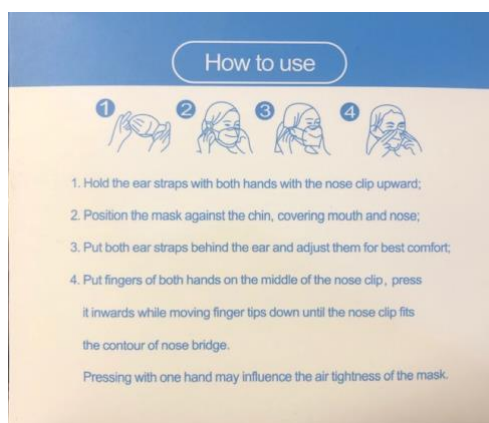
Brand D



Brand E



Brand F



Brand G



Brand H

Links of visited websites and disclosure material:

- 1 <<https://www.sll.se/verksamhet/halsa-och-varld/om-det-nya-coronaviruset/>>
- 2 <<https://fb.watch/3R2Wb1nCUY/>>
- 3 <<https://www.1177.se/Stockholm/sjukdomar--besvar/lungor-och-luftvagar/inflammation-och-infektion-ilungor-och-luftror/om-covid-19--coronavirus/sa-anvander-du-munskydd/>>
- 4 <<https://www.1177.se/Stockholm/aktuellt/aktuellt-i-stockholms-lan/6-janmunskydd-i-kollektivtrafiken-fran-den-7-januari/>>
- 5 <<https://www.folkhalsomyndigheten.se/smittskydd-beredskap/utbrott/aktuella-utbrott/covid-19/om-sjukdomen-och-smittspridning/smittspridning/munskydd/>>
- 6 <<https://www.folkhalsomyndigheten.se/publicerat-material/publikationsarkiv/s/sa-anvander-du-engangsmunskydd/>>
- 7 <<https://sl.se/aktuellt/nyheter/anvand-munskydd-i-kollektivtrafiken/>>
- 8 <<https://sl.se/omdirigeringar/trangsel/>>