CRANFIELD UNIVERSITY

ADRIEN BAILLY

How to best communicate Bioaerosol Science to different audiences?

SCHOOL OF WATER, ENERGY AND ENVIRONMENT

MSc. Environmental Management for Business

MSc.

Academic Year: 2020 - 2021

Supervisor: Dr Gill Drew

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This thesis is submitted in partial fulfilment of the requirements for the degree of MS.

(NB. This section can be removed if the award of the degree is based solely on examination of the thesis)

ABSTRACT

Scientific research aims to advance society through its results and discoveries. However scientific discoveries and results are for most people very difficult to access, both from the point of view of pure understanding and the accessibility of science to non-expert audiences. Making scientific knowledge more accessible to wider public is challenging, especially for an interdisciplinary field like bioaerosol science, where effective communication to various stakeholders is facing complex challenges.

This study is integrated into the BioAirNet research network, in the theme of public and policy engagement. Here, the focus is on how best to communicate the science of Biological Particulate Matter (BioPM) or airborne micro-organisms (bioaerosols) and associated results. The aim of the research was to develop a framework for communicating bioaerosol science to different stakeholder; the General Public (GP), professionals, from different areas and the regulators. To do this, the research work consisted of analysing the concerns of the stakeholders, conducting a literature review, and carrying out qualitative data analysis (QDA). Then with the result obtained an investigation on the best communication mechanisms and the research on the key message for the stakeholders.

The results of the study led to a Framework that is an asset for a better understanding of stakeholder engagement (SE) through effective scientific communication. this research confirms the fact that when the objective is to communicate to a certain audience or stakeholders identified, understanding the audiences and their concerns is crucial for the achievement. This study provides mechanisms through the choice of well-adapted tools for science communication. The framework developed allows reducing as much as possible the uncertainties and the technical/scientific issues inherent to science communication.

Keywords:
Science Communication, Bioaerosol, BioPM, audiences and stakeholders, Framework for science communication.

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Finally, I must express my very profound gratitude to my parents, my sister, and my grandparents for providing me with unfailing support and continuous encouragement during my years of study. This achievement is in a way theirs.

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LIST OF ABBREVIATIONS

BioAirNet	Indoor/Outdoor Bioaerosols Interface and Relationships Network
BioPM	Biological Particulate Matter
DM	Deficit Model
GP	General Public
HCP	Health Care Practitioners
NICABM	The National Institute for the Clinical Application for Behavioral Medicine
NASEM	The National Academies of Sciences, Engineering and Medicine
PM	Property Managers
PUS	Public Understanding of Science
QDA	Qualitative Data Analysis
SA	Stakeholder Analysis
SC	Sense Checking
SE	Stakeholder Engagement
SPF	Strategic Priorities Fund
UKRI	UK Research & Innovation

1 INTRODUCTION

1.1 Science communication

1.1.1 Importance of Science Communication

Scientific research aims to advance society through its results and discoveries. However scientific findings and results are for most people very difficult to access, both from a comprehension point of view and for the accessibility of science to non-academic audiences, as the current scientific publication system makes it difficult to make research accessible to different audiences, and therefore limits the engagement of different people potentially concerned (Day et al., 2020).

Communicating science is more complex than simply translating scientific publications or changing the "*scientific*" language used into a more accessible language (National Academies of Science, Engineering and Medicine (NASEM), 2017). The process of communicating science needs several methods to be effective on all the targeted audiences.

Burns, O'Connor and Stocklmayer (2003), defined Science communication as the use of skills, communication channels, activities and dialogue to reach one or more responses to science: awareness, understanding, interest, opinions, and enjoyment of science. The main objective is to achieve greater SE through various methods. Sellnow et al (2009), defined the stakeholders as "any person or group of persons whose lives could be impacted by a given risk." (p5), so stakeholders are people with a direct interest in a specific outcome of scientific research.

1.1.2 Study Background

The academic literature on science communication is very much focused on the lay audience. The focus is often on non-expert audiences or the wider public and less on professionals who may already be involved in one or more scientific fields (Brownell, Price and Steinman, 2013; Burns, O'Connor and Stocklmayer, 2003; Buxton, 2020; Dahlstrom, 2014; Day et al., 2020; Erikainen et al., 2020;

Guimarães Pereira et al., 2013; Hajdu and Simoneau, 2020, pp.166–179; Petts et al., 2010).

The Deficit Model (DM), said that that if the scientific message is well built for one of the audiences, it will be efficient for all others NASEM (2017c). However, the authors added that for effective science communication, context and engagement with all audiences are necessary. Thus, it is important to consider how to build a communication process that considers the different audiences.

Guimarães Pereira et al (2013) described three models of public engagement in science:
The public understanding of science, called PUS: hypothesises that the lack of public support for science and innovation is due to a lack of public understanding of "*scientific illiteracy* "(Wynne et al. 2007, reported by Guimarães Pereira, 2013). This is a model based on a pedagogical approach, and on the DM, which describes the public as ignorant and science as a concept understandable by all, and which tries to increase the public's scientific knowledge and understanding.

The second model is called Public Dialogue and Participation: which seeks to involve the public in the discussion of scientific research or innovations but also in the policy decisions that result from them. One example is the "*GM Nation*" in the UK where the public and some policymakers were invited to participate in a public debate in 2003, on genetically modified organisms. In total, 675 public debates took place.

Finally, the third model described is the Public Co-production of Knowledge, which seeks to establish a dialogue between the public, whether directly concerned or not, and all the other participants on the scientific challenges encountered by society.

Kappel and Holmen (2019), on the other hand, stated that science communication models can be divided into 2 main paradigms:
The first is the Dissemination Paradigm of Science Communication. It sees science communication as a means of transmitting information about science from scientific experts to the public. Most experts consider that the transmission

should be done through education, i.e., in the traditional school system, or "(re)education" through the media, in general.

The second is the Public Participation Paradigm of Science Communication, which aims at improving or starting communication in a bi-directional way, i.e., bringing about dialogue and even deliberation between the public, experts and/or scientists and regulators.

The usefulness and necessity of communicating science to engage regulators are predominant (Eastwood, 2020; Carter and Paulus, 2010; NASEM, 2017; Ross-Hellauer et al., 2020). It is important to make and support decisions through science.

Science communication increases the knowledge and awareness of stakeholders, but it can also lead to those same stakeholders making decisions in the most informed way (Brownell, Price and Steinman, 2013). Advances in science will start to impact the lives of the public more and more (health, climate change for example), and non-scientists, like the public but also other stakeholders, will need to be able to understand scientific information to take actions that will impact on their lives and those of others (Brownell, Price and Steinman, 2013). Especially for an interdisciplinary field like bioaerosols, with a multitude of scientific fields involved, the communication to various stakeholders is difficult (Douwes, Eduard and Thorne, 2008).

1.2 Indoor/Outdoor Bioaerosols Interface and Relationships Network

This project is part of the Indoor/Outdoor Bioaerosols Interface and Relationships Network (BioAirNet), funded under the UK Research & Innovation (UKRI) Strategic Priorities Fund (SPF) Clean Air Programme. BioAirNet addresses the interdisciplinary challenges of characterising the emission dynamics, exposure patterns and health effects of BioPM in a continuum of different indoor and outdoor environments (BioAirNet, 2021).

The network is organised around four broad themes:

- Theme 1: BioPM sources and dynamics in the indoor/outdoor environments.
- Theme 2: BioPm sampling and characterisation.
- Theme 3: Human, health, behaviour and wellbeing.
- Theme 4: Policy and public engagement.

This research will therefore focus on theme 4, and more specifically on the communication of science to the different audiences that constitute the stakeholders. The focus will be on BioPM or bioaerosol science and how best to communicate it.

To this end, the following questions should be addressed:

- Who are the stakeholders?
- What are the most effective mechanisms for communicating bioaerosol science to them (scientific findings, risks)?
- Where and when should these mechanisms be put in place?
- What is the most important information to communicate?

1.3 Aim and Objectives

The study aims to develop a framework for the communication for bioaerosol science to different stakeholders.

This will be achieved through the following's objectives.

1. Identification of the stakeholders, i.e., the people concerned by BioPM.
2. Stakeholder analysis, to identify the concerns of the stakeholders.
3. Investigate the best communication mechanisms, to obtain a better engagement and understanding from each stakeholder.
4. Realise a Literature Review.
5. Carry out a QDA, interviews for sense checking (SC).
6. Identify the best context for these mechanisms, with the key messages to deliver to the right stakeholders.

The communication objectives can be: increase awareness, exchange knowledge, engage stakeholders in research, reach a wider audience.

This framework first focuses on the identification of audiences potentially directly or indirectly impacted by bioaerosols, the stakeholders. It will then introduce the communication manners to the stakeholders, as well as the different outcomes of the QDA and the SC of this framework with different stakeholders. Thus, this work will first present the approach used for the development of this framework, then in one chapter it will present the results of the different research used and we will discuss them, their implications, and the utility for BioAirNet. The SC will be used to give tracks of improvement and the future development of this framework. This approach was chosen to present the results with clarity, as the work will take the form of an instrument for the communication of the BioPM sciences.

2 METHODOLOGY

2.1 Stakeholders Identification and Analysis

2.1.1 Stakeholders Identification

Identification of stakeholders is one of the bases of the scientific communication process, indeed, knowing the audience will participate to investigate the best way to communicate (Ross-Hellauer et al., 2020).

Stakeholders were identified by considering who are likely to be impacted, who may be engaged in bioaerosol science or in the indoor/outdoor air exchange interface impacted by BioPM.

2.1.2 Stakeholder Analysis

Then, with the identification of the stakeholders, it is important to know the stakeholders. Knowing the stakeholders means understanding the needs, interests, and concerns of stakeholders from the research outcomes (Ross-Hellauer et al., 2020). The same authors show that the more the audiences is known, the more the communication process can correspond to its expectations.

For the stakeholder analysis (SA) the process used here is the stakeholder matrix. The stakeholders' Matrix was used to improve the understanding and the needs of each stakeholder (IAEA, 2017a). The different stakeholders have various ways to perceive and expect from bioaerosol science, and these factors have an influence on the communication (IAEA, 2017a).

The stakeholder matrix has been constructed based on the QDA (thematic analysis) and the literature review.

2.2 Literature Review

The literature review conducted during this thesis project is needed at several stages to achieve different objectives. Initially, the first searches in the academic and scientific literature were conducted, to gather background information. The aim will be to highlight the actual results in literature by summarising them, to show the state of research at that time (University of Southern California, 2019).

This short part will give a start to the study and shows the interest in the current research. This also contributes to the stakeholders' identification and analysis objective and constitutes the first step of the investigation about the science communication mechanism.

Once the identification of stakeholders and the SA had been carried out, the literature review was continued to review methods of engagement and scientific communication for the identified stakeholders. The outcomes given by this review of academic literature, articles, and more general publications, are fully integrated into the results of this thesis. The literature review has been done also to reach the objective of finding the key messages, which constitute the context of science communication.

Indeed, it is part of the realisation of the Framework for Scientific Communication, but also in the preparation of the preliminary framework for the interviews (testing and SC).

To carry out the literature review, a curation tool called *Pearltrees* (https://www.pearltrees.com) was used. This allows to put in an online workbook, the literature reviewed, but also, add a short explanation and thus organise the literature review.

2.3 Qualitative Data Analysis

2.3.1 Data from the previous Workshop

This QDA is based on the workshop organised in the framework of Theme 4 *Policy and Public Engagement* of BioAirNet.

The aim is to analyse how the different persons involved in the workshop communicate and through what mechanism, but also analysis their concerns, needs and expectations. The analysis done here is one of the methods used to achieve some of the thesis objectives: SA, the investigation on the best communication mechanisms that can be interesting, but also to obtain insights about the context of the communication.

To conduct that, a systematic method of QDA is needed. This data analysis has been carried by using an analytical coding method, to identify a range of responses in categories and identify recurrent themes in the data. But also to explore differences/similarities in response categories across respondent clusters and identify differences between stakeholders. The search for ideas, concerns, and thought patterns of the people involved in this workshop and more generally in the BioAirNet network, justifies such an analysis. Indeed, it is part of the investigation of a communication framework.

Before starting the analysis process, it is crucial to collect all the qualitative data needed. These data come from two sources: the first is the recordings made during the workshop and the second comes from observation notes from the workshop. The data has not been processed beforehand.

When the coding process starts, it's important to define the coding unit, for this work the choice made was to use a semantic analysis. The semantic analysis instead of splitting up the whole text, as in syntactic analysis, the study may choose to focus only on passages that have meaning i.e., the key ideas the important patterns. The semantic unit includes the idea expressed by the interviewees (for the next analysis) and participants and generates the meaning (Andreani and Conchon, 2005). From these notes and transcripts, and thanks to the coding unit, patterns concerning ideas have emerged, then from these, it is observed the appearance of categories which will allow several patterns to be grouped in the same codes (Seers, 2011). New thought patterns or concerns have emerged that correspond to, or at least are like, the categories, so it is possible to group them into a single theme, which represents a more abstract and encompassing concept of the data set (Seers, 2011). In the use of coding, the words used do not matter, their meanings are more important, allowing key concepts to be clustered in the data (Young et al., 2018).

So, the data come from observations, because they are the results of the participation of some people involved in the workshop, but there were analysed in a thematic manner (Mohamadi et al., 2018).

2.3.2 Data from Interviews and Sense Checking

The QDA was based on interviews made to test the initial output, the preliminary communication framework, with professionals, who represent some stakeholders. According to Virginia Tech (2018, p2):

> *"They help you explain, better understand, and explore research subjects' opinions, behavior, experiences, phenomenon "*

An informed consent form was developed to inform interviewees of how the data will be handled, according to the developed consent forms all data were collected and have been stored in harmony with GDP Regulation (see Appendix A). Each interviewee was given a participant number, allowing them to be identified anonymously, and allowing the transcripts to be identified (Lacey and Luff, 2009; Data Protection Act 2018).

The main objective of this was to check the plausibility and the viability of the initial framework, made from the first QDA and a literature review.

Firstly, the aim was to give a comprehensive presentation of the state of research and the Framework, to the experts and let them react to it. The reactions and comments made it possible to carry out SC, but also to collect data to be analysed, and useful for the realisation of the project. SC allows more evidence to be considered (Garnett et al., 2016), these consultations would help to check the approach regarding the preliminary framework.

The second objective was to carry out another QDA, based on the same process used for the first range of data, to achieve the SA, the methods research, and the investigation on the context objectives.

Indeed, according to Bogner, Littig and Menz, (2009), conducting interviews is a better way to gathering data in a short time, and it is a more efficient method.

Then coding process has been conducted, to cluster data in themes to continue the QDA.

Therefore, conducting such interviews is justified by the need to verify the validity of the previously conducted analyses and established communication methods.

2.4 Thesis Workflow

The approach used in the form of a workflow is shown in Figure 1.

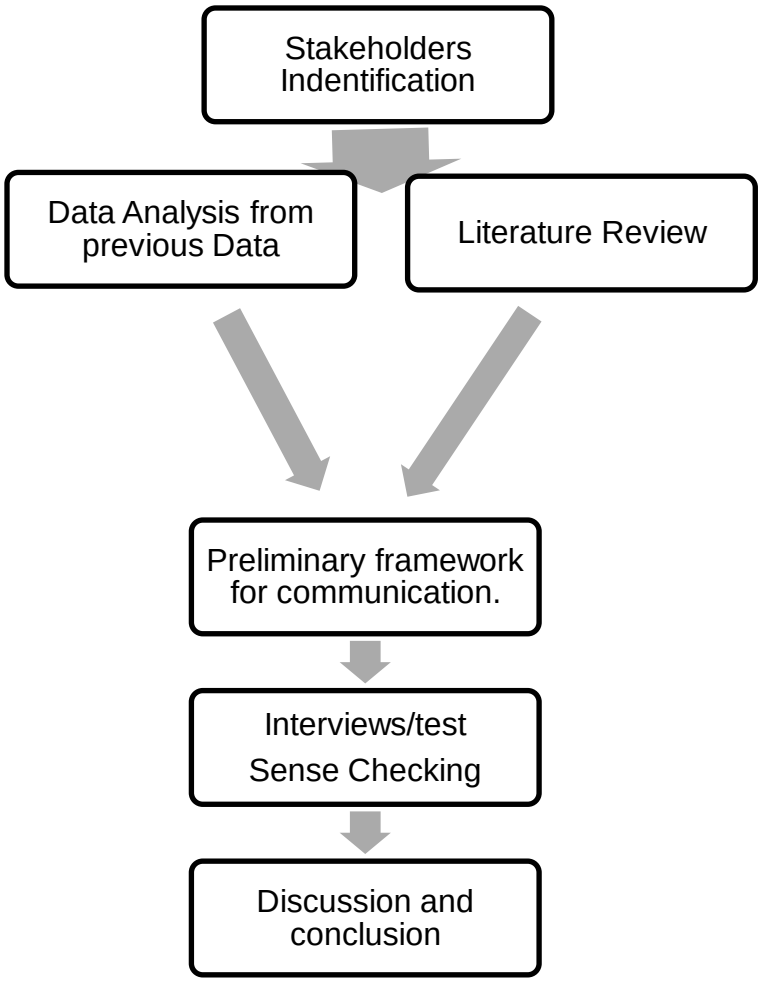

Figure 1 - Thesis Workflow

3 RESULTS

3.1 Stakeholders

3.1.1 Identification

Communicating to targeted audiences, i.e., well known, and understood ones, is necessary for reaching the communication objectives (IAEA, 2017a; NASEA, 2017), and just for an efficient communication and engagement process. However, before that, it is necessary to start choosing the audiences. Indeed, whether it is to create a marketing plan for a business or to communicate to and involve people, targeted the audiences is necessary (Petrovski and Pestana Neto, 2017). Thus, it was necessary to start from the interest of the research network of which this thesis is a part, Indoor/Outdoor Bioaerosols Interface and Relationships Network (BioAirNet). Indeed, this work focuses on the communication of bioaerosol sciences within the framework of a research network that seeks collaboration in research on interfaces and indoor/outdoor relations concerning air. The interests of the network make it possible to better target different categories of people (Petrovski and Pestana Neto, 2017).

The GP should be one of the stakeholders. Indeed, bioaerosols are naturally in the outdoor and indoor air, and represent a risk, but not necessarily. As a risk for the population, the regulators are naturally impacted, they guarantee the security of citizens. Thus, the regulators and the policymakers are stakeholders. Furthermore, the results of the quantitative data analysis led to four pillars of regulatory justification: new regulations must be evidence-based, proportionate, measurable, and targeted. This is one of the arguments for engaging policymakers with science in general.

Then comes the choice of different professionals. As previously mentioned, studies concerning the communication of scientific information, although it may appear to be very useful, to professionals and the media are not well documented, so their engagement among researchers is important to study. Thus, given the theme, the choices were Health Care Practitioners (HCP), other academics, the media, architects, and property managers (PM).

Indeed, the initial study of qualitative data demonstrated the willingness of many stakeholders to engage more real estate and buildings professionals within BioAirNet, to engage in conversation and collaboration.

Furthermore, Hamidi, Sabouri and Ewing, (2020), published a study about urban density and Covid-19 spreading in New York City, and they concluded with recommendations for urban planners and urban architects. They said that urban planners should listen to scientist and their findings, and start to use empirical evidence which shows e.g., that urban sprawl leads to a high virus death rate, because of lack of ventilation system and access to health services. Indeed, they said that urban sprawling is complicated, especially in the poorest neighbourhood, the implementation of efficient aeration systems, that show their efficiency in Covid-19 transmission decrease.

The stakeholders implicated in the workshop, have been agreed in the fact that a significant part of the HCP, especially General Practitioners, do not have sufficient knowledge about bioaerosols, the associated risks and some consequences for the health.

For academics, the objective is double. Firstly, for a multidisciplinary area as bioaerosol science, the collaboration between academics and researchers is primordial. Collaboration among researchers is crucial to face complicated challenges within the scientific effort (Hall et al., 2018). Secondly, academics and scientists should find a way to communicate to the public and the regulators, for the reasons explained sooner (see the introduction and background parts).

Engage with the media is a crucial part of science communication. As said by Kappel and Holmen (2019), one of the ways to disseminating science is by education or the reeducation of the public through the media. So, the media will be an important stakeholder. However, one of the experts interviewed raised the point that media is a complicated target audience to reach, its concerns are both about informing the public and mercantile. Stakeholders are illustrated in Figure 2.

In addition to that, the Royal Astronomer Lord Martin Rees, during an interview (0:01:29) said that an important proportion of the issues faced by the society, and which implicate decisions by a government have a scientific component, for a range of different aspect: health, energy, environment, etc. He continued by saying that it's important to give a "*general science feel*" to the public.

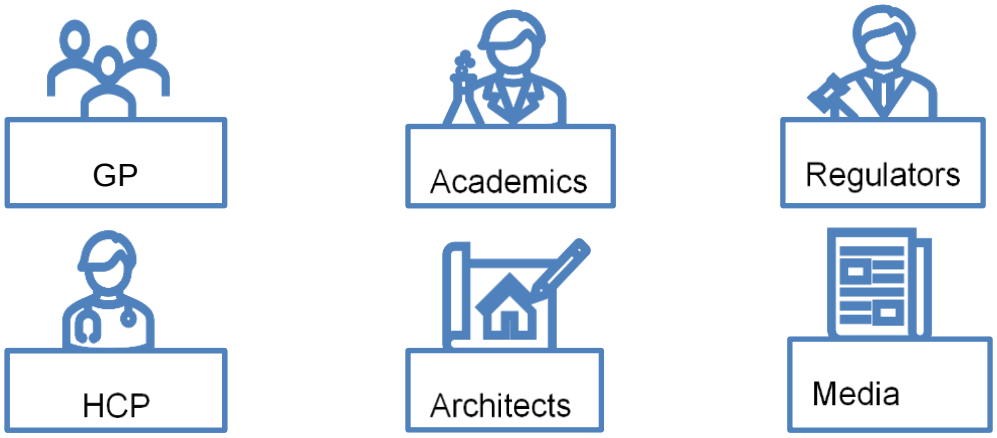

Figure 2 - Stakeholders Identified

3.2 Qualitative Data Analysis

The process of the QDA have been already explained. This part shows the outcomes. The results obtained are classified by themes which are extracted from the data after using the transcripts to find codes (Dudo, Besley and Yuan, 2020). The outcomes, with the codes and the themes are available in Appendix B.

3.2.1 Stakeholder Analysis

it is necessary to understand the concerns, to construct the best communication process. The identification of these concerns constitutes the SA.

Some of the stakeholders' concerns are obvious because they concern everyone, like the health issues, some others were sought.

The following table, Table 1, shows the summary of the SA.

Table 1 - Stakeholder Matrix

Stakeholders	Key concerns (Themes)
GP	Health issues. Allergies, respiratory problems. Olfactory disturbances. Knowledge.
HCP	Health issues. Allergens causes and consequences. Awareness about health troubles that they aren't specialist.
Academics	Scientific findings and their impacts (Harding, 2019). Potential impacts of their own field of research/interests. Exchange knowledge. Engage with the public and the policy makers.
Media	Have good stories to sold (Rouquette, 2019). Be interesting for a maximum number of people (Rouquette, 2019).
PM/Architects	Indoor air pollution. Exchange knowledge. Increase their own awareness about the air quality and mitigation of indoor air risk factors. Cost benefits analysis.
Regulators/Policy Makers	Understand the issues and the concerns of the public and make the best decisions (National Co-ordinating Centre for Public Engagement, 2014). Awareness about risk and benefits. Cost benefits analysis. Use research to inform decisions (Ion et al., 2019).

The SA is on majority based on the QDA, from the two made for this thesis. Indeed, the first workshop contains some good insight about the concerns of different stakeholders. Thus, the table 1 represents a part of the outcomes of the QDA, by showing the themes, which was extracted from the data (Dudo, Besley and Yuan, 2020). The coding process is available in Appendix B.

3.3 Framework for Science Communication

3.3.1 Communication Challenges

But first, in this research, it appeared that communication of science is also a challenge because it has challenges and difficulties. Indeed, communicating science, and especially science such as bioaerosol which is multidisciplinary, involves a lot of biases that will disrupt the process and thus prevent reaching the desired audience.

Indeed, in terms of science communication, the main challenges are the explanation of data and technical issues, the uncertainties, and the fact of having several stakeholders, with different aspirations and concerns.

3.3.1.1 Dealing with technical issues and Uncertainty

Some people will need "*good background*" or good "*explanatory information*", when they have access to scientific findings, in any form. As explained by Petts et al, (2010, p17):

> *"It is important to pitch the information at the level of the participant with the least technical knowledge to ensure that all participants can understand the information"*

The same authors added that when science is communicated to laypeople, it is important to assume that the reader, the listener, or the participant is not an expert. Even when the communication is made for other academics or HCP some academics do not have sufficient background in the bioaerosol field and some HCP lack awareness.

3.3.1.2 Uncertainties

Despite very well processed science and strong evidence, uncertainty persists. Of course, further research can answer uncertainties, but the rest of the time, uncertainty will persist (NASEM, 2017b). Even with the uncertainty, communicating science, in the right way is crucial. Because, Science will always

have the aim and desire to inform and justify everyday life and policy decisions but also how to interpret the relevance of scientific information, and lead debates between stakeholder groups (Dietz, 2013, reported by NASEM, 2017b).

Frewer and Salter (2007, reported by NASEM, 2017b) report that despite the temptation to avoid uncertainty when communicating science, this may be a mistake. Some audiences are aware of uncertainties and want to be informed about the uncertainties of the scientific results they are given.

In the context of bioaerosol science, risk assessment is important and is part of the communication to different audiences, and Petts et al (2010, p17) report that "uncertainty is inherent in risk assessments". Indeed, one of the experts interviewed reported that many questions remain unanswered about BioPM, such as the effect of particle size on their penetration into organisms or buildings, etc. Thus, the same authors say that these uncertainties must be communicated, but that the communication must be based on the best possible scientific data.

3.3.1.3 Data communication

The NASEM (2017b), talk to us about the numerical and data problems in science communication: Computing and data problems even affect scientists outside their fields of expertise. Thus, when communicating and conveying diverse data, it is important to consider that audiences often misperceive data, and therefore the best tools must be used to present it simply and accurately.

Data, especially numerical data, can be too complex for some stakeholders, and the best way to overcome this is to think visually. Indeed, the graphical representation of quantitative data helps to achieve understanding by all.

3.3.1.4 Multiple stakeholders

Firstly, there is no "one size fits all" approach (Carter and Paulus, 2010, p86). Not all stakeholders have the same priorities or scientific knowledge (Petts et al, 2010).

This applies to all sorts of communication, although targeting and building a personalised communication process can make this quite useful.

3.3.2 Best Mechanisms for Science Communication

This section will present the different mechanisms investigated during this research work. It was developed based on a literature review.

It was a matter of finding and developing different communication methods that would best inform and engage the different audiences and intended to address the challenges posed by science communication.

3.3.2.1 Cross Impact Analysis and Participatory events

Cross Impact Analysis to facilitate exchanges between different audiences is a method described by Winowiecki et al, (2011), in the article Tools for Enhancing Interdisciplinary Communication.

This method aims to bring together as many stakeholders as possible and to facilitate exchanges.

The first step is the creation of a mind map by all participants. This will involve brainstorming about the factors that influence each other, and the issues related to bioaerosols. This will allow everyone to understand the issues of the other stakeholders.

The second step is the cross-impact analysis itself. The aim is to establish links between all the points raised by the participants. Thus, it is possible to explore "the relationships between each major theme identified" (p76).

This is critical to understand what is at stake for the different stakeholders, to communicate the best message to them but also to engage them in the scientific research to come. This is very useful between different academics and scientists coming from different fields but also with other professionals (HCP, PM, and architects) to establish their needs and lack of knowledge about bioaerosols.

Participatory events as a workshop are great methods to communicate and engage with other stakeholders. Indeed, some experts interviewed highlighted the efficiency of events like that. Firstly, it is a good place to make a presentation in front of an interested audience, secondly, the face-to-face interactions arise from the events. A large amount of evidence shows that face-to-face interactions

result in more productive communication than other forms of remote interactions such as email, chat, or telephone exchanges. Face-to-face communication is more persuasive and results in better attention (OECD, 2020).

Furthermore, improvised encounters, as often happens at such events as people share the same space and time, are essential for knowledge sharing and thus for establishing effective communication (Claudel et al., 2017, reported by OECD, 2020). The lack of face-to-face exchanges can also reduce the exchange of knowledge between those involved in these communications. As people learn by engaging in interactions with others, especially at events, the lack of face-to-face communication and exchange will slow down the acquired knowledge through practice and collaboration (OECD, 2020) and in the desire to engage and increase the awareness of audiences, this makes matters more complicated. Moreover, the Science team, the collaboration and communication process with policymakers, shows the importance and the efficiency in science to communicate and collaborate (Hall et al., 2018).

3.3.2.2 Summary Document

The Summary document is a communication tool described by Ross-Hellauer et al., (2020). It is a very useful tool to disseminate research outputs.

This method consists of producing a document that summarises all the research. It is a 1–2-page document that will give the main findings and conclusions. The authors describing this communication mechanism give two main components: the main conclusions and a description of the facts, which they advise to make visual with schema and graphics, the researchers should make people want to read it.

This document can be written in different forms depending on the targeted stakeholder (Ross-Hellauer et al., 2020):

- Vulgarise this research and make the paper very accessible, for non-experts and the GP. This can make the paper interesting, and it is possible to release it on social networks.

- Target certain key findings voluntarily, with their issues. This has the aim of reaching certain regulators, and thus engaging them. This method appeals to some of the interviewees, for the simplicity of engagement and the fact that it is a simple document to read. But they also doubt the effectiveness of this method alone for communication with politicians.
- Write the document in a catchy way, for the media using the inverted pyramid structure (Hut et al, 2016), which will be described later as a mechanism.

3.3.2.3 Open Science

Open science as such is not a communication method but using it in a certain way can make it useful for communication. This mechanism is primarily intended for expert audiences or professionals with an interest in bioaerosol science.

Professor Jean-Claude Bradley was the first to use the term "open-notebook science", in 2006. Bradley said that the information needed by the researchers must be available for the other and the rest of the world,

The purpose of doing research using open notebook science is to share in open access research. Systematic literature of Open Science made by Vicente-Saez and Martinez-Fuentes, (2018, p1) gives this definition:

> *"Open Science is transparent and accessible knowledge that is shared and developed through collaborative networks".*

They did this definition, by reviewing articles and publications, and by identifying patterns in some documents. Most of the literature reviewed used the same word or using synonyms.

Collaboration and therefore commitment is one of the communication objectives. The use of the Open Science method is very effective. Each stakeholder learns and teaches other stakeholders, and a crucial point of learning in either direction is to demonstrate one's findings and beliefs, question one's understanding, and revise one's opinions (NASEM, 2017a). This is what Open Science allows.

Harding (2019) showed that research, here on Huntington disease, and many others Open notebook can both increase the publications' impact and be used as a mechanism to engage stakeholders in the scientific process. In the case of BioPM, engagement with some professionals like architects can have a positive impact on research in the outdoor/indoor interface, and collaboration with peoples from the GP that suffer from allergies, to work conjointly and mitigate the risk and the causes.

3.3.2.4 Visual Tools

Communicating science and scientific results is still dominated by the written and spoken word (Ross-Hellauer et al., 2020). But a more visual presentation of scientific results and data can better reach the desired audience, as it is often more accessible and attractive.

Data and especially numerical data can be complex for some stakeholders that the communication process wants to reach, and most of the time the best way to overcome these issues is the use of visual representation of data. For example, scientific theory, as well as observation or sampling of bioaerosols, allow the use of "*graphs and new advances in form and content*" (Friendly, 2008). Indeed, graphical representation of quantitative data allows to reach the understanding by everyone. But according to Ross-Hellauer et al. (2020), the graphical representation can be complicated to understand for the non-specialist, but the authors recommend the use of an ad hoc image can innovatively represent the data or an infographic to simplify the data visualisation.

Scientists involved in research can have a good understanding of the number on their own, in their field, but it is not the same for every stakeholder. But data visualisation can tell a story that will give the data a sense for the maximum of stakeholders (Nediger, 2020).

Most often top information can be difficult to take in. So having a graphical tool to visualise data or scientific results can help. It is possible to use illustrations, graphics, descriptive text, and attractive design. But more than that, using visual

tools will help to organise data in a way that will reach more audiences and thus reach more stakeholders at the same time (Nediger, 2020).

An example of infographics made by the National Institute for the Clinical Application for Behavioral Medicine (NICABM), shows a very good way to use visual representation for communicating science, here the Neuroplasticity is available in appendices (**Erreur ! Signet non défini.**Appendix C).

3.3.2.5 Storytelling and Narratives

Storytelling in science communication and sharing is rather criticized. Katz (2013), illustrated that science publications should follow journalistic storytelling, for communicate messages. But he adds that this approach has a pitfall, which can result in a distorted message that misrepresents the data. Another view from the same author (p1):

"Storytelling encourages the unrealistic idea that scientific projects correspond to a singular narrative. Biological systems are difficult to measure and control, so almost all experiments are open to multiple interpretations but storytelling actively denies this fact of science"

But Dahlstrom (2014), assumes that, when the context is to communicate science to non-experts' audiences that is one of the targeted stakeholders, indeed the GP, the regulators and some professionals can be non-experts' audiences, tell stories, use anecdotes become more appropriate and even more important. Indeed, Green (2006, reported by Dahlstrom, 2014), showed in his research, that narratives are easier to understand, and the audiences find the narratives more engaging than a traditional publication.

Moreover, the results of the experts' interviews show that narrative and storytelling are well viewed when the targeted audience is the GP, but following the first paragraph of the part, the use of narratives for academic's communication can be perceived as not enough valuable.

Moreover, audiences with a low level of numerical literacy prefer and are more easily influenced by facts and data in the form of stories than by simple numerical interventions (Dieckmann et al., 2009, reported by NASEM, 2017b). And conversely, people who are more sensitive to numbers are less influenced by the form of communication (Institute of Medicine, 2014, reported by NASEM, 2017b). People with little or no scientific background will prefer narrative information even when the narrative or storytelling is not relevant to the topic (NASEM, 2017b).

In addition to that, Bruxton (2020), said that for this kind of communication mechanism, to have the best response and engagement, the narratives or the storytelling should avoid jargon. The author recommends the use of metaphors and analogies, often from the life of every day because most people can relate to them.

3.3.2.6 Nudge Theory

Nudge comes from behavioural economics. This technique was popularised by two economists Richard Thaler and Cass Sunstein (2009), they defined the Nudge as:

> *"A nudge, as we will use the term, is any aspect of the choice architecture that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives. To count as a nudge, the intervention must be easy and cheap to avoid "*

As described above, Nudge is not a communication technique but can be useful when the objective is to communicate in a softer way for the adoption of good behaviour. Indeed, in an interview, the journalist Géraldine Woessner gives two good examples of Nudge, firstly the interest and the objective of the Exemption Certificate (Appendix D) put in place by the French government at the first lockdown had for objective to show that going out is a particular act and with a certain seriousness because the mix between the complexity and the simplicity

of this attestation was precisely studied. The second example is also during the COVID-19 crisis. Airing a room regularly, to avoid the spread of the virus, is a behaviour that would have deserved the intervention of the Nudge for its adoption.

However, the Nudge can be useful in some points, especially when the issues or what we want to communicate is a result of behavioural issues or one that needs to be highlighted. Lynn (2018) said that nudge can be used in communication to:

- Adopt a new behaviour
- Stop a harmful behaviour
- Prevent the adoption of harmful behaviour
- Change or modify an existing behaviour

Nudge can be used on all identified stakeholders; it is most often aimed at a whole population.

3.3.2.7 Inverted Pyramid Structure

The inverted pyramid is a communication method from journalism as usually this writing structure is used by journalists. This structure uses the headline directly to communicate the main finding of the research. Then the first section contains the main idea to be communicated, the explanation of why this research is being done and the associated findings most relevant to stakeholders (Research Retold, 2019). Then the rest of the article goes into more detail and gives the rest of the facts (Hut et al., 2016). Figure 3 shows this structure.

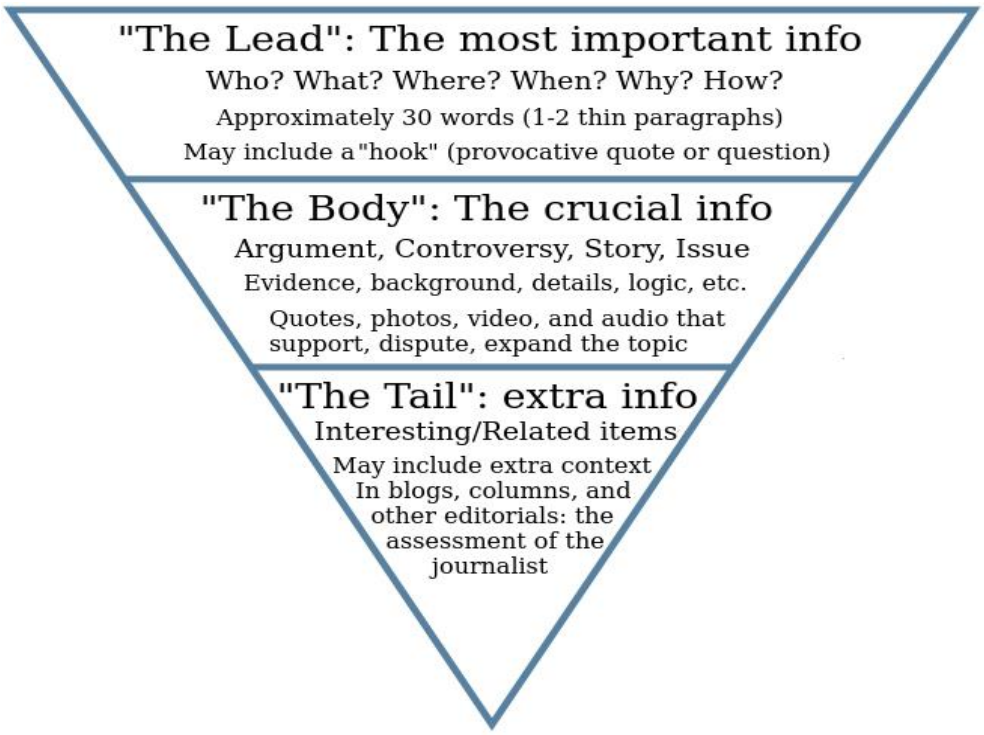

Figure 3 - Inverted Pyramid Structure ("*Inverted pyramid in comprehensive form*", Christopher Schwartz, licensed under CC BY-SA 3.0, 2013)

It is possible to couple this structure with storytelling, to engage/involve and attract certain audiences, as telling a story using the headline to deliver the conclusion is more effective.

This structure contrasts with traditional scientific communication through traditional publications, which first present the details and background of the study and then expand to the results and conclusion (Hut et al., 2016).

3.3.3 Context

Investigations into the best communication mechanisms and those into the best contexts are closely linked. Indeed, the context for communicating these messages to the stakeholders is derived from the methods themselves. Some of the methods require a workshop or a participatory event and on the other hand, some methods are designed to be used in writing.

As seen above, there are many methods of written communication, and the contexts for establishing them are somewhat less so. The interest in giving free access to the research conducted is a context of engagement. In addition,

methods such as summary documents or structured inverted pyramid writing can be and often are intended for publication via traditional media.

But a new communication channel that is not widely exploited by scientists today is very promising for science communication: social networks. Indeed, according to Martin and MacDonal (2020), scientists are slow to embrace social networking, with 13% of scientists regularly using Twitter and only 50% of those participating in debates on the platform.

However, Pavlov et al (2018), using different social networks by their research group, have shown that it is possible to bridge the gap between the GP and scientists, to engage and inspire a new generation of researchers, but also to reduce the gap between scientific knowledge and the beliefs of the GP. They add that this will enable the public, professionals and above all policymakers to make informed decisions. It's also the best place to use the visual tools, which have a good chance to be viewed by a lot and shared.

Furthermore, initiatives such as that of the European Union and the Joint Research Center (JRC), which publishes short information briefs for citizens and regulators, which are available online under the name *"Science Flash for You".*

Make a presentation in front of an interested public, during a workshop or any other event, it's a very good way to communicate your message and engage people.

3.3.4 Key Messages

The construction of the messages is the last step of the framework. The aim is to find the best message, but also to find the best way to start the communication process, to engage the audience. It is based on QDA, from thematic analysis. The results are compiled in Table 2. The coding process is available in Appendix B.

Table 2 - Qualitative data analysis results for key messages construction

Themes identified
Health issues
Cost Benefit
Engaging story
Nuisance/potential cause of harm
Environmental issues
Awareness
Impact assessment
Not necessarily dangerous
Interrogations

Several themes emerge as key messages to communicate to stakeholders.

3.3.5 Summary Tables

This summary is divided into three tables that separate the three main groups of stakeholders: the GP, the Regulators, and the Professionals from Different Areas.

The tables summarise, by column, the different steps of the approach. The last column: Massages (What?), gives the names of the different themes identified for the key message elaboration (Table 2).

Table 3 - Summary Table for the General Public

Stakeholders (Who?)	Communication Mechanism (How?)	Key moments for communication (Where? When?)	Messages (What ?)
GP	Storytelling and Narratives Inverted Pyramid Visual tools	Traditional communication Channels Public conferences Social networks, website, and Blogs	Health Issues Nuisance/potential cause of harm Engaging story Not necessarily dangerous

	Nudge for behavioural issue Participatory events		Environmental issues Awareness

Table 4 - Summary Table for Regulators

Stakeholders (Who?)	**Communication Mechanism (How?)**	**Key moments for communication (Where? When?)**	**Messages (What ?)**
Regulators	Inverted Pyramid Cross impact analysis* and Participatory events Summary document Visual tools	Workshop/Participatory event for concerned communities Meetings Writing communication	Health Issues Awareness Impact assessment Cost Benefit Environmental issues

Table 5 - Summary Table for the Professionals

Stakeholders (Who?)	**Communication Mechanism (How?)**	**Key moments for communication (Where? When?)**	**Messages (What ?)**
HCP	Cross impact analysis* and participatory events Open science Summary document	Traditional Scientific publication Workshop Specialised Meetings Writing communication	Health Issues Awareness Not necessarily dangerous Nuisance/potential cause of harm

			Interrogations
Academics	Open science Cross impact analysis* and participatory events Scientific Publication	Writing communication Workshop	Awareness Interrogations Environmental issues
Media	Summary document Storytelling and narratives Inverted Pyramid Visual reports and tools	Writing communication Workshop Press conferences and press releases Social network, blogs, and website	Health issues Engaging story Awareness Nuisance/potential cause of harm Environmental issues
Architects and PM	Cross impact analysis* Participatory events Storytelling and Narratives Inverted pyramid Summary documents Open science	Writing communication Workshop Specialised meetings	Health issues Cost Benefit Impact assessment Awareness Interrogations

3.4 Discussion

The initial objective of this thesis was to develop a framework for stakeholder communication. This was done in several steps, and summary tables (Table 3, Table 4 and Table 5) compiles and shows the different results.

The approach developed follows the important point observed in the literature (Brownell, Price and Steinman, 2013; Besley and Nisbet, 2011; Burns, O'Connor and Stocklmayer, 2003; Carr, 2008).

The results of the research show that communicating science to different audiences is important. These also show the necessity to adapt the message and the communication process (IAEA, 2017a; NASEM, 2017a, b and c; Petrovski and Pestana Neto, 2017). Indeed, as demonstrated by outcomes of the data analysis, the stakeholders' concerns are different, and the impact reached by the fact that the communication with them is done by the same process is less important (Pestana Neto, 2017).

The study also demonstrates the range of mechanisms that can be used for science communication. This supports that it is possible and crucial to communicate and engage with the professionals and not limited the communication to the GP (IAEA, 2017a).

The data gathered, at different steps, for this work justify and reinforce the choice of the mechanisms identified and constructed. Indeed, they can answer the different communication objectives: raise awareness, involvement of the stakeholders in research and the network for collaboration and knowledge exchange.

Finally, the study led to the construction of a framework, which will be useful for BioAirNet, and theme 4, for the SE. The framework constitutes an instrument and an asset for science communication.

The framework thus developed is an instrument for people who want to communicate their bioaerosols' scientific findings. The framework helps to select the right mechanisms, contexts, and key messages to communicate and engage

stakeholders. This will allow the construction of a communication process adapted to the target audience and the communication objectives.

This study also looked at scientific communication to different professionals, which is a less studied audience than the public and regulators. Indeed, the lack of documentation and literature for the engagement and communication of scientific results to professionals but also to researchers from other fields of expertise, as scientific collaboration is important and necessary (Claudel et al., 2017).

During this study, this observation was made several times and one of the important results is the need, in the field of bioaerosol and the indoor/outdoor continuum, to work with building professionals, especially architects.

This study can have a positive impact on SE and therefore an impact on the BioAirNet network. This study provides a useful tool in BioAirNet's objective to communicate in the best possible way and thus engage different audiences.

3.4.1.1 Sense Checking

SC has enabled us to verify and obtain criticism of the work carried out. As the interviews were conducted after the end of the data analysis and the bulk of the desk study, the results were almost definitive. The SC allowed to justify the work as useful but also the approach used to arrive at the Framework.

On the other hand, some missing or weak points were raised. Indeed, when identifying stakeholders, some interviewees pointed out that the GP is difficult to qualify as stakeholders, in the true sense of the definition. Indeed, many people in the GP are not directly affected by bioaerosols. But the scientific literature around scientific communication always talks and documents around communication to the GP. Experts have also suggested splitting the GP into two parts: one part impacted by BioPM, such as allergy sufferers or people who live near composting areas or agricultural fields, and the other part to seeing the public as a large audience to be sought out by those who are not necessarily interested in BioPM because they have little or no impact. The choice was made to keep the GP as a stakeholder and to develop the framework with a "validated"

approach by the interviewees. This may bias the use and impact of the Framework by making it less effective for communication with the GP.

In terms of stakeholder identification, other points were raised by the SC. Firstly, the lack of precision concerning architects and PM, as the two do not, for the interviewees, have quite the same concerns. Some see architects as more credible stakeholders, as they are at the base of the construction process and are therefore the ones to be engaged in priority. Furthermore, for another interviewee, ventilation design engineers are a stakeholder to be integrated into the communication process. Indeed, for this person, these professionals are important to understand the indoor/outdoor interface and the associated air exchanges. Thus, further information for this stakeholder and an investigation of other potential communication mechanisms is needed, as this is a gap not necessarily for the developed framework but for the BioAirNet network.

An important point raised by experts that supports the findings of the literature review is the difficulty of engaging the media (NASEM, 2017b; Besley and Nisbet, 2011; Burns, O'Connor and Stocklmayer, 2003). As the media have both commercial and informational interests, engaging them is more complicated. The health problems posed by certain BioPMs are a solution to interest the media and through them increase people's awareness and understanding.

An outcome of the SC is the existence of other communication mechanisms. Indeed, some others communication mechanisms were mentioned. Addressing these other mechanisms would complete the framework, especially since some methods have already been proven, such as Video Abstract (Ferreira et al., 2021).

3.4.1.2 Limitations of the findings

Time was a limiting factor for this study. Indeed, to launch the interview process, which included a test of the results: SC, it was necessary to complete the research and obtain almost all the results. Thus, the interviews started in the middle of July and continued in August. Thus, many of the experts requested did not respond or were not available, given the time frame.

Moreover, some results of the systematic analysis of qualitative data were contradictory. Indeed, the ideas and patterns developed by some of the experts contradicted each other, especially on the choice of stakeholders. Thus, each finding has been interpreted as best as possible in its context and shows different points of view (May, 2010). However, this meant that a choice had to be made to allow for the identification of stakeholders that confirmed the other data and the results of the literature review. Furthermore, participants have different reasons for being interested in bioaerosols and different results this led to different exploitation of certain scientific results concerning bioaerosols by the participants.

All the stakeholders identified was not represented during the interviews and the initial QDA. So, the outcomes for the SA and the related key concerns are potentially incomplete. The time constraints complicated the task of gathering interviewees for each category of stakeholder. To complete the SA and the rest of the study, which results of the SA, interviewing each stakeholder could be a milestone.

The first data analysis, the one based on the workshop, is made from recordings of the workshop. This workshop consisted of presentations by the speakers and brainstorming on certain questions posed by the chairperson.
But these recordings do not include the discussions around the questions on the commitment of different audiences, for reasons of data protection. But these discussions (which I was not able to attend) would have been of great help for the realization of this work. As mentioned earlier, discussions and collaboration are important and effective elements (Claudel et al., 2017; OECD, 2020). Thus, many of the results, especially for the identification of stakeholders and key messages, are derived from this analysis, which therefore contains gaps that could have had an impact on the rest of the study.

Research that involves qualitative analysis, and even more so with interviews, is subject to bias. The main advantage here is that the interviews were conducted in the form of SC and not question-based interviews, which avoided biases related to leading questions, which lead the interviewee into a certain type of response (Shah, 2019). On the other hand, quantitative data analysis can lead to

confirmation bias, which is one of the most common (Shah, 2019). Indeed, these interviews were conducted after the completion of a first framework and therefore after the research was well advanced, and the temptation to use data to confirm what was done is great. The data were therefore analysed as neutrally as possible, but the confirmation bias cannot be neglected.

The use of such mechanism leads to some ethical questions, and Dahlstrom (2014) presents them with some explanations:

- Should scientific communication favour one outcome or promote autonomy to make choices?

The autonomy of the individual seems to be more ethical, but the use of some form of persuasion can be useful when the benefits (environment, health, etc) are important enough.

- What level of accuracy should be used?

This depends on the purpose of the communication; indeed, some communications contain a level of accuracy that is not relevant to maintain. Indeed, some facts should be accurate, to represent science in the real world, but for others it may be appropriate to be less accurate in some elements, as a greater purpose is required. For example, the presentation of a process, which may not be relevant to the GP.

3.4.1.3 The future

This study and the resulting framework are a first step in the research on bioaerosol science communication and may need to be taken further. Initially a choice of audiences and stakeholders was made but other stakeholders need to be integrated. Furthermore, the results, to complete the research as much as possible, need to be fully tested.

Indeed, the framework makes it possible to build a complete communication process and to test it fully, it would be necessary to carry out a communication process using these results, for each stakeholder. Then carry out an impact assessment of these communication processes. This impact assessment will

demonstrate the value and impact and potential influence of the communication undertaken (Franklin, 2021). This can be done by collecting feedback after events, media coverage, questionnaires with different audiences to assess their understanding of the topic and feedback on the method used. This study will allow us to confirm or correct certain results, and obtain better results, tested directly on the stakeholders (Franklin, 2021).

4 CONCLUSION

This research aims to develop a framework for bioaerosol science communication, to answer the question: How to best communicate bioaerosol science to different audiences? Desk-based research through a literature review and QDA allowed the creation of an instrument for the stakeholder's communication.

This research confirms and uses the fact that when the objective is to communicate to a certain audience or stakeholders identified, understanding the audiences and their concerns is crucial for the achievement.

The construction of a communication process for bioaerosol science involves the choice of mechanisms adapted to the stakeholders and the communication objectives. This study provides these mechanisms through the choice of well-adapted methods and tools for science communication.

The framework developed allows reducing as much as possible the uncertainties and the technical/scientific issues inherent to science communication.

The construction of a message, based on the QDA permits to find a message that fit the stakeholders but also to launch the communication process, from these messages intended for them.

The study constitutes the first step and the framework developed should be tested. By testing all the methods on the stakeholders, and by adding some of new of them to reach the maximum impact of the bioaerosol science communication.

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APPENDICES

List of Figure

Appendix A – Informed Consent Form for the interviews

Informed Consent Form

Title of the project:	How does the science respond to the public?
Name of the researcher:	Adrien Bailly
Participant number:	
Date:	23/07/2021

- I confirm that I have been informed about this research project and I agree to take part.
- I understand that all personal information I provide will be treated with confidence and my name will not be used in any report, publication or presentation.
- I have been provided with a participant number as shown above. The researcher(s) will record data against my participant number instead of recording my name. The file linking my name to my participant number will be accessible only to the main researchers, and will be securely destroyed after
- I understand that the data I provide will be used by Cranfield University for the purpose of research. The data will be stored on the University's network that can only be accessed by authorised users, in line with UK Data Protection Act 2018.
- Interviews will be recorded and securely stored on the Cranfield University network as recording files. These recording files will be securely deleted as soon as they are no longer required.
- The recordings will be transcribed and saved as text files. These files (and any backups) will also be securely deleted as soon as they are no longer required.

I confirm that I have read and understand the information provided on this form and give my consent to taking part in this research.

Participant's signature:		**Date:**	
Participant's name:			
Researcher's signature:		**Date:**	15/07/2021

Appendix B – QDA outcomes

This annex gives the results of the QDA, in the form of screenshots made from the excel file of the analysis.

Figure B-1 Coding for Stakeholders Analysis

CODE	Meanning
1	Not suffisant knowledge, Lack of Knowledge of the stakholders
2	BioPM never included
3	Indoor/outdoor air could be publicised more
4	Health cause and consequnces
5	Prevent rather than treat it
6	No listenning from the industrial part
7	Commercial and policy are more important
8	Public opinion can drive this
9	BioPM should be included in the PM curriculum
10	GP knowledges
11	Develop concept note
12	More impact to help change behaviour
13	Reserchers need to get those involved to share data and knowledge
14	Give cost benefit analysis to stakeholders
15	Nuissance and pertrurbations
16	Explain the risk, and the also the normality of being exposed
	These codes are derived from the processing of transcripts made for the QDA.

Figure B-2 Themes for Stakeholders Analysis

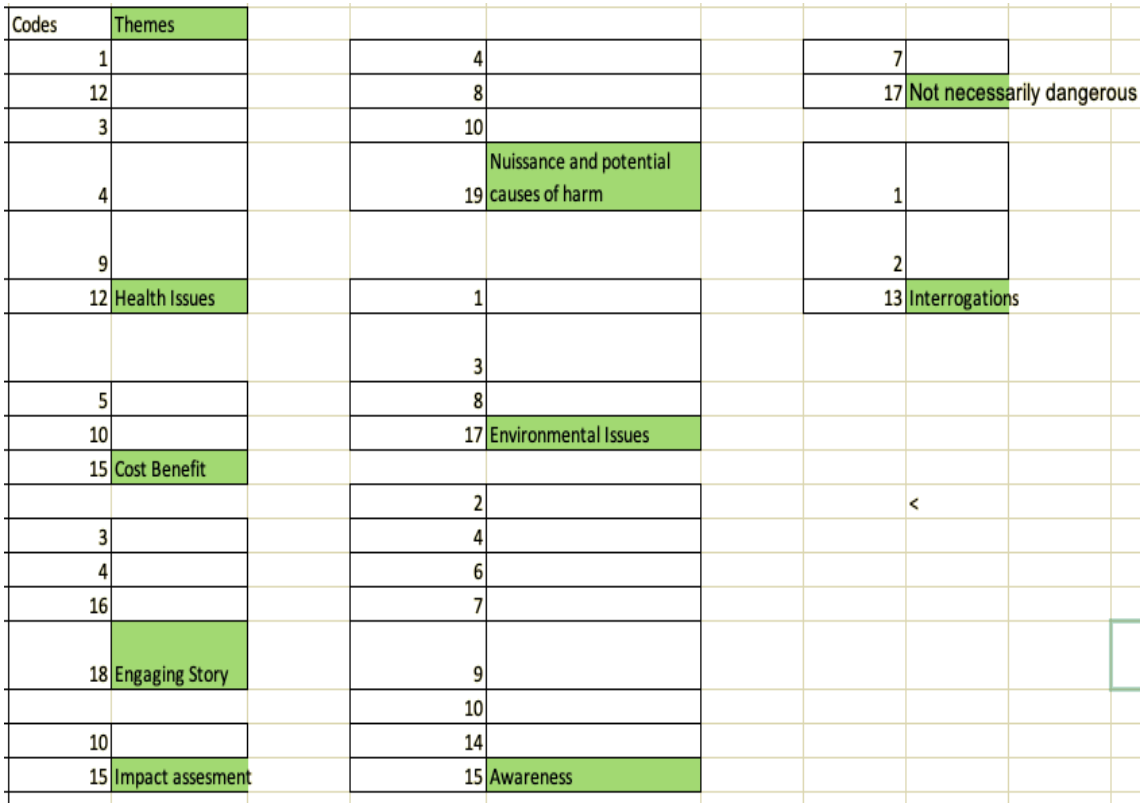
Codes	Themes
1	
2	
3	
4	
5	
9	
10	
11	
12	
15	
16	Raise awareness
4	
5	
6	
11	
14	
15	
16	Health issues
1	
3	
5	
9	Indoor/outdoor air polution
1	
3	
5	
10	Knowledge exchanges

2	
3	
7	
8	
9	
10	
12	Researchers engagment concens
4	
5	
12	Heatlth causes
2	
3	
6	
7	
9	
13	Impact of BioPM Research
1	
5	
6	
14	
16	Risk prevention and governance
3	
4	
6	
8	
15	
16	Nuisances causes and consequences

Figure B-3 Coding for Key messages

CODES ID	CODES
1	Cause and consequences of Pollen allergies and other allergies.
2	Communicate on research challenges.
3	Viruses and pandemic risk.
4	Explain the potential cause of damage/harm.
5	Showing the risk cost, why should they spend money on a system and what are the benefits to manage BioPM?
6	Communicate Scientific findings.
7	Challenges for communication: bioaerosol are necessarily harmful and be exposed to them it's fine.
8	Agricultural waste.
9	Raise awareness of the GP and some professionals (HCP, architects).
10	Convince public or policy makers. Make links between the science and the benefits.
11	General lack of knowledges.
12	Engage Public and Policy makers with health issues is the most efficient.
13	To give potential leads for advancing the knowledge of bioaerosols.
14	Redaction of a booklet for good mitigation methods to reduce risk of allergies.
15	Make know the existing solutions to counter the risks. Make informed decisions for policy makers.
16	Tell a personal story.
17	Bioaerosol should be communicated as something we live with.
18	Use the affect.
19	Olfactory nuisance near composting area and agricultural field.

Figure B-4 Themes for Key messages



Codes	Themes
1	
12	
3	
4	
9	
12	Health Issues
5	
10	
15	Cost Benefit
3	
4	
16	
18	Engaging Story
10	
15	Impact assesment

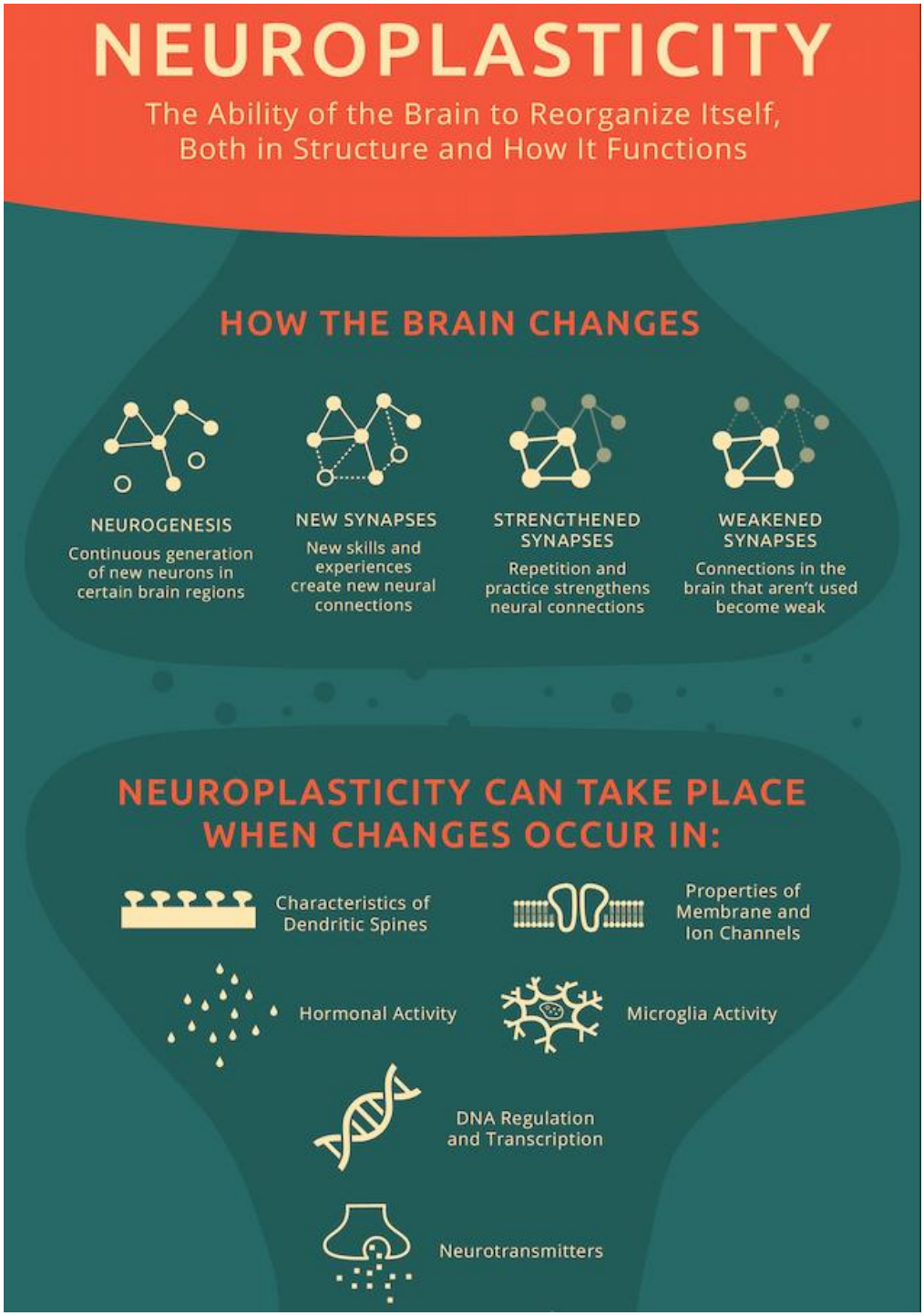
4	
8	
10	
19	Nuissance and potential causes of harm
1	
3	
8	
17	Environmental Issues
2	
4	
6	
7	
9	
10	
14	
15	Awareness

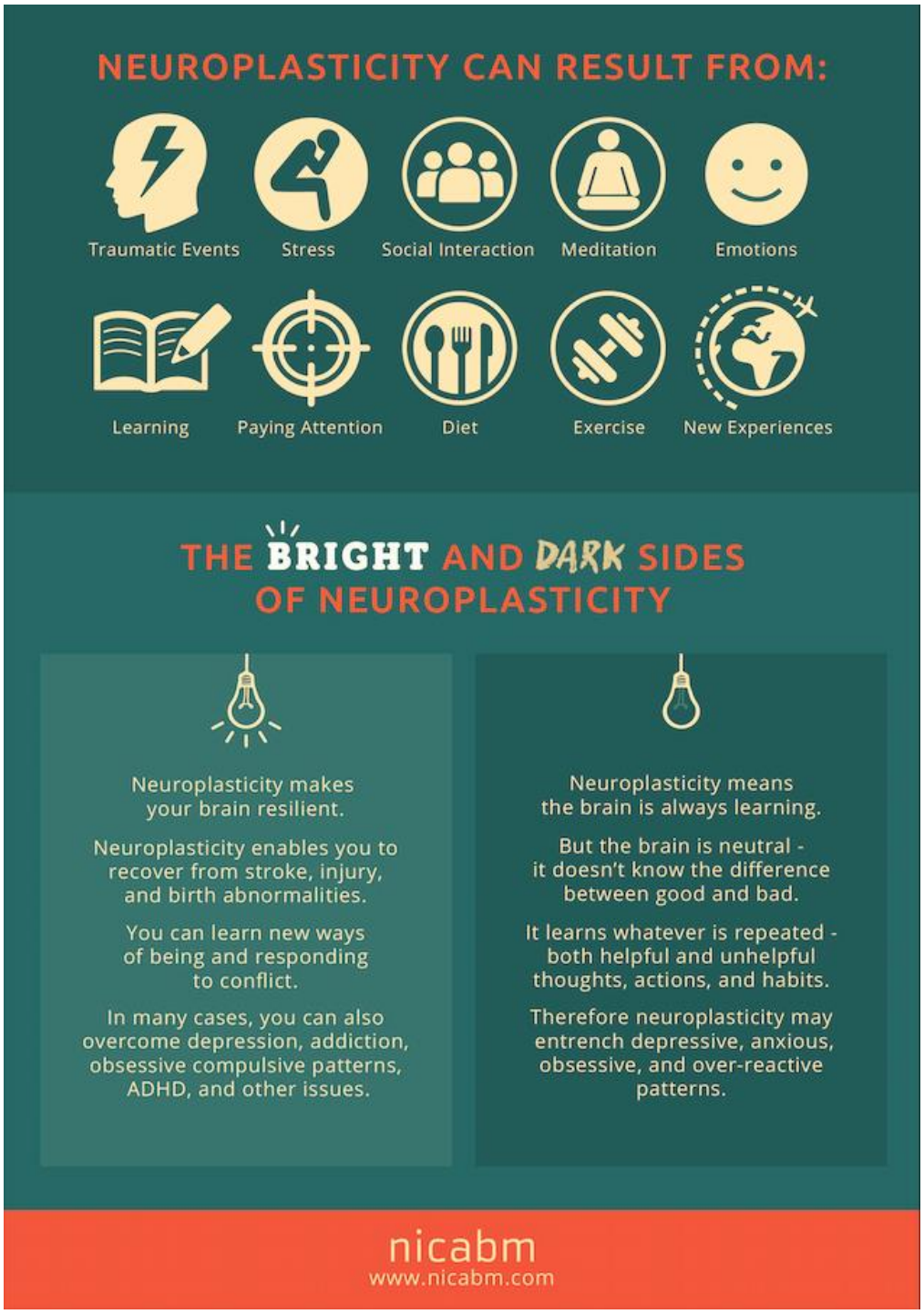
7	
17	Not necessarily dangerous
1	
2	
13	Interrogations
	<

Appendix C – Example of Infographics

This appendix gives an example of infographics used in scientific communication.

Figure C-1- Neuroplasticity infographics (NICAM, 2020)




NEUROPLASTICITY CAN RESULT FROM:
Traumatic Events
Stress
Social Interaction
Meditation
Emotions
Learning
Paying Attention
Diet
Exercise
New Experiences
THE BRIGHT AND DARK SIDES OF NEUROPLASTICITY
Neuroplasticity makes your brain resilient.
Neuroplasticity enables you to recover from stroke, injury, and birth abnormalities.
You can learn new ways of being and responding to conflict.
In many cases, you can also overcome depression, addiction, obsessive compulsive patterns, ADHD, and other issues.
Neuroplasticity means the brain is always learning.
But the brain is neutral - it doesn't know the difference between good and bad.
It learns whatever is repeated - both helpful and unhelpful thoughts, actions, and habits.
Therefore neuroplasticity may entrench depressive, anxious, obsessive, and over-reactive patterns.
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Appendix D – Example of Nudge, the Exemption Certificate used in France During the lockdown (French Government, March 2020)

EXEMPTION CERTIFICATE DURING LOCKDOWN

Pursuant to the decree n°2020-1310 of October 29th, 2020 prescribing rues necessary in the fight against the spread of the Covid-19 virus

I, the undersigned,

Ms/Mr:

Born on:

In:

Address:

certify that my reasons to be outdoors match one of the following situations (check the box) authorised by the decree n°2020-1310 of October 29th 2020 to tackle the spread of Covid-19 as part of the state of health emergency[1]:

☐ Commuting to and from work or university and training places; business trips that cannot be delayed[2].

☐ Running necessary errands to purchase items for professional activity, or basic commodities[3] available in the businesses allowed to provide service, order withdrawal or home deliveries

☐ Consults and provision of care that cannot be done remotely; medication purchase

☐ Imperative family reasons, assisting vulnerable persons, persons in a precarious situation or taking care of children.

☐ Persons with a disability and their accompanying person

☐ Individual outdoor exercise (collective physical activity is not allowed), walking out with only the people living in the same household or walking out a pet, within 1km of one's place of residence and for one hour

☐ Judicial or administrative summons; appointment to public service offices

☐ Participating in a mission of general interest upon request from an administrative authority

☐ Taking children to and picking them up from school or after-school activity

Signed in

On: at

(Date and time are mandatory)

Signature:

---

[1] People whose situation matches one of the aforementioned and can therefore be exempt must carry, when outdoors, written proof to justify that exemption.
[2] To be used by self-employed workers, when they cannot get a travel document from their employer.
[3] Including the acquisition of free commodities (food distribution, etc.) and trips related to the receipt of social benefits and cash withdrawals