Mitigation Strategies for Airborne Infection Control (MIST) Public-Private cooperation

SUMMARY

In the context of the current pandemic due to the SARS-CoV-2 virus, more and more evidence suggests that airborne droplets and aerosols play a key role in the transmission. Rather surprisingly, very little is known about the fate of the smaller droplets within these aerosols. As a consequence, their role is not well-represented in the current safety standards that are used in both businesses and society. In order to close the gap in our knowledge of aerosols and towards the development of up-to-date standards which take aerosols into account, we have initiated the program: **Mitigation Strategies for Airborne Infection Control (MIST)**. Ultimately, this program will deliver recommendations for the draw-up of new standards dedicated to mitigation strategies of the airborne infection route. These standards can then be widely adopted by businesses and society throughout and will thus enhance the safety guidelines that are currently implemented by governments. Not only will these standards help in reducing the social, health and economic impact of the current pandemic, but will also be applicable to other viruses like the common cold, influenza, and even future pandemics.

THE PROBLEM AT HAND

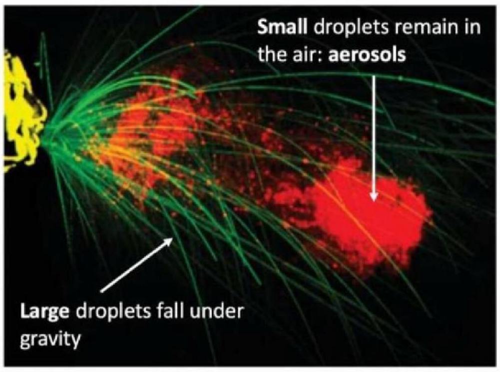

Figure 1: High-speed imaging of a sneeze. Taken from Bourouiba et. al, 2019, Phys. Today.

The spreading of the SARS-CoV-2 virus occurs through virus-laden droplets which are expelled while a person is sneezing, coughing, singing, shouting, screaming, speaking or even breathing. Within these respiratory events, one may find **droplets of various sizes**. While the *large* droplets fall quickly under the influence of gravity, the *small* droplets can potentially stay airborne for a longer time in the form of aerosols (see Figure 1). In an attempt to reduce the risk of infections, governments have introduced safety guidelines– like the 1.5 meter rule in the Netherlands– so as to reduce the risk due to the large droplets which are associated with the first recognized transmission route, the so-called "direct" route. As soon as these droplets are deposited onto a surface, they can potentially lead to the second recognized transmission route via contaminated surfaces. But what happens with the **smaller droplets**? These smaller droplets–which are typically of the order of 1 - 50 microns – **form aerosols** and can remain airborne longer and travel further than the larger droplets. Within a closed environment this is particularly worrisome, since the probability of these virus-laden droplets to infect another individual depends on multiple factors like the amount of viruses carried by these droplets, humidity, the quality of the ventilation and the geometry of the environment, the presence and efficiency of air filters, among many others.

Therefore, in order to close the gap In the knowledge of aerosols and towards the development of up-to-date scientific based standards which take aerosols into account, we have initiated the program: **Mitigation Strategies for Airborne Infection Control (MIST)**

THE CORE OF MIST

At the core of **MIST** lies **up-to-date scientific knowledge** generated by a renowned group of experts in the fields of **epidemiology, virology, fluid mechanics, ventilation, engineering**; thus covering various disciplines and length scales (microns to meters). The focus of the research is on the infectivity and dynamics of virus-laden expelled droplets (of all sizes: large and small) and the design of mitigations strategies (organizational and technological) that minimize their threat while they remain airborne. In addition, we will define–together with businesses–**representative use cases** across different sectors of society (**retail, transport, leisure, labor, home, health-care and education**), where we will develop and test assessment methodologies to evaluate the effectiveness of the different mitigation strategies developed in the programme. These strategies include **local/global ventilation concepts, sanitization methods (UV-C, air-purification) and mechanical filters (face-masks, HEPA filters).**

THE RESEARCH TEAM

[redacted] 5.1.2e

[redacted] 5.1.2e **– University of Twente (UT)**
- University Medical Center Groningen (UMCG)

[redacted] 5.1.2e **– Radboud University (RUMC)**

[redacted] 5.1.2e **University of Amsterdam (UvA)**

[redacted] 5.1.2e **- Technical University Eindhoven (TUe)**

[redacted] 5.1.2e **- Technical University Delft (TUD)**

[redacted] 5.1.2e **- MARIN**

[redacted] 5.1.2e **– TNO**

[redacted] 5.1.2e **- NLR**

SCOPE OF WORK

Within the programme, we have envisioned five different projects, all aiming at better mitigation strategies:

Project 1 – Infectivity of viruses in airborne droplets (UMCG, RIVM, RUMC, UvA, TNO)

The medical basis of the project, where a multidisciplinary group of experts in **epidemiology, virology and physics** will investigate key topics such as

- Distribution of expelled droplets for different activities: sneezing, coughing, singing, shouting, screaming, speaking or even breathing, etc.
- Required virus concentrations within droplets required to infect an individual

Project 2 – Spreading of airborne droplets (UT, UvA, TNO, MARIN)

A more fundamental project which is led by **fluid mechanics** experts which will investigate key physical aspects such as

- Influence of environmental parameters such as temperature, humidity and an external flow on the lifetime of droplets
- The effect of turbulence and multiphase phenomena on droplet spreading

Project 3 – Ventilation Concepts for the Removal of Airborne Droplets? (TUe)

This part of the programme is led by experts in **ventilation** and focuses on the development of ventilation concepts that are applicable to both the short and long range aerosols by investigating the effect of

- Mixing and displacement ventilation
- Global vs local ventilation concepts
- Air treatment (UV-C, filters) face masks
- A crime-scene-like investigation unit who focuses on the so-called "super-spreader" events.

Project 4 – Real World Use Cases (TNO, TUD, UvA, TUe, MARIN, NLR)

In this project, we make a step into the **engineering** and together with businesses we investigate how to mitigate the effect of the virus across different sectors of society (**retail, transport, leisure, labor, home, health-care and education**) in the real world. Specifically

- For a certain sector of society, what combination of technological (ventilation (local/global), air treatment (UV-C, filters, etc.), face masks help) and organizational measures are the most efficient, cost-effective and sustainable in order to mitigate the effect of the virus?

Project 5 – Strategies for Infection Control (TUD)

The ultimate output of the programme. Here, we use the output of the research generated by the first four projects to

- Draw-up mitigation strategies for infection control
- Communication and outreach of the established strategies

APPROACH

The current economic impact to business along with the societal needs calls for a swift and prompt response from the research team. In order to honor that call, we have structured the program in two phases: Firstly, a **fast-track phase (1.5 years)** followed by a **long-term phase (5 years)**. While the fast-track phase addresses the needs of businesses and society by issuing recommendations based on the most influencing parameters in an accelerated manner, the long-term phase (5 years) expands the knowledge generated thus far and continues the research albeit with a high-level of detail.

COSTS AND FINANCING

The cost of the **fast-track** is estimated to be about 8.5 million Euro, which includes 0.7 million Euro in-kind contribution from businesses involved in the program. The **long-term** phase is estimated to be about 11 million Euro, which includes 0.8 million Euro in-kind contribution from businesses. Therefore the **total program** cost is estimated to be about 19.5 million Euro. A cash contribution of business is expected for the program. A caveat is however that those businesses which need the results of the program most urgently, are for the very same reason presently under financial pressure.

MIST IS OPEN TO BUSINESSES

MIST is open to all businesses **(end-users, technology providers)** who wish to support the programme and in addition, to actively participate in a use case.

When only supporting the program, **end-users** will have access to the development and the limitations of the latest mitigation strategies for their own sector, while **technology providers** learn about the requirements needed to provide mitigation strategies for various businesses and learn about the standards required to provide solutions for a specific use case.

In addition, when actively participating in a use case, **end-users** also obtain a complete overview of the possibilities and needs for their own business in terms of mitigation strategies while these are developed in-house. On the other hand, **technology providers** that participate in a use case also obtain the means to evaluate and improve their solutions in direct cooperation with the research team and the end-users that participate in the programme.

CONTACT: For more information please contact [redacted] ([redacted]@utwente.nl)