Evaluation of Denmark's handling of the COVID-19 pandemic – Subreport 1:

Effects of non-pharmacological interventions on the spread of infection. A literature review

Summary

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Summary

The purpose of this subreport is to shed light on the effect of non-pharmacological interventions on the spread of COVID-19, as part of the overall evaluation of the authorities' handling of the pandemic in Denmark. The subreport builds upon both Danish and international research-based knowledge, and the focus is on non-pharmacological interventions aimed at limiting spread of infection in society, including test strategies, lockdowns and other interventions targeting the general population outside the health and care sector. The evaluation was initiated by The Epidemics Committee of The Danish Parliament and it is to contribute knowledge about and provide an overview of the handling of COVID-19 in Denmark.

In this subreport, non-pharmacological interventions are defined as the interventions that were applied during the COVID-19 pandemic to limit spread of infection in the population without use of medical treatment or vaccines. The review is restricted to legislative interventions, such as bans on meeting, travel restrictions, testing strategies, infection detection, quarantine and use of face masks, as well as the health authorities' recommendations, such as hand hygiene and ventilation and airing out. Spread of infection is defined as transmission of disease from one person to another and is typically measured by reproduction numbers, which indicate how many other persons an infected person infects on average, or by the total number of infected persons at a given time. Other ways of measuring spread of infection are also used, such as COVID-19-related hospital admissions and deaths.

The literature search was based on a systematic search in scientific databases and on the websites of relevant authorities and organisations. The purpose was to identify the best available knowledge on the effect of non-pharmacological interventions on the spread of COVID-19 infection.

The search strategy was developed in collaboration with an information specialist working at VIVE and was adapted to the project's focus on interventions targeting the general population and activities outside the health service and the care sector. The method combines a wide range of searches in international databases, with a special focus on Nordic and Western countries. Nordic and Western countries were chosen as the geographic delimitation to ensure as far as possible that the results are relevant and transferrable to a Danish context.

In the international databases, searches were carried out for systematic reviews and meta-analyses, while the searches in the Nordic databases and authorities´ websites also included primary efficacy studies. This combination both provides an overview of the total body of evidence and enables an uncovering of the Danish and Nordic experiences.

The literature review includes both published scientific literature and grey literature, meaning material such as reports and papers that are not published in scientific journals but are often written by authorities, research institutions or organisations. To ensure the quality of the references included, clearly defined criteria of inclusion and exclusion were used. In the results section, only

empirical studies that investigate how the interventions have worked in practice are included. Modelling studies are treated separately, as they are mainly based on assumptions rather than observed data and often do not take implementation and contextual factors circumstances into account.

The literature review includes a total of 75 references and reports published in the period 2020-2024. The references cover a broad range of Western countries and contexts, and data from Denmark are included in 18 of the references. The material mainly consists of empirical efficacy studies and systematic reviews that analyse the effects of non-pharmacological interventions on the spread of COVID-19 infection and COVID-19-related hospitalisations and mortality.

The majority of the available references in the literature review are based on observational studies – i.e. studies of how infection, hospitalisations or mortality developed before and after the application of certain interventions. In observational studies, there is a risk that groups being compared differ in other ways than in terms of the non-pharmacological interventions. However, the randomised design can be imitated in the observational studies by having a strong focus on finding comparable groups or by having detailed before-and-after measurements, which some studies have included.

In the selection of references, only references from particular geographic areas were accepted. This was due to a wish to include references from areas with demographic and social conditions similar to those in Denmark. It is still important to note, however, that differences may exist that make it difficult to transfer the results from a well-designed international investigation to Danish conditions.

Overall, the literature review shows that the combined implementation of multiple non-pharmacological interventions reduced COVID-19 infection, including hospitalisations and mortality. Moreover, the combined evidence indicates that the efficacy increases when interventions are introduced early on and there is a high level of compliance in the population.

In the following, the main results are presented for each of the non-pharmacological interventions.

Face masks, especially medical and N95 face masks, can, according to the evidence, reduce transmission of and mortality due to COVID-19 to a moderate to considerable degree, especially as part of an overall strategy for preventing spread of infection. The efficacy depends on the type of face mask, correct use and compliance, highly filtering face masks providing better protection than simple face covers, and mandatory use being more effective than voluntary use, especially in the case of early and consistent implementation. For visors, plexiglass and other physical shielding interventions, evidence is limited. It is difficult methodically to isolate the effect of facemasks alone as most references evaluate the effect of several simultaneous interventions.

School lockdown during the COVID-19 pandemic contributed to reducing spread of infection and hospitalisations, while the effect on mortality is less clear. The effect seems to be greatest when school lockdown was implemented as part of a broader intervention, and some references show that the effect is greatest when school lockdown occurs early on in the pandemic. However, the

efficacy varies from reference to reference, and there is no clear documentation that school lockdown in itself has reduced mortality substantially, as school lockdown is usually combined with other interventions. A Swedish study indicates that teachers and their households had increased risks of infection, while infection among parents of school children was relatively limited.

Lockdown of workplaces can reduce spread of infection, especially when the interventions are introduced early on and are combined with other preventive measures, such as physical distancing and use of face masks. It is difficult, however, to assess the individual effect of workplace lockdown, as the intervention was often introduced as part of a whole package of interventions.

Lockdown of liberal professions, cultural institutions, sports activities and events have contributed to reducing spread of infection, especially when the interventions were introduced early on and were targeted. Eating out at restaurants is particularly associated with increased spread of infection, while there is greater uncertainty regarding risk of infection in the case of indoor music events and access to gyms with physical distancing. As lockdown of the public space was often combined with other interventions, it is difficult to assess the individual effect.

Tests and test strategies have been central tools to identify infected persons and limit spread of infection, especially when they were introduced early on, used on a large scale and combined with isolation and infection detection. A high testing activity may have contributed to lower spread of infection and fewer hospitalisations, but the effect depends on the timing, the quality of tests and behaviour of the population. Tests alone have rarely been sufficient but have had the greatest effect when used as part of a combined strategy.

Infection detection combined with quarantine of close contacts can reduce transmission, hospitalisations and mortality, especially when the intervention is introduced early on, is carried out systematically and is part of a broad strategy. A limited effect is seen in cases of late implementation, a high prevalence of infection, low compliance or lack of supplementary interventions.

International travel restrictions can reduce the number of imported cases of infection and delay the introduction of new virus variants, especially when they are introduced early on and combined with testing and quarantine. Testing before departure has a limited effect, symptom-based screening is assessed as being ineffective, while diagnostic testing can identify more infected travellers. The effect is greatest in countries that have already eliminated the infection, or where the borders have been almost completely closed. The documentation for the effect on hospitalisations and mortality is limited.

Local travel restrictions and lockdowns can reduce spread of infection, but a study has found a connection with increased mortality. The effect varies depending on local conditions, such as population density, level of infection and faith in the authorities, and it is difficult to separate the direct effect from changes in behaviour, which often occur prior to implementation.

Ban on meetings can reduce spread of infection, especially when it is introduced early on and has a low limit on maximum number of people. The effect is difficult to isolate, and there may be a risk

of unintended consequences if the bans lead to more indoor socialising. The effect depends on context, form, compliance and combination with other interventions.

Physical distancing can be an important tool for limiting the spread of infection, especially when combined with other interventions, such as testing and face masks. The effect is influenced by timing, context, settings and compliance, and in some cases voluntary changes in behaviour have had a greater effect than formal orders. In some studies, voluntary changes in behaviour are assessed as having been more important than orders coming from the authorities.

General lockdowns can reduce spread of infection, reduce mortality and reduce hospitalisations, especially in the case of early implementation, sufficient duration and high compliance. The intervention includes several of the isolated interventions described above, and the effect is increased when lockdowns are combined with other interventions.

Hand hygiene can reduce spread of infection, but the effect is assessed as being modest to moderate and depends on compliance and context. The effect is increased when hand hygiene is combined with other interventions, but the evidence base is limited as hand hygiene is rarely assessed in isolation.

Ventilation and airing out can most likely reduce spread of infection, while the documentation for effects on mortality and hospitalisations is limited.

In the literature review, we have identified several areas where the evidence base is limited, or where we found no references that met our search criteria. This applies to, for instance, the effect of covid passports, lockdown of day-care centres and lockdown of places of higher education. It is important to stress that the lack of findings in our review does not necessarily mean that no relevant research exists, but merely that we have not identified such research within the framework of our search strategy and inclusion criteria.

As a whole, the literature review thus shows that a combined implementation of several non-pharmacological interventions reduced COVID-19 transmission, including COVID-19-related hospitalisations and mortality. Moreover, the literature review shows that several non-pharmacological interventions have contributed to limiting the spread of COVID-19 infection. However, it is difficult to isolate the effect of each individual intervention. Most interventions were introduced early on and often simultaneously, which makes an assessment of which interventions had the greatest effect difficult.

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