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Stakeholder perceptions of the COVID-19 modelling

Report on the results of the stakeholder survey conducted by RIVM's Centre for Infectious Disease Control as part of its audit of COVID-19 modelling and data analytics

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The perceptions of stakeholders with regard to COVID-19 modelling by RIVM

Major societal relevance, limited capacity

Virtually all stakeholders indicated that RIVM has performed remarkably well. The societal relevance of the models was high. And according to stakeholders, predictions based on the models were usually accurate. The results of the models were leading in the crisis meetings where decision-making regarding measures took place. Some stakeholders indicated that the predictive value of the models decreased as the crisis went on, due to declining oversight of the virus' spread. A number of stakeholders also mentioned that RIVM's capacity for modelling was limited. RIVM was not always able to fulfil requests for significant, supplemental models. It was also suggested that RIVM's modellers hardly ever cooperated with other modellers in the Netherlands.

Trust in the scientific quality, limited transparency

RIVM's modelling is considered to be state of the art, and nearly all stakeholders said it is among the very best in the world. As a result, stakeholders generally placed a great deal of trust in the COVID-19 modelling. According to the stakeholders who were present during crisis meetings (such as the Outbreak Management Team (OMT) and Catshuis deliberations), RIVM devoted a great deal of attention to communication regarding uncertainties in the modelling. Some stakeholders – media and scientists – noted that actually evaluating the scientific quality of the most important model (the transmission model) was possible to only a limited degree because the code for this model was not made public.

RIVM functioned as a trusted advisor and is widely considered to be independent

The majority of stakeholders felt that RIVM successfully functioned as a trusted

advisor during the pandemic. Factors that contributed to this included the authoritative explanation and clarification of the models, the opportunity for informal contact with key figures and the responsive attitude of RIVM. Above all, stakeholders perceived the modelling to be independent: they saw no indication whatsoever that RIVM had tweaked its models to make the results more desirable in the political or policy-making sense. That being said, some interviewees did note that RIVM's role as an independent modeller was insufficiently distinct from its role as 'hub' for the OMT. Some stakeholders felt that, as a result, criticism of the OMT (which was convened by RIVM) sometimes carried over to RIVM itself in its role as an independent modeller. Stakeholders also noted that RIVM could have done more to make the public aware of the internal checks and balances in place, as a means of strengthening the public's trust in RIVM's independence.

Suggestions for the future from stakeholders

Stakeholders put forth a variety of suggestions for reinforcing the independence, quality and impact of the modelling in the future. AEF has grouped these suggestions into five thematic clusters:

1. suggestions with regard to strengthening cooperation;
2. suggestions with regard to guarantee of quality and transparency;
3. suggestions with regard to scientific and other communication concerning the models;
4. suggestions with regard to further development of the models and the data quality and infrastructure;
5. suggestions with regard to the various roles of RIVM.

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RIVM asked AEF to compile an overview of stakeholder perceptions regarding the COVID-19 modelling

Scientific models provided the basis for measures to combat the spread of COVID-19

During the period of the COVID-19 pandemic, RIVM's Centre for Infectious Disease Control developed scientific models to visualise the spread of the coronavirus. These models were used to formulate policy recommendations on measures to combat the spread of COVID-19 in the Netherlands.

RIVM is undergoing an audit with regard to its COVID-19 modelling and data analytics

At the behest of the RIVM Scientific Advisory Board, RIVM is undergoing an audit concerning the Centre for Infectious Disease Control's work. The audit is being conducted by an international committee of independent experts, chaired by Prof. André Knottnerus.

RIVM asked Andersson Efficers Felix (AEF) to collect stakeholder perceptions by means of a stakeholder survey

AEF was tasked with collecting stakeholder perceptions regarding the COVID-19 modelling. This stakeholder survey was part of an audit of RIVM. In order to ensure the independence of this research, AEF was asked to interview the stakeholders and record the results in this report.

Stakeholder survey

AEF was asked to conduct a stakeholder survey among the 'top ten' most impactful stakeholders. Stakeholders were asked to reflect on **three components** of RIVM's COVID-19 modelling and data analytics:

- societal relevance, impact and influence;
- scientific quality;
- independence and reliability.

In this report, we will describe the perceptions of stakeholders

AEF was asked to deliver a report containing the results of the stakeholder survey. This report supplies the input for the final conclusion of the international audit committee.

When reading this report, it is important to note that the interviewed stakeholders hold varying opinions. They are familiar with different aspects of RIVM's data analytics and modelling work, and by virtue of their different positions, each stakeholder is considering RIVM's performance from their own perspective. In this report, we have attempted to distil from these varying perspectives a picture of the overall perceptions of stakeholders that is as clear and integrated as possible with regard to the three themes listed above.

The scope of the stakeholder survey encompasses COVID-19 modelling and data analytics by RIVM



✓ The audit addresses the COVID-19 modelling and data analytics, plus the data flows and open data from the Centre for Infectious Disease Control needed to facilitate policy recommendations to the Dutch Ministry of Health, Welfare and Sport in the period from 1 January 2020 to 1 June 2022, often submitted via the Dutch Outbreak Management Team (OMT) and the Health Council of the Netherlands.

✗ The audit does not address the Dutch government's COVID-19 management policies or the organisation of the scientific advice with regard to infectious disease control. Nor does it deal with research projects at the Centre for Infectious Disease Control that were not used to make policy recommendations. The audit also does not address research and advice from other actors in connection with the COVID-19 pandemic.

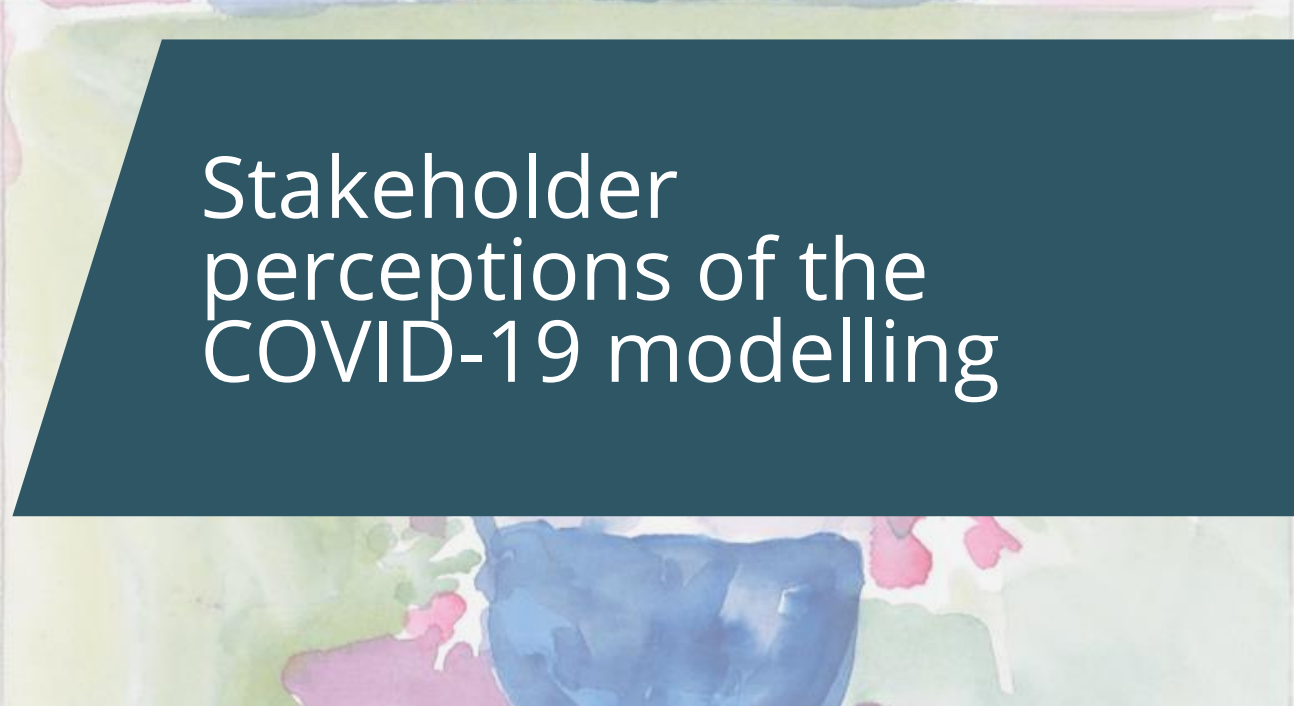
We applied an organised approach, with this report as the final result

We worked according to a six-step plan, some components of which were carried out by RIVM

1. RIVM identified, assigned priorities to and selected the stakeholders. [Appendix 1](#) describes how this process was conducted.
2. The stakeholders were approached by AEF, with a formal invitation from RIVM attached. The stakeholders who participated in the survey are listed in the box to the right. [Appendix 2](#) contains a complete list of the interview subjects.
3. A topic list was drawn up by RIVM. This topic list was then refined based on feedback from both the RIVM Scientific Advisory Board and AEF. In preparation for the interview, the participants were sent a copy of the topic list. The topic list is included in [Appendix 3](#).
4. AEF conducted a total of 19 semi-structured interviews of around 1 hour each.
5. AEF compiled an abridged report of each interview and submitted it to the subject for their approval and to check for any factual inaccuracies.
6. AEF analysed the results of the interviews. This report sets out the common threads from these interviews, grouped into three thematic clusters ([see green text box on slide 4](#)). We conclude this report with suggestions for the future offered by the stakeholders.

Stakeholders (no. of subjects interviewed)

- Ministry of Health, Welfare and Sport (VWS) (2)
- Outbreak Management Team (OMT) (2)
- Participants in Catshuis deliberation (4)
- Health Council of the Netherlands(1)
- National Coordination Center for Patient Distribution (LCPS) (2)
- National Intensive Care Evaluation (NICE) Foundation (1)
- International scientific partners (2)
- Dutch scientists (2)
- National media (3)



Stakeholder
perceptions of the
COVID-19 modelling

Stakeholders were unanimous in their appreciation for the effort and dedication shown by RIVM during the pandemic

Stakeholders expressed a positive opinion of RIVM's dedicated efforts during the pandemic

- In virtually all interviews, stakeholders indicated that RIVM performed remarkably well during the pandemic. Under immense social pressure, in the midst of great uncertainty and (in many cases) under considerable time pressure, RIVM was responsible for making estimates and predictions that had a major impact on the lives of millions of Dutch people.
- Another thing mentioned in virtually all interviews was that the RIVM modellers showed tremendous effort and dedication in addressing the major issues they faced during this unique period. They proved themselves capable of meeting the sometimes extremely tight deadlines while at the same time continuing to deliver high-quality work.
- Most stakeholders were pleased with how contact with RIVM was arranged: they described RIVM employees as engaged, knowledgeable, honest and helpful.
- Decision-makers noted that RIVM was always available to take part in relevant meetings in order to explain the results of its modelling and data analytics and, by doing so, to supply the crisis management with an ongoing factual basis for their actions.
- Media representatives indicated that RIVM was always willing to provide an explanation along with its models. They found RIVM to be approachable and open.

Reading guide

In the remainder of this section, you will read the perceptions of stakeholders with regard to three components of RIVM's COVID-19 modelling and data analytics:

- societal relevance, impact and influence;
- scientific quality;
- independence and reliability.

On the last slides of this section, you will find suggestions from stakeholders aimed at strengthening the modelling and data analytics in the future.

Models

During the interviews, stakeholders referred primarily to two models: 1) the forecast concerning the number of hospital admissions and bed capacity in the IC and nursing units (also known as the transmission model); and 2) the modelling of the reproduction number.

Where this report speaks of 'the models', we are therefore referring to these two models (unless otherwise indicated).

Stakeholders found the models to be accurate and a source of direction for policy decisions

During the crisis meetings, the modelling work done by RIVM served as the basis for decision-making regarding efforts to combat and manage the pandemic

Stakeholders were unanimous in their opinion regarding the societal relevance of RIVM's modelling work and mentioned two main points.

1. The models' degree of accuracy with regard to the epidemiological development was high, especially in the first 18 months of the pandemic. One stakeholder noted that the results of the modelling were *'astonishingly good'*, while another stated that *'it was possible to accurately model the tipping point of the virus, down to the day'*.
2. The epidemiological picture compiled by RIVM and its modelling of the effects of measures were leading for decision-making regarding measures during crisis meetings at the administrative and other levels. Stakeholders (decision-makers) also indicated that they found RIVM's advice concerning measures to be taken (which was offered during crisis meetings and was based on its modelling) to be both 'clear' and 'well defined'. They appreciated the consistency shown by RIVM in this area: practically every meeting began with a presentation on the status of the epidemiological situation given by RIVM, followed by the projected development in the subsequent period and the expected effects of the deployment of various types of measures. As examples of the important role played by the models, numerous stakeholders mentioned the decision-making surrounding the Christmas lockdown in 2021 and the introduction of the curfew. Both measures were, to a large extent, deployed based on the RIVM modelling, and particularly the prediction that these measures were necessary in order to remain under the

threshold of 800 COVID-19 patients in the ICUs.

The results concerning the development of the virus and ICU admissions were particularly accurate and useful

Various RIVM models played a role in decision-making. According to virtually all stakeholders, the most vital models by far were the modelling of the projected development of ICU occupancy (the transmission model) and the development (i.e. spread) of the virus based on the reproduction number. At crucial moments, these results were the primary point of reference for decision-making concerning measures.

Some stakeholders reported that the impact of the models decreased over time

According to some stakeholders, the predictive value of the models decreased as the crisis went on. Those stakeholders listed three main reasons for this.

1. *The virus became less predictable.* The predictive value of the models declined as the vaccination coverage went up and new variants of the virus emerged.
2. *The interests weighed in connection with measures became broader.* As the crisis went on, economic and social interests were given broader consideration; the models were no longer the sole basis for decision-making.
3. *It proved difficult to predict the effectiveness of individual measures.* While RIVM showed itself to be capable of predicting the general epidemiological development, predicting the effectiveness of individual measures – as well as the dependencies between measures – proved difficult.

According to some stakeholders, the capacity of RIVM was limited. It was not possible to conduct all the desired analyses

According to some stakeholders, the capacity of RIVM was limited. It was not always in a position to fulfil requests for specific models

Some stakeholders pointed out that the group of modellers at RIVM was small. These stakeholders indicated that, as a result, the modelling process was vulnerable during the COVID-19 pandemic. One interview subject said that, if even a single modeller had been unable to work, the situation could have become precarious. Those same stakeholders asserted that (despite limited capacity) RIVM was usually prepared to explore supplemental questions when this was relevant for policy recommendations. In such cases, RIVM was able to quickly supply answers to the questions.

At the same time, however, these stakeholders felt that RIVM was not always able to accommodate (more) specific questions as well as large (policy) questions when these questions called for additional modelling. According to stakeholders, RIVM devoted 100% of its modelling capacity to delivering 'basic models' in connection with the general epidemiological situation and its standard recommendations to the OMT and crisis meetings. Various examples of models RIVM was unable to provide were given, such as modelling the effectiveness of measures on schools, the effects of changes to the testing policy and the use of the COVID certificate (CTB).

The RIVM models were unable to accommodate all existing needs

The modelling carried out by RIVM did not meet the needs of all stakeholders who were interviewed. The LCPS, for instance, noted that the results of the models were

unsuitable as management information for hospitals because the degree of uncertainty meant that hospitals had too little to go on. For that reason, the LCPS developed its own models for forecasting trends in the number of beds required in IC and nursing units. The LCPS models did in part rely on data supplied by RIVM. One stakeholder asserted that the results of certain models were not always in alignment with one another: the results of models for extrapolating the vaccination strategy yielded results with different quantities than the models for calculating the effects on ICU capacity. According to the stakeholder in question, these specific results were therefore harder to explain to the outside world, because the effects on aspects such as death rates and hospitalisation rates were of a different order of magnitude than the other RIVM models. The concern was that this would give rise to confusion and debate.

Enhancing the usefulness of the models will require improvements in data quality

Some stakeholders noted that the quality of data (and hospital data in particular) was not good enough. For example, they reported that the NICE data was not initially sufficient to accurately extrapolate bed occupancy because (among other reasons) the data provided no insight into whether patients were being admitted to hospital *with* COVID-19 or *due to* COVID-19. These stakeholders did, however, state that the cause of this was outside RIVM's sphere of influence.

Stakeholders say it would have been useful if RIVM had cooperated more closely with other modelling groups in the Netherlands

Enhancing the usefulness of the models will require improvements in data quality [cont.]

It was also mentioned that the possibilities for data exchange between RIVM and other stakeholders were limited and that these had to be set up and expanded during the course of the pandemic. According to the parties involved, these facilities were ad hoc in nature: there was no overarching system for data exchange.

Multiple stakeholders noted that the RIVM modellers undertook only limited cooperation with modelling groups at Dutch universities

Multiple stakeholders – particularly the Dutch scientists with whom we spoke – noted that the group of RIVM modellers undertook only limited cooperation with other modelling groups at Dutch universities. National groups who offered assistance encountered – in the words of one interview subject – ‘a closed door at RIVM’. There is a perception that nationwide cooperation – led by RIVM – could have helped utilise the knowledge and expertise of other groups and provided a network in which to identify the questions that were already present or expected in the medium term and then assign those questions to various parties.

Some stakeholders said they felt that RIVM did cooperate a great deal with foreign institutions that had tasks similar to RIVM's. According to the international collaborative partners interviewed, this cooperation was valuable and was conducted

in a constructive way. They perceived RIVM to be an expert and good collaborative partner.

Stakeholders expressed a desire to share results of models more often and at an earlier stage

Stakeholders who did not participate in the crisis meetings (such as the OMT, MCMC, Catshuis deliberations, etc.) stated that RIVM did not publish the results of the models until after OMT meetings had taken place and any decisions regarding measures had been announced. According to journalists, this made it impossible to check the correctness and substantiation of the models during press conferences: *‘During press conferences, it could be said that infections were going to go up or down, and no one was able to verify this or offer an opposing argument.’*

Other stakeholders who were not part of the crisis meeting also indicated they felt a need for greater openness from RIVM with regard to the results of modelling and, in specific instances, would have liked to receive those results at an earlier stage. For the LCPS, for instance, it would have been helpful if RIVM had been able to share results with a small group of relevant partners. This would have made it possible to better utilise the results for decision-making other than that of the government, such as for instance with regard to hospital occupancy.

Stakeholders trusted the scientific quality of the models, although their ability to assess the transmission model was limited

RIVM's modelling is considered to be state of the art; as a result, stakeholders had a great deal of trust in the models

According to virtually all stakeholders, RIVM's modelling is renowned for its excellent quality. They stated that RIVM is among the best in the world when it comes to modelling infectious diseases. As a result, stakeholders generally expressed a great deal of trust in the expertise of the RIVM modellers. That trust was well-placed: in hindsight, most of RIVM's models were shown to be extremely accurate. Stakeholders consider this an important indication as to the reliability of the models.

Almost none of the Dutch and/or international stakeholders were able to evaluate the scientific quality of 'the models'

The majority of stakeholders said they were unable to give an opinion as to the scientific quality of the models. On the one hand, stakeholders indicated they had not made any real effort to explore the subject, while on the other, various stakeholders asserted that they felt it was impossible for them to evaluate the scientific quality of 'the models'. The evidence given to support this assertion is that the code and underlying data for the most important model – the transmission model for forecasts on ICU occupancy (1) – were not made public. One of the scientists interviewed had this to say, *'I had insufficient opportunity to verify the scientific quality of the transmission model because the code for this model was not made public. In evaluating the scientific quality, academics were forced to make do with the*

limited information that was presented to the House of Representatives. Because the underlying assumptions, uncertainties and parameters in the model could not be deduced from that information, they could not be verified either.'

On the one hand, stakeholders understood why the code underlying the transmission model was not made public; on the other hand, they viewed it as a missed opportunity

The majority of stakeholders understood why RIVM opted not to share the code underlying the transmission model with the public during the crisis. One stakeholder, for instance, noted that it is not possible to 'simply' publish this code. It must be accompanied by a detailed explanation so that the code does not 'take on a life of its own'. Drafting such an explanation costs time and effort.

At the same time, a number of stakeholders said that not making the code public was a 'missed opportunity' because it meant that Dutch scientists outside RIVM were unable to evaluate the modelling. Those in the media said this could ultimately pose a risk to society's trust in the modelling. This is reflected in the following quote from one of the interviewed journalists, *'When independent scientists – who we call for information – say that they are unable to evaluate the models because they cannot review the code, that means we can't say anything about it in the paper, either. And that poses a risk to society's trust in the models.'*

Stakeholders say that RIVM devoted a great deal of attention to conveying uncertainties in the modelling

The scientific quality was evaluated by international collaboration partners; Dutch stakeholders had little insight in this area

Various Dutch stakeholders indicated they were aware that the scientific quality of the models had been evaluated by an international team of academics from countries including Switzerland and England. Almost none of the Dutch stakeholders interviewed had insight into the evaluation process of international scientists and/or the results of such an evaluation process. One of the international collaborative partners indicated that this usually takes place via *'scans of preprints and publications that the consortium members conducted on each others' work, with the goal being to provide a quick assessment of the quality within 24 hours'*.

The international collaborative partners who were interviewed stated that the quality of the models is high. This is reflected in a quote from one such partner, *'The scientific quality of the COVID-19 modelling work done by RIVM is high. The models are based on the proper foundations (characteristics of the virus), consist of strong methodological components and are applicable for modelling scenarios used to formulate policy recommendations in connection with the previously implemented COVID-19 measures. The Dutch data is of high quality as well.'*

In the opinion of some stakeholders, scientific publications by RIVM modellers declined in number during the pandemic

Some stakeholders pointed out that scientific publications by RIVM modellers declined in number during the pandemic. As a result, there was no opportunity for external evaluation by means of peer review by the broader scientific community. They also

noted that, as a result, Dutch scientists were able to make only limited contributions to the gathering of domestic and international scientific evidence regarding the pandemic.

These stakeholders indicated that – presumably due to lack of time and limited cooperation with other modelling groups – the RIVM modellers were unable to publish scientific articles during the pandemic. The following quote from a stakeholder illustrates this: *'Owing in part to the fact that RIVM carried out all modelling independently, scientific publications authored by RIVM modellers dropped off during the pandemic. That is a missed opportunity. In England, for instance, where there was a nationally operating network of modellers, a large number of publications were submitted.'*

During crisis meetings, RIVM devoted a great deal of attention to communication regarding uncertainties in the modelling

According to decision-makers, during crisis meetings (such as OMT meetings and the Catshuis deliberations), RIVM was effective in its ability to explain the content of the models and how to interpret the margins of uncertainty. Presentations by RIVM included clear descriptions of the applicable degree of uncertainty. These stakeholders noted that there was also a verbal explanation of the unknowns in connection with the models. Stakeholders who did not attend crisis meetings (such as scientists and media representatives) sometimes missed out on the nuances surrounding uncertainties. This was partly because they were obliged to distil the inherent uncertainty and nuance in connection with uncertainties for themselves from the information presented to the House of Representatives.

On the whole, stakeholders viewed RIVM as a trusted advisor during the pandemic

Stakeholders felt that RIVM functioned as a trusted advisor

The picture that emerges from the interviews with decision-makers is that, in its modelling efforts, RIVM succeeded in striking the proper balance needed in order to function as a trusted advisor (see text box). They indicated that they perceived RIVM to be 'within reach' in its advisory capacity. One of the interview subjects described the RIVM models as a 'single point of truth' that was of crucial importance for clear decision-making on how to manage the crisis.

Multiple factors contributed to the perception of RIVM as a *trusted advisor*. First, interviewees stated that, in crisis meetings such as the Catshuis deliberations and ministerial committees, the explanation and interpretation of the models provided by Prof. Jaap van Dissel was perceived to be authoritative and reliable, which fostered a sense of trust.

Second, the interviews revealed that stakeholders had good contact with key figures at RIVM such as the members of the modelling group. This strengthened the perception of the RIVM modelling as being accessible and within reach.

Third, RIVM was generally perceived to be *responsive* and *constructive*: according to interviewees, RIVM was usually prepared to explore new questions when this was relevant for policy recommendations and was able to quickly supply answers (although it was only able to address a limited number of these specific questions: see also '[scientific quality](#)').

The concept of a **trusted advisor** is a layered and multidimensional notion. The most important aspects of this are that a trusted advisor must both operate independently and be perceived as 'within reach' by their client. This is a matter of striking the proper balance: an overly-independent interpretation of the role can be detrimental to the feeling of being within reach and to mutual trust, as can an approach that is not independent enough. Yet in this balancing act, it is vital to preserve scientific independence at all times [\(1\)](#).

The parties involved did not doubt the scientific integrity and independence of the RIVM models

With regard to RIVM's role as a trusted advisor, virtually all stakeholders considered the independence of RIVM's recommendations essential.

The interviews revealed that stakeholders have a great deal of trust in RIVM's scientific integrity and independence. The excellent scientific reputation of the RIVM modellers contributes to this sense of trust. The fact that the RIVM models were, to a significant extent, comparable (in design and/or result) to the models made by similar foreign institutes was mentioned here multiple times. During interviews, the parties involved in crisis meetings (such as the OMT and ministerial deliberations) stated that they saw no indication whatsoever that RIVM had tweaked its models to make the results more desirable in the political or policy-making sense. Nevertheless, stakeholders see clear opportunities to make RIVM's independence more visible towards the outside world and, by doing so, to strengthen public trust in the independence of RIVM. See the following slide for more on this.

Stakeholders felt that RIVM could do more to avert doubts about its independence in the outside world

While stakeholders, in general, do not doubt the independence and integrity of RIVM (see previous slide), they still put forth a number of areas for attention and improvement by which RIVM could reinforce its independence.

Stakeholders did not always see a clear distinction between the different roles of RIVM

RIVM played multiple roles during the COVID-19 pandemic. The head of RIVM's Centre for Infectious Disease Control, for instance, was both chair of the Outbreak Management Team (OMT) and the individual with final responsibility for the independent modelling. In particular, the journalists we interviewed said that there should be a clearer division between these two roles of RIVM, because the current situation creates a risk of real or perceived role ambiguity. One participant in the Catshuis deliberations noted this as well, although they said that having these two roles brought together in a single person was beneficial in terms of decisiveness.

Interview subjects saw a variety of areas for attention in connection with independence

In the interviews, subjects also shared other remarks about RIVM's independence and possible ways to strengthen it during potential future crisis situations. Multiple interviewees noted that RIVM's essential role as trusted advisor carries with it a duty to ensure maximum investment in internal checks and balances, along with critical

assessment of RIVM's work – and most importantly, making these safeguards and efforts more visible to the outside world. Offering the outside world more insight into these procedures would make RIVM less vulnerable to external criticism of its independence and integrity. One example given by these interviewees is the appointment of one or a few independent external scientists who would regularly assess the RIVM models and report their findings to the public. Publishing the source code underlying the models would be another way to enhance public trust in RIVM [\(1\)](#).

It was also mentioned in this context that it might have enhanced the perceived independence of RIVM if the RIVM models had been made public prior to the deliberations in crisis meetings, so that critics would not be able to suggest that the models (or their presentation) were tweaked afterwards to align them with the decisions that had been made. Several interviewees also indicated that it would be beneficial to the public trust in RIVM's independence (and in RIVM in general) if the products delivered to the OMT were made public in an integral fashion. Furthermore, interviewees would like RIVM to simultaneously publish the assumptions and methods it used to create those products, rather than primarily sharing the results.

Lastly, multiple stakeholders noted that it is difficult to prevent the appearance of undue influence in the current construction, in which modelling takes place within RIVM, because RIVM is part of the Ministry of Health, Welfare and Sport. They advocate for positioning RIVM (and/or its modellers) outside the Ministry. This might also prevent the Ministry from taking an overly managerial stance in connection with the tasks it assigns RIVM.

Stakeholders gave suggestions for permanently reinforcing the quality of the modelling [1/3]

All stakeholders agreed that the modelling work done by RIVM was of crucial importance to society during the pandemic. A variety of suggestions were offered for reinforcing the independence, quality and impact of the modelling in the future. AEF has grouped these suggestions into five thematic clusters, which are described below.

Suggestions with regard to strengthening cooperation

Numerous stakeholders noted that RIVM's modelling was carried out by a small number of individuals. As a result, these stakeholders felt that RIVM's capacity was limited, so that (in the stakeholders' perception) not all modelling-related questions could be answered. According to those interviewees, this also led to fewer publications being released and there not being enough time to share explanations of all models with the public. In order to make the modelling 'more robust' and to address a broader set of questions in the event of another pandemic, it was suggested that the cooperation with modelling groups in the Netherlands be intensified. Multiple stakeholders offered suggestions as to how this cooperation might be arranged, as illustrated by the following quotes:

- *'Invest in an "ecosystem" of cooperating modelling groups that discuss among themselves what "the big questions" surrounding modelling are and how these should be addressed. RIVM could take on a managing role within this network.'*
- *'Work together with other modelling groups in the Netherlands. During a pandemic, it must be possible to quickly scale up the modelling, and this can be effectively achieved*

in this country by cooperating with modelling groups that include academics. It is being done this way in England and France as well.'

- *'It would be helpful if there was greater cooperation in a network of modellers with experience in this field (infectious diseases). Within such a network, research and modelling can be validated by relevant, experienced parties, and the work to be carried out can be distributed in a better way. That has a positive impact on the quality.'*

Suggestions with regard to guaranteeing quality and transparency

Multiple stakeholders noted that it was impossible for the outside world to evaluate the scientific quality of the transmission model. The code underlying this model was not made public and, according to these interview subjects, could not be deduced from scientific publications. These stakeholders recognise the added value of enhancing transparency (such as by sharing the code and strengthening communication regarding the assumptions that have been incorporated into the models, etc.). Various interview subjects also suggested organising more peer evaluation by fellow modellers and/or an opposing voice, such as in the form of an independent 'critical friend'. This is illustrated by the following quote, 'RIVM could stand to strengthen the organisation of its internal review, such as in the form of 'critical friends'. This would make the modelling less vulnerable to external criticism.'

According to these stakeholders, RIVM should also provide the outside world with greater insight into which internal mechanisms it has adopted for guarantee of quality and assessment, in order to enhance public trust in the models.

Stakeholders gave suggestions for permanently reinforcing the quality of the modelling [2/3]

Suggestions with regard to scientific and other communication concerning the models

Virtually all stakeholders had found RIVM to be open to informal requests for explanation of its modelling. Yet the important nuances surrounding the limitations of and uncertainties in the models were sometimes lost, according to the journalists and several of the Dutch and international scientists interviewed. Numerous stakeholders emphasised that – when modelling has the degree of impact on society that it did during the COVID-19 pandemic – it is especially important to ensure maximum investment in pro-active communication with the general public regarding the purpose and creation of the models, the methodology behind the models, the assumptions that have been incorporated and any uncertainties in the modelling. RIVM could further expand its efforts in this area, according to some stakeholders, as doing so would increase public trust in the models. This is illustrated by the following quote, *'My most important suggestion for RIVM is to communicate more, more effectively and more simply with regard to its models.'*

To this, several stakeholders added that they felt a part of this task for RIVM is that it must also ensure that decision-makers consider its models in context, i.e. in relation to other societal values, factors and themes. In this vision, part of RIVM's role is to actively make administrators aware of the inherent and other limitations of models

and to point out to them any other values that should be taken into account in administrative deliberations. Other stakeholders said that this responsibility should instead lie with administrators and is beyond the scope of RIVM's role and task as a scientific institute.

Suggestions with regard to further development of the models and the data quality and infrastructure

Stakeholders gave various suggestions for further strengthening the modelling of infectious diseases going forward.

An initial suggestion was that RIVM should further expand its modelling in the future by offering greater insight into the role that socio-economic factors play in the spread of the virus. According to these stakeholders, the increased attention for behavioural aspects could also be further expanded (via the behavioural unit) and utilised by RIVM in its recommendations.

A second suggestion pertained to making use of all information yielded by the pandemic itself and the various decisions made by different countries in an attempt to combat it. A number of stakeholders felt that this information could be put to use in further developing the models. Based on this information, the effectiveness of individual measures can be retroactively converted into objective data, and these patterns can be utilised to make the modelling more detailed.

Stakeholders gave suggestions for permanently reinforcing the quality of the modelling [3/3]

Suggestions with regard to further development of the models and the data quality and infrastructure [cont.]

The scientists interviewed suggested expanding the portfolio of models and adding other types of infectious diseases or measures that we may encounter in the future. In this context, it was also noted that it would be a good idea to further expand the established sewage monitoring.

A final suggestion was that continued development of the modelling will require better data and faster availability of data. Numerous stakeholders suggested working together with relevant parties, including hospitals and municipal public health services, to improve the data quality and data infrastructure, which was at times still too ad hoc in nature during this crisis.

Suggestions with regard to the various roles of RIVM

Some interview subjects noted that the distinction between RIVM's role as an independent modeller and its role as 'hub' for the OMT was insufficiently defined. Some stakeholders felt that, as a result, criticism of the OMT (which was convened by RIVM) sometimes carried over to RIVM itself in its role as an independent modeller. An example of this criticism is the claim that the OMT became overly 'political'. It was suggested that, to ensure a clearer separation between RIVM's different roles, RIVM could communicate more clearly and invest more in protocols and procedures for fulfilling distinctly defined roles.

Several interviewees also mentioned that the current positioning of RIVM makes it difficult to avoid the appearance of political or policy-related influence affecting its modelling. RIVM is, after all, part of the Ministry of Health, Welfare and Sport. These interviewees advocate for positioning RIVM (and/or its modellers) outside the Ministry.



Appendices

Appendix 1. RIVM compiled a list of the top ten most impactful stakeholders

RIVM began by identifying and assigning priority to potential stakeholders

RIVM began by compiling a list of potential stakeholders in order to gain a picture of parties who were involved with or had an interest in the COVID-19 modelling carried out by RIVM. Next, 13 employees of the Centre for Infectious Disease Control were asked to rank the potential stakeholders based on the aspects of influence and interest according to a five-point scale (with 1 being lowest and 5 highest). 'Influence' is defined as the influence exerted by the stakeholder on the COVID-19 modelling and data analytics activities during the audit period. 'Interest' is defined here as the influence exerted by the COVID-19 modelling and data analytics on the stakeholder. The results were plotted in a line graph.

RIVM then selected stakeholders to take part in the survey

RIVM then selected the stakeholders who were most relevant for the purpose and scope of the audit from the list of potential stakeholders, based on the results of the procedure for assigning priority described above. The degree to which the organisation or individual in question had direct access to and/or direct involvement with the results of RIVM's modelling activities was taken into account when selecting stakeholders. A good balance between different types of stakeholders was sought as well. To that end, stakeholders were selected from six domains:

- government
- healthcare
- scientific community
- media
- international
- industry

The identified stakeholders and the selection process were presented to and coordinated with the Scientific Advisory Board of RIVM [\(1\)](#). This Scientific Advisory Board is tasked with safeguarding the level of scientific quality at RIVM.

The stakeholders were approached via an official invitation

These stakeholders were approached via an official letter asking for their participation in this stakeholder analysis, signed by the head of the Centre for Infectious Disease Control and the director-general of RIVM. Initially, 20 respondents were approached. Five of these were unwilling or unavailable to participate. Consequently, a second round of additional invitations was sent. This yielded a total of 19 interviews ([see Appendix 2](#)).

Appendix 2. List of interview subjects per stakeholder

Stakeholder	Name of interview subject, position/role*
Ministry of Health, Welfare and Sport	<ul style="list-style-type: none"> - Afke van Rijn, deputy director-general for COVID-19 at the Ministry of Health, Welfare and Sport - Stephanie Wiessenhaan, crisis policy advisor at the Ministry of Health, Welfare and Sport
Outbreak Management Team (OMT)	<ul style="list-style-type: none"> - Prof. Christian Hoebe, OMT member - Prof. Marc Bonten, OMT member
Participants in Catshuis deliberation	<ul style="list-style-type: none"> - Erwin van Dam, Wijnand Stevens and Mirre Terpstra, senior advisors at the Ministry of General Affairs - Pieter-Jaap Aalbersberg and Don O'Floinn, National Coordinator for Security and Counterterrorism and head of the COVID-19 project department at the National Coordinator for Security and Counterterrorism - Prof. Kim Putters, director of the Netherlands Institute for Social Research - Ferdinand Grapperhaus, Minister of Justice and Security
Health Council of the Netherlands	<ul style="list-style-type: none"> - Prof. Bart-Jan Kullberg, president of the Health Council of the Netherlands
National Coordination Center for Patient Distribution (LCPS)	<ul style="list-style-type: none"> - Willy Rensen, chief of staff for LCPS - Dr Michiel uit het Broek, lead data scientist at LCPS
National Intensive Care Evaluation (NICE) Foundation	<ul style="list-style-type: none"> - Prof. Nicolette de Keizer, board member at NICE
International scientific partners	<ul style="list-style-type: none"> - Prof. John Edmunds, The London School of Hygiene & Tropical Medicine - Prof. Niel Hens, Hasselt University and University of Antwerp
Dutch scientists	<ul style="list-style-type: none"> - Dr Quirine ten Bosch, assistant professor at Wageningen University & Research - Prof. Jan-Diederik van Wees, principal scientist at the Netherlands Organisation for Applied Scientific Research (TNO)/Utrecht University
National media	<ul style="list-style-type: none"> - Rinke van den Brink, editor at NOS - Niels Klaassen, reporter for AD - Wouter van Loon, (data) journalist with NRC

Appendix 3. Interview questions for 'COVID-19 modelling & data analytics audit'

General

1. How did you or your organisation interact with RIVM concerning COVID-19 modelling and data analytics? What services/results offered by RIVM did your organisation make use of?
2. How would you describe the relationship with RIVM concerning COVID-19 modelling and data analytics?

Scientific quality

3. How do you evaluate the overall scientific quality of RIVM's COVID-19 modelling and data analytics activities?
4. How do you rate the following aspects of scientific quality?
 - Usefulness of results for intended goals
 - Quantification and description of uncertainty
 - Participation in international consortia
 - Publication of the results
 - Documentation of the data and methods (FAIR principles, Open Science)

Societal relevance

5. How do you rate the societal relevance of RIVM's COVID-19 modelling and data analytics activities?
6. What were the most and least important services/results for you or your organisation concerning COVID-19 modelling and data analytics?

Trusted advisor and independence

7. To what extent do you consider RIVM to be a trusted advisor in COVID-19 modelling and data analytics? *Context (based on RIVM's website): the terms 'trusted' and 'advisor' have layered and complex associations: credibility, independence, reliability, proximity and self-orientation. To earn that trust, the other person must have a positive impression of all four dimensions.*

8. How do you experience the independence of RIVM's COVID-19 modelling and data analytics activities? *Context: independence means that the methodology, the choices in the model specification and the results produced by the model are not influenced by other parties or how desirable certain outcomes would be for such parties, such as the Dutch Ministry of Health, Welfare and Sport or the pharmaceutical industry, or by RIVM's own interests.*

Impact and influence

9. How did you or your organisation use RIVM's work concerning COVID-19 modelling and data analytics specifically? Can you illustrate this with examples? How did RIVM's COVID-19 modelling and data analytics activities affect you or your organisation? Did restrictions on data availability (e.g. by GDPR legislation) attenuate the usefulness of RIVM's services/results, and if so, how?
10. How would you describe RIVM's COVID-19 modelling and data analytics activities compared to those of alternative providers, possibly from the international context?

Future


11. If you look back on your collaboration with RIVM concerning COVID-19 modelling and data analytics, which aspects could be handled differently in the future?
12. What relevant emerging developments in COVID-19 modelling and data analytics should RIVM focus on?

Final question

13. Are there any other topics that were not discussed during this interview but that are crucial for this audit in your opinion?



Until next time



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