MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

MINISTRY OF HEALTH
MANATŪ HAUORA

BRIEFING

COVID-19 Vaccine Strategy – Framework to guide vaccine purchase decisions

Date:	2 September 2020	**Priority:**	High
Security classification:	In Confidence	**Tracking number:**	MBIE: 2021 - 0662

Action sought

	Action sought	Deadline
Rt Hon Jacinda Ardern **Prime Minister** Hon Grant Robertson **Minister of Finance** Hon Dr Megan Woods **Minister of Research, Science and Innovation** Hon Chris Hipkins **Minister of Health**	**Note** the contents of this briefing. **Agree** to the proposed framework to guide purchase decisions for COVID-19 vaccines.	8 September 2020

Contact for telephone discussion (if required)

Name	Position	Telephone	1st contact
Simon Rae	Manager, COVID-19 Vaccine Policy & Strategy, MBIE	9(2)(a)	✓
Maree Roberts	Deputy Director General, MOH	9(2)(a)	
Michael Contaldo	Principal Policy Advisor, MBIE	9(2)(a)	

The following departments/agencies have been consulted

MFAT, Medsafe, PHARMAC, Treasury, MBIE, MoH, DPMC

Minister's office to complete:

☐ Approved ☐ Declined
☐ Noted ☐ Needs change
☐ Seen ☐ Overtaken by Events
☐ See Minister's Notes ☐ Withdrawn

Comments

BRIEFING

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Date:	2 September 2020	**Priority:**	High
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Purpose

To seek agreement to a decision framework which will guide commercial negotiations with vaccine developers to support New Zealand's acquisition of COVID-19 vaccines.

Officials are providing a briefing separately [*Briefing 2021 - 0702*] which outlines the process and oversight for negotiations of Advance Purchase Agreements (APAs).

Recommended action

The Ministry of Business, Innovation and Employment, and the Ministry of Health recommend that you:

Agree the decision-making framework attached at Annex One of this briefing.

Agree / Disagree

Agree to forward a copy of this briefing to the Minister for Foreign Affairs.

Agree / Disagree

Rt Hon Jacinda Ardern
Prime Minister
…../…../…..

Hon Grant Robertson
Minister of Finance
…../…../…..

Hon Dr Megan Woods
Minister for Research, Science, Innovation
…../…../…..

Hon Chris Hipkins
Minister for Health
…../…../…..

Maree Roberts

Deputy Director General, Ministry of Health

2/9/2020

Dr Peter Crabtree

GM, Science, Innovation, International, MBIE

2/9/2020

Background

Cabinet has agreed a purchasing strategy to acquire COVID-19 vaccines

1. On 10 August the Cabinet agreed the purchasing strategy to support acquisition of COVID-19 vaccines [CAB 20-MIN-0382]. This recognised the need to build a portfolio of vaccine investments through the urgent negotiation of a number of advance purchase arrangements with vaccine developers so as to maximise the chances of accessing a safe and effective vaccine for New Zealand in a timely manner. The strategy identified three main purchase pathways:
   - A multilateral approach delivered through the COVAX Facility coordinated by GAVI, the Vaccine Alliance;
   - A "bloc" approach engaging with partners such as Australia, Singapore and the UK to purchase collectively; and
   - New Zealand negotiating directly with vaccine developers to agree APAs.

2. Cabinet agreed that the Prime Minister, Minister of Finance, Minister for Research, Science and Innovation, and the Minister for Health would jointly approve the framework to guide purchase decisions overall. This will ensure that negotiations with developers align with New Zealand's overall objectives for responding to COVID-19.

3. Advice has been provided separately on New Zealand's participation in the COVAX Facility [*Briefing 2021-0725 refers*]. The investment in COVAX provides a valuable "insurance" mechanism alongside New Zealand's other advance purchase arrangements with individual vaccine developers. It provides access to a diversified and actively-managed portfolio of many of the world's leading vaccine candidates. New Zealand has indicated in a non-binding letter of intent that we would like all purchase options for doses to cover 50 percent of our population. Initially all participants will receive doses for up to 20 percent of their population. We are seeking clarification of how the remaining doses for 30 percent of the population will be allocated, including whether and how the WHO's Global Allocation Framework will be used. New Zealand may choose a lower level of coverage if we seem likely to be a low priority for access for the additional doses.

4. Given the progress made towards launching the COVAX Facility there has been little interest in a formal purchase bloc amongst other countries, and it has seemed less relevant at this stage. We are continuing to coordinate closely with Australia and others, however.

5. Advance Purchase Agreements directly negotiated with vaccine developers may give New Zealand more control over timing for delivery of a vaccine. They are, however, dependent on getting access to doses from vaccine developers.

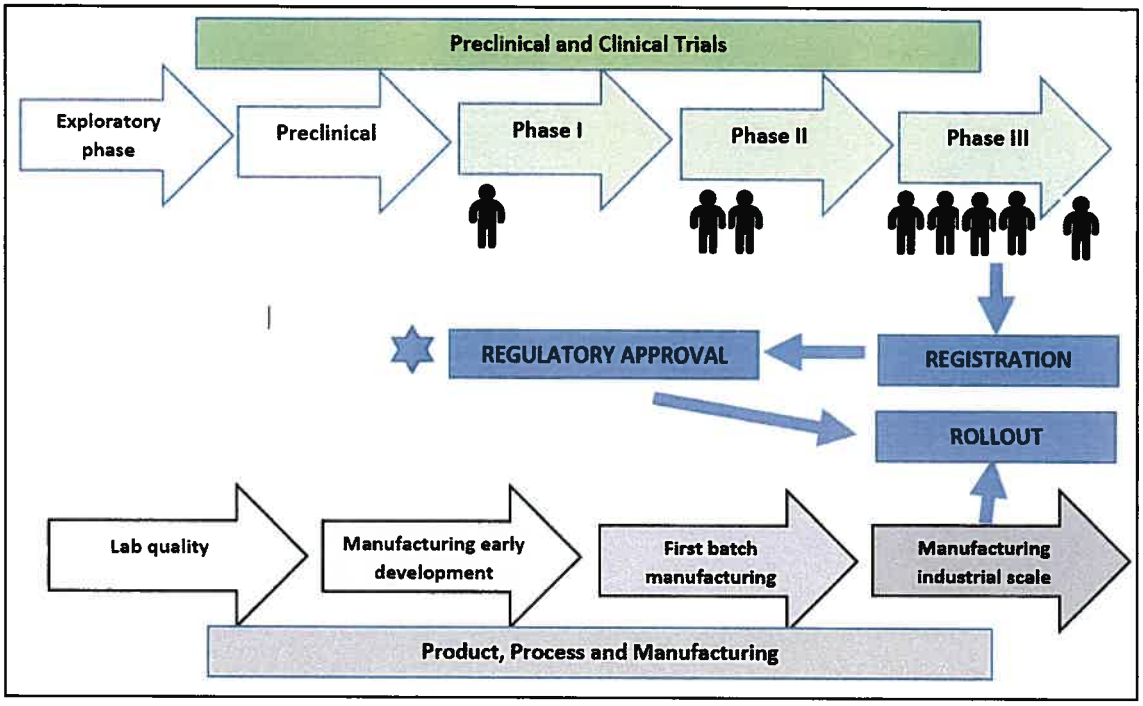
A framework to guide COVID-19 vaccine purchase decisions

We have identified a target set of vaccine developers to help prioritise urgent engagement

6. Initial discussions with international counterparts and vaccine developers has indicated that we need to proceed urgently with negotiations to enter into APAs, as there is expected to be a global shortage of vaccines, and a number of large countries have already reserved significant quantities of vaccine doses in advance purchase arrangements (a list of examples is attached at Annex Two).

7. The COVID-19 Vaccine Strategy Task Force has conducted an initial prioritisation of vaccine candidates globally under development to identify a set of targets. This target list is attached at Annex Three and focuses on potential vaccines which are either: (1) currently in Phase II or III clinical trials, or (2) where we know that the developer or manufacturer has a strong track record in producing vaccines or other pharmaceuticals. This reflects the reality that of the nearly 200 vaccine candidates currently in development, only a handful effectively have access to the substantial resources required to fund Stage 2 and 3 clinical trials that are necessary to prove a vaccine's safety and effectiveness.

8. The diagram below shows the pre-clinical and clinical trial research phases that a vaccine must pass through as part of its development. Alongside this there will be work undertaken often in parallel to scale up production and manufacture capabilities. No vaccine can be used as part of a wider immunisation strategy within New Zealand until it has received regulatory approval from MedSafe. A further description on the clinical trials and manufacturing process for human vaccine production is set out at Annex Four.



9. As part of the prioritisation exercise, research candidates have been ranked into three groups (Priority A, B and C) by considering expected vaccine performance and expected availability and access. The list of target candidates has subsequently been shared with the Science and Technology Advisory Group (STAG) for further input drawing upon expert clinical and scientific advice. The STAG broadly agreed with the identified targets although the consensus was to move Sanofi/ GSK from Priority B to Priority A.

10. With this prioritisation in place it allows us to seek additional information from the developer as well as other scientific experts to build a more detailed assessment. This will help reassure that purchase negotiations meet our objectives around safety and effectiveness, as well as responding to the wider requirements of our immunisation strategy. The framework has also been developed alongside a tool that considers practical scenarios (Annex Five).

A decision-making framework will assess vaccine candidates to guide acquisition choices

11. The priority vaccines candidates identified in Annex Three will be assessed against a decision-making framework as direct negotiations are undertaken with vaccine developers. This framework is attached at Annex One. This recognises that the key issue will be about getting the best possible information, data, and analysis to test vaccine candidates against.

12. The broad approach of the proposed framework is as follows:

1. Expected vaccine performance + 2. Expected availability and access + 3. Contribution to portfolio balance and strategic approach

13. In an ideal scenario, expected **vaccine performance** would consider factors such as:

    - Safety profile;
    - Effectiveness;
    - Ease of distribution across population as a whole and particular groups especially Māori; and
    - Immunity type – sterilising (prevents onward transmission) versus disease prevention (protects from illness).

14. Additionally in an ideal scenario anticipated **availability and access** would consider factors such as:

    - Production (for example the historic performance of vaccine developer, capacity, licensing arrangements, credibility and certainty of manufacturing plans);
    - Contracting (including options to manufacture within New Zealand, and the type of agreement): and
    - State behaviour and geopolitical dynamics (for example the extent to which sovereign hoarding poses risks, or how we are able to leverage existing relationships).

15. This proposed framework has also been shared with the STAG. Initial thoughts were to include immunity duration as part of the consideration around performance. However, scientists felt that this would be too difficult to do in the absence of final data and should therefore be taken out.

16. New Zealand will only want to enter into final purchase agreements that meet minimum standards around safety and effectiveness. However, given intense global competition for vaccines in a context where there will be continuing production constraints in the short to medium term, we will need to make decisions around what commitments to enter into based on the best information available at the time. This intelligence will be continually reviewed. In advance of full vaccine development and regulatory approval and in the absence of final data, it is possible to use a number of proxies to help inform choices.

17. Such proxies can include:

    - Ensuring that any scientific and clinical information is assessed by experts in the field including members of the STAG, but also other national and international expert opinion. Additionally, tracking new and emerging information on vaccine efficacy as it becomes available;
    - Understanding the approaches taken by the COVAX Facility, the Bill and Melinda Gates Foundation as well as other countries, and an awareness of examples of advance purchase agreements already entered into;
    - Evaluating the previous track record and reputation of the vaccine developer and the calibre of scientists and researchers involved in the project;
    - Using intelligence and data obtained through participation in the COVAX Facility where the same vaccine candidates may be under consideration;
    - Evaluating the arrangements already in place to develop and scale-up manufacturing capabilities; and

- Collecting intelligence on the price per dose of vaccines offered to other countries. With regards to our current discussions with vaccine developers we think the prices that we are being offered are reasonable at this stage of the pandemic.

The creation of a portfolio of vaccines will increase the likelihood of New Zealand being in a position to use a vaccine as part of its response to managing COVID-19

18. While the framework sets up a structure against which to assess individual purchase agreements, we still need to manage risk by constructing a portfolio of vaccine candidates to improve the chances of acquiring one of more vaccines that ultimately work, and are suitable for use in New Zealand. Such a portfolio would need to consciously select vaccine candidates that ensure diversity across technology platforms, suppliers, timeframes, and that address equitable population coverage (including the Pacific). Such considerations will become even more important and nuanced over time as the portfolio develops.

19. Acquiring vaccine candidates across technologies, for example, recognises that some platforms could simply fail and that it would be counter-productive to put all our focus in one place. Or it may be the case that others may provide better a better immune response in certain groups (e.g. older people), but at the same time may bring different challenges in terms of deployment (e.g. RNA vaccines may require very cold storage infrastructure). Annex Six sets out detail on the various vaccine technology platforms.

20. At the initial stage we are looking to secure a couple of early agreements that provide certainty of New Zealand accessing some vaccine. The COVAX Facility provides some of this reassurance as it offers a good spread of credible candidates across all the technologies and from different geographies. However, it will not be able to cover our whole population, and delivery timeframes are uncertain, which is why we are looking to secure additional deals through APAs.

21. There will continue to be uncertainties in how vaccines under development will actually perform, as well as whether we can access them easily. However, waiting until there is clear data on safety and effectiveness and guaranteed availability will mean we would not able to acquire any vaccines in the short to medium term because of constraints over global supply. The more certainty we seek then the more limited is our ability to move quickly. Instead our judgements about a candidate's particular fit or complementarity within the developing portfolio will change over time as additional deals are secured.

22. We also need to continue to monitor how much fiscal exposure we take on as we enter into APAs. Our current understanding is that most if not all developers will require us to make a commitment to buy for at least a significant portion of contracted volume. This will require us to balance volumes across multiple vaccines in order to manage the total cost of the portfolio. We may also need to account for indemnity risks on some agreements. On the positive side of the ledger, however, the offers we are receiving are competitively priced, and have a relatively small at risk component.

There are issues to consider as we construct a portfolio of vaccine candidates

23. There are also challenges that we need to consider when constructing a portfolio. Even though we have a target set of vaccine candidates identified for initial discussions, the reality is that we have limited control over the sequencing of purchases because vaccine developers are approaching us with limited stocks available. The amount of vaccine we can also purchase from each developer will also vary – partly because of overall availability, but also because we may decide we want smaller or larger allocations depending on how we anticipate using the candidate. For example, for limited numbers

of people in high exposure or high risk categories, or for whole population. Additionally, while it's possible we may agree the bulk of deals over coming months, if, when and how much of the different vaccine candidates become available will vary.

24. The ultimate intention is that purchasing decisions will be made to develop a vaccine portfolio that provides a strong chance of one or more vaccines being useful for New Zealand's immunisation approach. This approach, and an immunisation strategy, cannot be finalised until we have regulatory approval for vaccines based upon accurate and full clinical information. However, agreements with vaccine developers will help align our expectations for safety and effectiveness and increase the likelihood of delivering a successful immunisation programme across New Zealand.

25. A vaccine for COVID-19 will also have to work alongside public health measures such as testing, border restrictions and therapeutics to manage the pandemic both in transition and over the longer-term. Such considerations will therefore need to be reflected in the construction of a vaccine portfolio to determine how it relates to wider need.

It is important a framework is urgently agreed as advance purchase agreements with vaccine developers cannot be finalised until this is in place

26. Alongside the framework set out above, the Vaccine Strategy Task Force has agreed a clear process to manage the negotiation and sign-off for purchase agreements with developers. We are providing a briefing separately on this [*Briefing 2021 - 0702*]. A cross agency negotiating team with external commercial advisors is being created and will work to secure APAs that align with the criteria identified through the decision-making framework. Decisions on APAs presented to Ministers will place individual agreements in the wider context of the portfolio, and the Task Force will adjust this portfolio and target list accordingly as each deal is agreed.

27. It is important that the framework be agreed urgently as negotiations with vaccine developers cannot be finalised until this is in place, and this potentially compromises New Zealand's ability to secure timely access to a vaccine in a global context where initial demand will outstrip supply. There has been positive engagement with some target vaccine developers that suggests we could be in a position to secure some early commercial deals.

28. Once the framework is approved then officials expect to potentially provide joint Ministers with the first contract for consideration in September.

Recommendations

The Ministry of Business, Innovation and Employment, and the Ministry of Health recommend that you:

Agree the decision-making framework attached at Annex One of this briefing.

Agree / Disagree

Agree to forward a copy of this briefing to the Minister for Foreign Affairs.

Agree / Disagree

Annex One: Final decision making framework

Ideal set of information for decision making:

1. **Vaccine performance**	**Importance**
• Safety profile	**CRITICAL**
• Effectiveness	**CRITICAL**
• Ease of distribution across population as a whole or for particular population/ age groups especially Maori	**HIGH**
• Immunity type: sterilising vs immunity from disease	**MED**
2. Availability and access	
• Production o Confidence in company (eg historic performance) o Reliability of supply chains for raw materials o Capacity (incl domestic manufacturing and flexibility) o Licensing arrangements o Delivery schedules	**CRITICAL**
• Price	**HIGH**
• Contracting o Type of purchasing agreement (eg future buy options) o Type of partnership incl with other countries o Options to manufacture	**HIGH**
6(a) [redacted]	
• COVAX commitments	

What we can assess in absence of full information from clinical trials:

1. **Vaccine performance**	**Importance**
• Available data on safety and effectiveness (likely to be limited to preliminary or final results from Phases I/II) [Note: We are highly unlikely to enter into an APA with no indication of safety and effectiveness]	**VERY HIGH**
• Safety and effectiveness projections of international experts	**VERY HIGH**
• Existing APAs by like-minded countries	**VERY HIGH**
• Track record and reputation of the vaccine developer and key	**HIGH**

scientists (including signals from regulators and CEPI)

2. **Availability and access**

• Route to manufacture (arrangements in place; funding; CEPI support)	**VERY HIGH**
• Track record, reputation and reliability of manufacturer	**VERY HIGH**
• Existing APAs by like-minded countries	**VERY HIGH**
• International risk assessment	**HIGH**
• Price offered to other countries	**VERY HIGH**

3. **Contribution to portfolio balance and strategic approach**

To manage risks, the portfolio needs diversity across technology platforms, suppliers, timeframes, and equitable population coverage (including the Pacific). This will become more important over time as the portfolio builds.

Annex Two: Advance purchase agreements entered into by other countries

The table below shows how other advanced economies are taking a portfolio approach that spreads risk across a range of technology platforms and takes into consideration factors such as access and reputation of the developer.

Country	APA agreed	Analysis
United States	• AstraZeneca • Pfizer • Moderna • Sanofi • Janssen • Novavax	6(b)(i)
United Kingdom	• AstraZeneca • Pfizer • Valneva • Sanofi • Janssen • Novavax	
European Union	• AstraZeneca • Sanofi • Janssen	
Canada	• Moderna • Pfizer	
Japan	• Pfizer • AstraZeneca • Novavax	
Australia	• AstraZeneca	

Annex Three: Initial targeting of vaccine candidates

The table below shows an initial prioritisation on the leading vaccine targets. This was made by cross-agency officials in consultation with the COVID-19 vaccine task force and the Science and Technology Advisory Group (STAG):

Vaccine candidate	HQ/ country	Expected vaccine performance rating and comment	Expected availability and access rating and comment	Overall rating
University of Oxford/AstraZeneca **Currently Phase III**	UK/Sweden	A Results from Phase I/II openly published. Phase III trial with 10000 participants in the UK aged 18-55; scaling up 30000 participant trial in the US; as well as South Africa and Brazil to bring to over 50000 participants worldwide. Animal challenge trial not fully protective (ie pointing to non-sterilizing immunity). One dose at this stage. CEPI-backed. Some like-minded already have APAs.	A Licenses in a diverse range of places, including possibly Australia. AZ has strong track record in pharma. Probably will be first COVID-19 vaccine to enter the market. Offering not-for-profit pricing during the pandemic phase	**A**
BioNTech/Fosun Pharma/Pfizer **Currently Phase III**	US	A 18-85 age range for Phase II and III (in US, Argentina and Brazil). Participants include both naïve and exposed people. Phase I already done in healthy adults aged 18-55. CEPI-funded	A Pfizer very strong track record in vaccines. Good manufacturing capacity across Europe and the US. APAs with US, UK, Japan and Canada. 6(b)(i) CEPI-funded	**A**
Moderna/NIAID **Currently Phase III**	US	A Phase I 18-45 year olds. Phase III: 30,000 participants in adult volunteers. 18 years and over in US. Solicited adverse events occurred in more than half participants. CEPI funded.	A Supported by Operation Warp Speed. CEPI funded. Moderna has never brought a vaccine to market. Canada and Switzerland have signed an APA. RNA vaccines easy to scale. 6(b)(i)	**A**
Janssen Pharmaceutical Companies **Currently Phase I/II**	Belgium	A Strong track record. Conducting Phase II. Phase I and IIa (160 participants 19-64 age) trial results published in the Lancet. Vaccine induced high levels of antibody responses in roughly 95% of study participants. CEPI-backed. Funding from Gates Foundation and the US Department of Defence	A Well established manufacturing. 9(2)(ba)(i), 9(2)(ba)(ii)	**A**
University of Queensland/CSL/Seqirus **Currently Phase I**	Australia	A Currently Phase I (18-55 year olds, 1 or 2 doses). No results yet. UQ has track record in developing vaccines and commercialising them. CEPI-backed. Received $5	A Well established manufacturing route, experienced with vaccines. 9(2)(ba)(i), 9(2)(ba)(ii)	**A**

		million in funding from Australia government.	9(2)(ba)(i), 9(2)(ba)(ii) Established supplier for Australia/NZ and the Pacific. 9(2)(ba)(i), 9(2)(ba)(ii)	
Novavax **Currently Phase I/II**	US	A No published results yet in peer-review journal, but results available on company website. Phase I trial conducted in 131 healthy adults aged 18-59 years old (two doses) in Australia. Vaccine induced immune response in 100% of participants. Phase III up to 30,000 patients. Late stage biotech company. APA with the US. CEPI-backed. Supported from Operation Warp Speed	A APA with the US. Manufacturing facilities in South Korea, Czech Republic and Spain. Establishing large-scale manufacturing, supported by Operation Warp Speed funding ($1.6 billion grant to support manufacture at Fujifilm Diosynth Biotechnologies). Plans to rapidly produce 100 million doses by end of 2020.	**A**
Curevac **Currently Phase I/II**	Germany	A- No results from Phase I/II (168 participants 18-60 year olds in Phase I). German government, Gates Foundation and GSK have invested. CEPI-funded. Small company with 90% of resources devoted to COVID-19 vaccine development. Two doses.	A Expects to be able to manufacture 250 m doses by end 2021, 300-400 million by end 2022. Has its own manufacturing facility in Germany: 40-80 million doses per year. 9(2)(ba)(i), 9(2)(ba)(ii)	**A**
Sanofi Pasteur/GSK **Currently preclinical**	France/UK	B Sanofi Pasteur strong track record in vaccine development and manufacturer. GSK contributing the adjuvant. APA with UK, US and EU in advanced discussions	A Well established manufacturing capability with track record on vaccines. Plans to manufacture $1 billion doses per year. Support from Operation Warp Speed ($2.1 billion).	**A**
Anhui Zhifei Longcom Biopharmaceutical/Institute of Microbiology, Chinese Academy of Sciences **Phase II**	China	B Results from clinical trials not yet published. CAS is highly reputable scientific organisation.	B Production expected of 600 million doses per year by Anhui Zhifei Pharmaceuticals. Export decisions rest with the Chinese Government. Tech platform means production is scalable.	**B**
Sinovac **Currently Phase III**	China	A Inactivated tech platforms typically less effective. Results Phase II trials published in Science May 6. Phase III trials being conducted for elderly also. 8,800 participants in Phase III.	B Scaling up manufacturing difficult. Production expected to be Q1 subject to Phase III results (300 million doses per year in Beijing). Still developing production strategy. Access likely to be through the Chinese government. 2-3 years for roll-out. No facilities or experience manufacturing outside China and so would rely on overseas partners to support this. Reported to be open to a "full cycle transfer" of its IP to assist with production.	**B**

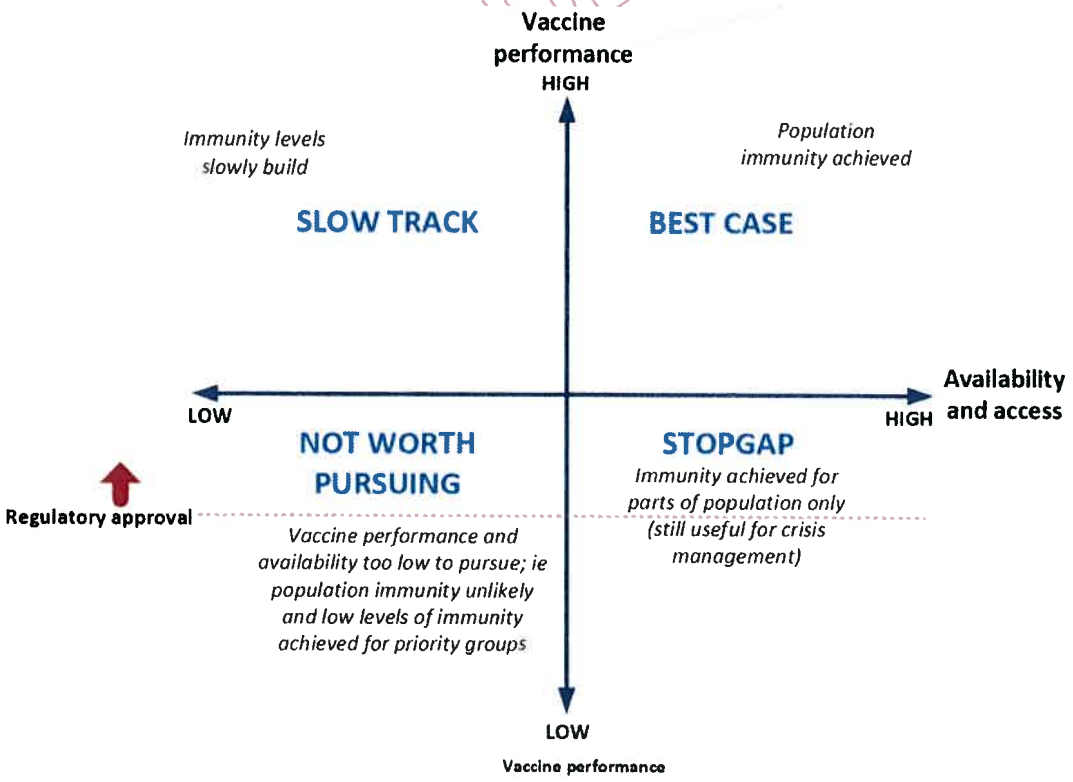
Annex Four: The steps to making a vaccine for human use

Moving a vaccine candidate through the standard phases of development can take more than a decade. Due to the urgency of the pandemic, researchers and regulatory bodies around the world are trying to eliminate delays and teams are running some phases concurrently in the hope of making a coronavirus vaccine in just 12 to 18 months.

Prototype development	This usually takes years, depending on the technique used. For the current coronavirus, researchers had prototypes within hours due to new technologies that identify the bits of a virus a vaccine might use.
Animal trials	These primarily test safety and the immune response generated by a vaccine. Skipping this stage can speed things up, but there may be safety trade-offs.
Phase I human trials	The first tests in people usually involve 20 to 80 individuals and are used to demonstrate safety and ensure any side effects aren't too severe.
Phase II human trials	Tests on larger groups of people reveal a vaccine's efficacy. Some vaccines can jump from here to regulatory approval if there is urgent need.
Phase III human trials	A new vaccine is tested on hundreds to thousands of people to clearly evaluate both efficacy and long-term safety.
Regulatory approval	Based on human trial data, regulatory bodies determine whether the vaccine can be licensed for public use. Follow-up safety testing may also be required.
Mass production	Vaccine manufacturing is ramped up under strict quality control and consistency standards.
Public access	Once a vaccine is available, governments and public health authorities must determine which groups of people get it first.

Annex Five: Scenario setting to help guide purchase decisions

Figure one below illustrates how the framework will help guide decisions in practice on which vaccines to acquire and which are not worth pursuing at this time. It is highly likely that at least in the short to medium term that availability of vaccines will remain low – both because of international demand and competition, but also because manufacture capabilities will be limited.



Annex Six: Vaccine technology platforms

Vaccines work by teaching the body's immune system to recognise and block viruses. Each category of vaccine technology works under this basic principle. Vaccines aim to activate the immune system's T-helper cells, which are responsible for detecting the presence of a virus. They instruct B-cells to create antibodies that block the virus from being able to replicate, and T-killer cells to destroy infected cells. Some vaccines may activate only part of this immune response.

There are a number of main ways that vaccine technologies for COVID-19 are being developed. Each type has different strengths and weaknesses, but there are also design choices within different vaccine technologies[1]:

Vaccines using nucleic acid (DNA and RNA)	• These vaccines have the advantage of speed – they can be quickly designed and manufactured. But they have never been approved for use outside medical research and will likely require two doses. • DNA vaccines contain genetic material that carries the blueprint for the spike protein. To get the DNA into cells, researchers use an electrical pulse to disrupt the cell membrane. Once inside, the DNA is used as a template to create spike protein. • RNA vaccines contain a strip of genetic material within a fat bubble. Once inside the cell, the RNA generates a protein found on the surface of the virus. The immune system, presented with the protein, learns to recognise the virus.
Viral-vectored vaccines	• Some vaccines use a virus that has been engineered to be harmless to ferry a gene from the coronavirus into cells. The gene codes for a distinctive part of the coronavirus, and the immune system learns to recognise it. • Viral-vectored vaccines can be designed quickly. One concern is that people can develop immunity to the viral vector, making this approach potentially less useful if booster shots are needed.
Subunit vaccines	• Some traditional vaccines work by delivering viral proteins to cells. The technologies to manufacture those protein fragments vary, but companies are using insect cells and yeast. The hepatitis B vaccine relies on a viral protein created by yeast.
Weakened (live attenuated) or inactivated virus vaccines	• In a more old-fashioned approach, in a live attenuated vaccine, the virus is weakened so that it does not cause disease, but still triggers the immune system's defences. The vaccine for measles, mumps and rubella uses this approach. • Inactivated virus vaccines contain dead virus, incapable of infecting people but still able to instruct the immune system how to mount a defensive reaction against an infection. The polio and flu vaccines use this approach.

[1] Taken from Aaron Steckelberg, Carolyn Y. Johnson, Gabriel Florit, Chris Alcantara, "Coronavirus: Top vaccine technologies to watch" in the Washington Post (August 2020)