

## Phase 2 data pending

## First phase 2 data in December

Bavarian Nordic will present first phase 2 data in December from its study of the COVID-19 vaccine candidate ABNCoV2. More data points are expected early next year and we anticipate a decision to start a phase 3 study before mid-2022. With financing granted from the state of Denmark and solid phase 1 data, we see a high likelihood of this scenario panning out.

This scenario would mean a possible rolling submission for approval of ABNCoV2 in late 2022 and a launch in first half of 2023, according to Bavarian Nordic's management.

#### **Bavarian Nordic tests rational for lower dose**

Some changes to the protocol of the phase 2 study were presented last week. Bavarian Nordic no longer intends to pursue only the 100  $\mu g$  dose in the study, but has added a 50  $\mu g$  arm as well. This may have consequences for the profitability and safety of the vaccine, but should have no implication for the royalty and milestone streams paid to AdaptVac and ExpreS2ion Biotechnologies.

## LOA raised, assumed number of doses lowered

Given the well-characterized nature of the antigen of the SARS-CoV2 virus and the design of the phase 2 trial we raise our assumption for the likelihood of this trial to succeed to 90 percent (70). The aggregated likelihood of approval (LOA) is raised to 60 percent (41).

Since the ABNCoV2 vaccine candidate is being positioned as a booster vaccine we also lower our estimate for the number of doses that will be procured to 450 million over the period 2023-27. The difficulty to predict the commercial scope of the product is still substantial, but we regard our new forecast to be more on the conservative side, supported by a good safety profile and a potential non-inferiority outcome to another booster vaccine in phase 3.

## Fair value raised to SEK 60 / share (55)

ExpreS<sup>2</sup>ion Biotechnologies could stand to gain a steady stream of royalty from AdaptVac by 2023, which will be a good platform for management to fund its operations. The in-house program of the breast cancer vaccine ES2B-C001 is advancing towards a phase 1 study in 2023 and may at least in part be funded by this royalty stream.

We raise our fair value by SEK 5 to SEK 60, leaving good upside in the near-term news flow from Bavarian Nordic's phase 2 study.

## **ExpreS<sup>2</sup>ion Biotech**

Date 19 november 2021 Analyst Sten Westerberg

#### **Facts**

Industry Vaccine Development Chairman of the Board Martin Roland Jensen Bent U. Frandsen Year of Listing 2016 First North Growth Market Stock List Ticker EXPRS2 Share price **SFK 47** No. of shares 2021, mln. 31,5 Market cap, SEKm 1 480 Cash 2021e, SEKm 130

Web site <u>www.expres2ionbio.com</u>

#### Kursutveckling senaste året



Source: Refinitiv

#### Forecasts & Key ratios, SEKm

	2019	2020	2021p	2022p
Revenues	14	15	13	22
EBIT	-18	-29	-45	-41
Net income	-17	-36	-44	-45
Earnings per share	-0,5 kr	-1,1 kr	-1,4 kr	-1,4 kr
Dividend	0 kr	0 kr	0 kr	0 kr
Revenue growth	55%	7%	-11%	65%
Cash	5	107	130	85
New share issue	8	133	83	0
P/E ratio	neg	neg	neg	neg
Dividend yield	0%	0%	0%	0%

Source: Bolaget, Analysguiden

## **Investment case**

#### **Continued need for booster vaccines**

The need for new vaccines to boost effects of currently approved products continues to spur the development of a large number of candidates in clinical development. Both of the mRNA vaccines have gained status as booster vaccine as well as the Johnson & Johnson vaccine.

So far, some 7.6 billon doses have been administered worldwide with the approved vaccines, primarily Pfizer's and Moderna's vaccines, and the ongoing discussions among health authorities suggest that the future use of boosters and add-on vaccinations will be extensive. In our forecast for the ABNCoV2 vaccine candidate we now assume that 450 million doses will be administered during 2023-27. This corresponds to a solid market share in the EU region, but given the prospect of a non-inferiority design in the phase 3 study we are not clear over which role the vaccine will play in regions outside EU.

## First data from the phase 2 study in few weeks

According to Bavarian Nordic's management we should expect first data from the 210-subjects phase 2 trial before year-end. The primary endpoint will look at how the number of virus neutralizing antibodies will be boosted by doses of either 100  $\mu g$  or 50  $\mu g$  of ABNCoV2. Since the main part of the study will consist of seropositive subjects, having been fully vaccinated since a minimum of 90 days, the bar of the trial is set higher than in the first-in-man COUGH-1 study.

When phase 2 data are released, it will be paramount to look at baseline values more closely than before. The inclusion criteria accept subjects with a last prime vaccination shot as late as 90 days before receiving the ABNCoV2 vaccine candidate. This may mean that baseline levels of neutralizing antibodies will be higher than seen in other booster trails, for example with the Moderna vaccine where a 19-fold increase in antibodies to the Delta variant was observed.

#### New assumptions bring fair value to SEK 60 (55)

Even if Bavarian Nordic made some unexpected changes to the dosing regimen in the ongoing ABNCoV2 phase 2 study, we believe that the potent immune responses to the SARS-CoV2 antigen seen in COUGH-1 will be repeated in the set of data panning out over the next quarter, allowing Bavarian to start a phase 3 study next year.

Our updated view on the likelihood of approval for the COVID-19 vaccine candidate, mitigated by a more conservative forecast of procured doses, brings our fair value for ExpreS<sup>2</sup>ion Biotechnologies to 60 SEK/share, up 5 SEK since last report.

## **Bavarian makes changes to protocol**

Bavarian Nordic is rapidly advancing its phase 2 trial of the ABNCoV2 vaccine with full enrollment achieved in one of three study arms. However, the initial trial design has been modified to include one additional dose, 50  $\mu$ g, over the single-dose 100  $\mu$ g, which initially was presented as the only dose in the study.

ABNCoV2 was licensed by Bavarian Nordic from the Danish vaccine developer AdaptVac in June last year. It was developed by a consortium, PREVENT-nCoV, which among others also comprises ExpreS²ion Biotechnologies. ExpreS²ion Biotechnologies holds 34 percent of shares in AdaptVac.

The phase 2 study was started in August this year and is carried out at two German centers. It is made up of 210 subjects, most of them being seropositive, i.e. having antibodies to the SARS-CoV2 virus antigen. A period of maximin 90 days separate the booster vaccination shot from the last previous vaccination with an approved COVID-19 vaccine. Results for the highest dosing regimen, 100  $\mu$ g, are anticipated in December.

## Design of Bavarian Nordic's ABNCoV2 phase 2 trial



Source: Bavarian Nordic Q3 presentation

The initial move by Bavarian Nordic in August to pursue a higher dose,  $100~\mu g$ , than the previously tested range 6-70  $\mu g$  in the initial COUGH-1 study may have turned out to be premature.

Upon assessment of the COUGH-1 results, the phase 2 trial has been amended and will expand the group of healthy volunteers with some existing immunity to a total of 180 (previously 150 subjects), of which 90 subjects will receive a single dose of 100  $\mu g$  ABNCoV2 and 90 subjects will receive 50  $\mu g$  of ABNCoV2, thus seeking to confirm the optimal dose for boosting the existing levels of SARS-CoV-2 neutralizing antibodies. Both the 50 and 100  $\mu g$  doses are unadjuvanted.

## Scope for lowering the dose

According to Bavarian Nordic, the recent findings from the COUGH-1 study (see below) may provide rationale for reducing the dose of the vaccine, while maintaining optimal effect, and thus could lead to a reduction of manufacturing costs. Bavarian has decided to add the non-adjuvanted 50  $\mu$ g dose in its phase 2 program. Were this dose to be approved it would substantially cut manufacturing costs compared to a product based on the 100  $\mu$ g dose. A lower dose may also confer

a better safety profile, even if safety so far has not been an issue with the ABNCoV2 vaccine candidate.

Data from the two enrolling arms, the 50  $\mu$ g and the 30 seronegative healthy volunteers on 100  $\mu$ g, will be presented in first quarter of next year, at a later point in time than the seropositive subjects on a single dose 100  $\mu$ g. With the full dataset available Bavarian Nordic can pick its final dosing preference and proceed to phase 3.

## The phase 3 initiation in 2022

Bavarian Nordic's management expects to start the phase 3 trial with ABNCoV2 in first half 2022. We assume this to be closer to mid-year since the company will have to wait for the 50  $\mu$ g data before making its final decision. Already by end of 2022 management expects to have topline results published and start a rolling submission at least to European authorities, potentially allowing the vaccine to be approved in the first half of 2023.

This scenario looks tight but is supported by the French vaccine developer Valneva, which recently presented phase 3 topline data for its COVID-19 vaccine VLA2001. As opposed to ABNCoV2, VLA2001 was not documented as a booster vaccine, but as a two shot prime COVID-19 vaccine.

Valneva started a 4,000-patient phase 3 trial in April this year, announced full enrollment in early June and presented the topline in October. A rolling submission had been initiated with the UK's Medicines and Healthcare products Regulatory Agency (MHRA), but later UK National Health Services terminated its agreement with Valneva to buy an initial 100 million doses.

Instead, the topline results for VAL2001 were awarded an advanced purchase agreement from the European Commission, committing itself to buy 60 million doses in 2022-23, of which 27 million in 2022. VAL2001 is based in inactivated viruses and resembles the AstraZeneca product rather than the protein-engineered ABNCoV2 from Adaptvac and ExpreS²ion Biotechnologies.

#### Regulatory interactions with EMA

Bavarian Nordic is currently in discussions on the design of the phase 3 trial with the European regulator EMA and national pharmaceutical regulatory agencies. At a later stage the company will also interact with the FDA, the US Food and Drug Administration.

Bavarian management expect the phase 3 trial to have a non-inferiority design, that is a design proving that ABNCoV2 is equally efficient in generating antibodies compared to approved booster vaccine products, such as the Pfizer's or Moderna's. This should have as consequence that Bavarian Nordic cannot claim superiority to its vaccine, which after all is no surprise to us, since the efficacy rates of current vaccines are approaching the +95 precent Sero-Conversion Rate.

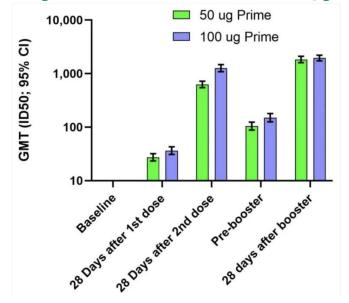
The Novavax product NVX-CoV2373, which is not yet approved for general COVID-19 vaccination, recently showed 89,7 percent vaccination efficiency in its phase 3 trial made up of a mix of different virus strains, such as alpha, beta and delta. NVX-CoV2373 is a protein-based vaccine candidate engineered from the genetic sequence of the first strain of SARS-CoV2. It is the late-stage vaccine which is most structurally related to Bavarian Nordics ABNCoV2.

## **Data on approved booster vaccines**

Recently, the United States Food and Drug Administration (FDA) approved a booster dose of the Pfizer vaccine Comirnaty for those who had been fully immunized with two previous doses 6-8 months earlier. The approval is for 65 years old or more or younger people between the ages of 18-64 years with a high risk of developing severe COVID-19, or those who are at an increased risk of COVID-19 due to institutional or occupational conditions.

The Moderna vaccine has followed suit and recently published data from a booster study. Serological responses were observed in almost 99% of those who received a booster dose of 50  $\mu$ g after a previous two-dose primary vaccine regimen. When the Delta variant was considered, the neutralizing antibody titer at baseline was 42 raising to 800 on Day 28 after the booster, a 19-fold rise.

## Strong reneutralization with Moderna 50 µg boost



Source: Chu, L., et al. (2021). Immune Memory Response After a Booster Injection of mRNA-1273 Moderna

The table above shows neutralizing titers in the total population of 171 subjects receiving the  $50\,\mu g$  booster dose. These results were later submitted to regulatory agencies and gained an emergency approval in the US for the booster indication.

## Strong efficacy signal in COUGH-1

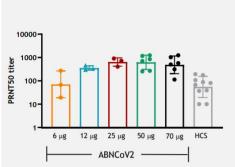
ExpreS2ion Biotechnologies recently presented the full efficacy data and safety set from the COUGH-1 study, the first human study with the vaccine candidate ABNCoV2. Forty-five healthy volunteers aged up to 65 years were treated at Radboud University Medical Centre in the Netherlands with two doses of six different strengths (6-70 µg) of ABNCoV2. Doses up to 25 µg came with adjuvans while the two highest doses did not include an adjuvant.

Surprisingly, the non-adjuvanted doses, 50 and 70 µg, did not convey any additional clinical benefit over the adjuvanted 25 µg dose. As mentioned, this plateauing of the immune response led Bavarian Nordic to amend its protocol of the ongoing phase 2 study to also include the 50 µg dose, a measure which should have caused some delay to the study. The primary endpoint of the study was to investigate safety, or reactogenicity, of the substance. None of the doses did cause severe side effects (grade 3 or 4) in these patients and it can thus be said that outcome was positive, admitting Bavarian Nordic to move forward with a Phase 2 study.

#### Vaccination efficacy plateueing

## ABNCoV2 induces high neutralization titers

- Dose response: increased titers with higher vaccine doses up to 25 mg, reaching a plateau at higher doses
- Up to 12-fold higher neutralizing antibody titers than seen in human convalescent samples (HCS)



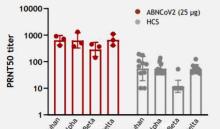
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to >10-fold reported for Comirnaty).

Strong cross neutralisation of variants

No reduction in neutralization capacity against Alpha

A 2.2-fold reduction is seen against Beta (compared



Source: Bavarian Nordic Q3 presentation

#### ABNCoV2 beats human immune system

As previously reported, the PREVENT-nCoV consortium showed that concentration of antibodies in ABNCoV2-exposed blood was 12 times higher than the concentration seen in a control of blood from convalescent COVID patients. These control patients may consist of a mixture of unvaccinated and vaccinated, but may also vary between symptomatic, asymptomatic or hospitalized individuals, making comparisons to other trials highly difficult. Pfizer and Moderna have cited 3 to 4 times higher neutralizing effect of their commercially available strengths compared to blood in convalescent patients. This surrogate measure, PRNT50, is considered to provide good guidance of the vaccination effect in a Phase 3 study. Phase 3 studies from

Pfizer and Moderna with prime vaccination conveyed a 90-95 percent vaccination grade (prevention of COVID-19).

## **Commercial scope of a booster vaccine**

In our initial scenario for ABNCoV2 we somewhat hastily assumed that the final product would be approved for prime vaccination use, but it now clear that Bavarian Nordic pursues a booster vaccine strategy. Based on the design of the phase 2 study we assume that use of ABNCoV2 will be restricted to the booster indication.

We believe that our initial scenario with 650 million doses sold during the period 2023-27 is optimistic. We are lowering our estimate for the period to 450 million doses sold as a booster to other approved COVID-19 vaccines. As for the pricing, we maintain a price per dose at EUR 20-21, slightly above the Pfizer list price in EU, which we understand is EUR 19,5. This price assumption is not defensive in our view, since other vaccines are priced below the premium Moderna and Pfizer ranges.

## Likelihood of approval on the rise

We note that Bavarian Nordic will capitalize its investment in the development of ABNCoV2, not incur the expenses over the income statement. This is an unusual approach in the pharmaceutical industry, but Bavarian Nordic concludes that "feasibility of developing a final vaccine and obtain regulatory approval is considered highly likely, because the development of other COVID-19 vaccine candidates based on the same antigen has been successful."

We raise our assumption for likelihood of approval to 60 percent from a previous 41 percent. We have assumed a 90 percent chance for the current phase 2 study to be positive, allowing for start of a registrational phase 3 trial next year.

## The Danish financing agreement

In August Bavarian Nordic entered a funding agreement, valued at up to DKK 800 million, with the Danish Ministry of Health to support the completion of the development of ABNCoV2 towards approval. The agreement included an upfront payment of DKK 80 million in October, in addition to payments of up to DKK 720 million. The additional payments are contingent upon reaching a number of predefined milestones including among others completion of the ongoing phase 2 trial, phase 3 development milestones and milestones related to upscaling of manufacturing for clinical and commercial production of the vaccine.

All payments are potentially subject to repayment, however only upon successful marketing authorization of the vaccine by the European Commission. Repayment may occur via supply of vaccines and royalty payments from the sale of the vaccine to other customers. Royalty

payments are only triggered upon reaching a certain volume in sales. The Danish Ministry of Health could be entitled to an additional, capped royalty payment if the sales reach a certain threshold.

We are surprised by the size of the financing, which in our mind is economical for being a phase 3 financing, which also includes investment in manufacturing capacity. The amount may suggest a phase 3 trial of less of 5 000 patients, which remains to be confirmed by Bavarian Nordic.

So far Bavarian Nordic has paid an upfront payment to AdaptVac of DKK 30 million last summer when the license and collaboration agreement was signed. It has also capitalized development costs of DKK 19 million for running the ongoing phase 2 study.

## Inhouse vaccine in preclinic

ExpreS<sup>2</sup>ion Biotechnologies has become close to a pure play on a COVID 19 vaccine. However, its proprietary breast cancer vaccine ES2B-C001 is a future driver for the valuation of the company as the candidate approaches clinical stage.

In February 2021, ExpreS<sup>2</sup>ion signed a final license agreement with AdaptVac whereby ExpreS<sup>2</sup>ion exclusively licensed in ES2B-C001.

Preclinical studies were initiated in Q2 and proof-of-concept data from animal study is expected to be presented soon. The company anticipate to submit a clinical trial application in the second half of next for starting a clinical trial in 2023.

## **Financial discussion and valuation**

As data are piling up for the vaccine candidate ABNCoV2 we raise our likelihood of approval (LOA) till 60 percent, including a 90 percent likelihood that the ongoing phase 2 study will be successful, allowing for a phase 3 trial to start half way into next year. Our previous assumption of a launch early 2023 may prove to be a few months too optimistic.

It is however still not entirely sure that Bavarian Nordic will go for an emergency approval, as other vaccine developers have done so far. If ABNCoV2 is submitted for a full approval a launch may drag into 2024. Given our new scenario for an improving chance of approval for ABNCoV2 and fewer doses sold we are raising our fair value to SEK 60 (55).

Sum-of-The-Parts valuation of ExpreS<sup>2</sup>ion Biotech

	Project value	Value /	Peak sales			Share of	
	(MSEK)	(SEK)	(MEUR)	LOA*	WACC	NPV	Comments
ES2B-C001	339	10,8	1 171	10%	14%	100%	
Royalty, ABNCoV2	448	14,3	9 452	60%	9%	100%	11% of Adaptvac
Adaptvac holding	871	27,8		60%	9%	34%	of DCF value
Platform	80	2,6	1,8	100%	7%	100%	cash flow based
Malaria project	110	3,5	175	21%	14%	10%	of consortium
Indigo (influenza)	30	0,6	952	5%	12%	8%	of consortium
Sum	1 878	60	based on th	e no. of sh	ares by end	d of 202	1, mln 31,3

<sup>\*)</sup> Likelihood of approval

Forecasts by Analysguiden

Discounted after tax and a LOA of 60 percent the valuation of AdaptVac, of which ExpreS<sup>2</sup>ion holds 34 percent, ends at SEK 2.6bn or SEK 28 per ExpreS<sup>2</sup>ion share. In this valuation we have only included the potential cash pile from ABNCoV2, but not assigned a value to Adaptvac's technology platform. In principle, we include two different components of potential revenue streams from ABNCoV2:

- The low-single digit royalty (estimated at 1.1 percent) and milestones on commercial sales of ABNCoV2 vaccine
- The 34 percent holding in AdaptVac, which may be realized in different ways, such as a stock market floating.

In the table below, we show that ExpreS<sup>2</sup>ion's royalties per share from Bavarian Nordic's commercial sales can amount to SEK 34 / share in our de-risked main scenario. Risk-adjusted and after tax, income sinks to SEK 17 / share. This value should be added to ExpreS<sup>2</sup>ion's stake in AdaptVac of 28 SEK / share. If our scenario materializes, AdaptVac will turn into a large pile of milestones and royalties from Bavarian Nordic.

## ExpreS<sup>2</sup>ion exposure to ABNCoV-2, three scenarios

	Slow scenario	Main scenario	Strong scenario	Comments
Aggregated sales , EURm	5 000	9 452	15 000	456 mln doses sold in main scen
EUR per dosis	20	21	21	Our assumption
Adaptvac royalty from Bavarian	7%	10%	13%	Single digit to double digit
ExpreS <sup>2</sup> ions royalty from Adaptvac	11%	11%	11%	Double digit number
royalty of vaccine net sales	0,8%	1,1%	1,4%	
ExpreS <sup>2</sup> ion revenues, EURm	39	104	215	Over period 2023-2027
in SEKm	389	1 050	2 166	
Milestone from Adaptvac, SEKm	20	20	20	EUR 2m in 2021-22
ExpreS <sup>2</sup> ion revenues, SEKm	409	1 070	2 186	
SEK/share	13,1	34,2	69,8	
Tax rate	18%	18%	18%	Assuming full taxation
Likelihood of Approval (LOA)	60%	60%	60%	67% phase 1/2, 65 % phase 3
Risk-adjusted after tax, SEK/share	6,4	16,8	34,3	Not discounted, see SoTP

Forecasts by Analysguiden, price inflation of 1 percent included in main scenario

We assume ExpreS<sup>2</sup>ion to receive 1.1 percent of total vaccine net sales as royalty, which is a product of the two royalty rates we have adopted in the table above. For AdaptVac's part, we believe that the royalty extends between 7-13 percent. AdaptVac's agreement with Bavarian entitles to milestones corresponding to a maximum of EUR 136 million, but only EUR 2 million of these are shipped down to ExpreS<sup>2</sup>ion in our model.

ExpreS<sup>2</sup>ion holds 34 percent of ownership in AdaptVac with the Danish academic group NextGen Vaccines ApS holding the remaining majority stake in AdaptVac. NextGen is a spin-out from the University of Copenhagen's Institute of Immunology and Molecular Biology, controlled by a handful of researchers at this institution.

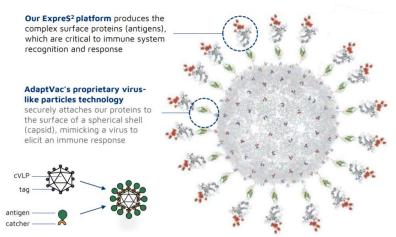
## Assumptions in Net Present Valuation of ExpreS<sup>2</sup>ion Biotech

SEKm	2019	2020	2021p	2022p	2023p	2024p	2025p	2026p	2027p	2030p
Operating income	14	15	13	22	408	281	204	17	18	18
ABNCoV-2		0	5	10	58	268	120	105	53	0
ES2B-C001 platform/services	14	11	5	12	331 19	-2 15	68 16	-2 17	95 18	85 18
EBIT	-18	-29	-45	-41	350	237	174	4	5	70
								4	3	
Cash	5	107	130	85	432	668	841			
ABNCoV-2 (EURm)		2020	2021p	2022p	2023p	2024p	2025p	2026p	2027p	2030p
Net sales				0	1 236	4 036	1 801	1 575	803	
EUR/dosis				20	20	21	21	21	21	
No. of doses, mln total o				0	61	196	87	75	38	
ExpreS <sup>2</sup> ion milestones, EURr	n		1	1	0	0	0	0	0	
Royalty, MEUR				0	10	44	20	17	9	
Royalty rate				#DIV/0!	0,8%	1,1%	1,1%	1,1%		
Expres2ion revenues, SEKm			10	10	96	448	200	175	89	0
Risk-adjusted			1,00	0,90	0,60	0,60	0,60	0,60	0,60	
Risk adjusted revenues, NPV	(SEKm)			0,0	57,5	268,4	119,8	104,7	53,4	
WACC	9%									
NPV, AV001 (SEKm)	448									
NPV/share, SEK	14,3									
LOA	60%									
ES2B-C001 (SEKm)		2020	2021p	2022p	Licens	2024p	2025p	2026p	2027p	2030p
Costs, preclinical / clinical		-7	-36	-24	-20	-14	0	-50	0	-75
incl milestones to	Adaptvac	-3,5	-3,5	-3,5	0	-14	0	-50	0	-75
Sales, EURm									147	921
Milestones, licensing partne	r 975 M	1EUR			75	0	100	0	200	200
Royalty 10%									15	92
Expres2ion revenues, SEKm					765	-14	1020	-50	998	2904
Risk-adjusted		1,00	0,75	0,56	0,56	0,23	0,11	0,10	0,10	0,10
Risk adjusted revenues, NPV	(SEKm)				331	-2	68	-2	95	85
WACC	14%									
Net present value (SEKm)	339									
NPV/share, SEK	10,8									
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## **Summary of the ABNCoV2 technology**

We classify ABNCoV2 as a combined protein subunit antigen technology, provided by ExpreS²ion, coupled with a capsid Virus Like Particle (cVLP), provided by the AdaptVac platform. The capsid-like particle is coated with 60-80 particles of the recombinant RBD protein fragment. After exposure to the ABN vaccine, mice serum was tested for antibodies to the receptor binding domain of SARS-CoV-2. Researchers have shown in a Nature article that RBD proteins glued to the CLP had a 3-4-fold higher immunogenicity compared to soluble RBD proteins injected without being mounted to the capsid-like particle, a strong rationale for the technology behind the ABNCoV2 cVLP vaccine.

## Schematic figure of cVLP expression and construct



Source: Company presentation

## Potential advantages with ABNCoV2

ABNCoV-2 has the potential to be a very potent COVID-19 vaccine. The readouts from preclinical animal data suggests an equal or stronger activity of neutralizing antibodies after two dosages compared to most other published preclinical animal data, also from currently approved COVID-19 vaccines, such as Pfizer-BioNTech's, Moderna's, and AstraZeneca-Oxford's vaccines.

Preclinical evidence in mice of the potency for ABNCoV2 opens for a possibility of single shot dosing, even if the schedule in the first clinical study makes use of double dosing. It is also speculated that the capsid based antigen display induces long-lived plasma T-cells, thus potentially conferring immunity for decades, as seen with the Human Papilloma Virus vaccines, which are also based on a VLP construct. This would be a differentiating factor to other recombinant proteins, which run the risk of not eliciting long-lasting responses by T-cells.

An additional advantage with the technology being used by AdaptVac and ExpreS<sup>2</sup>ion is that it would be relatively easy to replace the

current vaccine RBD antigen in the event that the SARS-CoV-2 virus should acquire mutations in the RBD domain and thereby reducing the efficacy of an existing vaccine. Another advantage being mentioned by the authors of the Nature article is that the vaccine does not contain any viral material and thus cannot infect or replicate in the human cell.

## **Summary of potential advantages**

- Potent immunogenicity by neutralizing antibodies, also to newer SARS variants of concern,
- No genetic content in the vaccine may confer better safety,
- One single shot administration may be enough in booster indication,
- Long-lasting response with the cVLP adjuvant,
- Stable storage in room temperature, easy to handle

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