Vaccine Development Status for COVID-19 with Patrick Soon-Shiong, M.D.

Presented June 3, 2020
Jefferies Healthcare Conference

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FORWARD-LOOKING STATEMENTS

These slides and the accompanying oral presentation contain forward-looking statements within the meaning of the Securities Act of 1933, as amended, or the Securities Exchange Act of 1934, as amended, that are based on management's beliefs and assumptions and on information currently available to our management. Forward-looking statements include, but are not limited to:

- our ability to pioneer immunotherapy, harness the power of the innate immune system, implement precision cancer medicine and change the current paradigm of cancer care;
- any impact of the COVID-19 pandemic, or responses to the pandemic, on our business, clinical trials or personnel;
- details regarding our strategic vision, including our planned therapies for virally induced infectious diseases such as COVID-19;
- our expectations regarding the potential benefits of our strategy and technology;
- our ability to utilize multiple modes to induce cell death;
- our beliefs regarding the benefits and perceived limitations of competing approaches, and the future of competing technologies and our industry;
- our beliefs regarding the success, cost and timing of our product candidate development activities and clinical trials;
- the timing or likelihood of regulatory filings or other actions and related regulatory authority responses, including any planned investigational new drug (IND) filings or pursuit of accelerated regulatory approval pathways or orphan drug status and breakthrough therapy designations;
- our ability to implement an integrated discovery ecosystem and the operation of that planned ecosystem;
- our expectations regarding our ability to utilize the Phase I aNK clinical trial data to support the development our other product candidates;
- our ability to produce an "off-the-shelf" therapy;
- our beliefs regarding the potential manufacturing and distribution benefits associated with our product candidates, and our ability to scale up the production of our product candidates;
- our ability to obtain and maintain intellectual property protection for our product candidate and not infringe upon the intellectual property of others;
- the ability and willingness of strategic collaborators, including certain of our affiliates, to share our vision and effectively work with us to achieve our goals;
- the ability and willingness of various third parties to engage in research and development activities involving our product candidates, and our ability to leverage those activities; and
- regulatory developments in the United States and foreign countries.

Factors that could cause our results to differ materially from those expressed in forward-looking statements include, without limitation:

- the fact that our business is based upon the success of aNK cells as a technology platform and the success of N-803, adenovirus constructs (hAd5) and the other product candidates;
- our aNK platform and other product candidate families, including genetically modified taNK, haNK and t-haNK product candidates, will require significant additional clinical testing;
- even if we successfully develop and commercialize our aNK product candidates or N-803, we may not be successful in developing and commercializing our other product candidates either alone or in combination with other therapeutic agents;
- we may not be able to file INDs, to commence additional clinical trials on timelines we expect;
- we will need to obtain substantial additional financing to complete the development and any commercialization of our product candidates; and
- risks associated with our ability to enforce intellectual property rights.

Forward-looking statements include statements that are not historical facts and can be identified by terms such as "anticipates," "believes," "could," "seeks," "estimates," "expects," "intends," "may," "plans," "potential," "predicts," "projects," "should," "will," "would," or similar expressions and the negatives of those terms.

Forward-looking statements involve known and unknown risks, uncertainties, and other factors that may cause our actual results, performance, or achievements to be materially different from any future results, performance, or achievements expressed or implied by the forward-looking statements.

These and other risks regarding our business are described in detail in NantKwest's Securities and Exchange Commission filings. We encourage you to review NantKwest's SEC filings in order to understand these risks. These forward-looking statements speak only as of the date thereof, and we disclaim any obligation to update these statements except as may be required by law. Given these uncertainties, you should not place undue reliance on these forward-looking statements. Also, forward-looking statements represent our management's beliefs and assumptions only as of the date of this presentation.

Except as required by law, we assume no obligation to update these forward-looking statements, or to update the reasons actual results could differ materially from those anticipated in these forward-looking statements, even if new information becomes available in the future. No representation or warranty, express or implied, is given as to the completeness or accuracy of the information or opinions contained in this document and we do not accept any liability for any direct, indirect or consequential loss or damage arising from reliance on such information or opinions. Past performance should not be taken as an indication or guarantee of future performance. You should read this presentation completely and with the understanding that our actual future results may be materially different from what we expect.

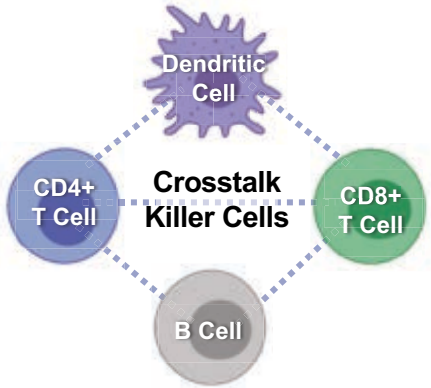
2010-2020

NantKwest & ImmunityBio

Platform Companies Developing Immunotherapy Products to Orchestrate the Innate and Adaptive Immune System for the Treatment of Cancer and Infectious Diseases

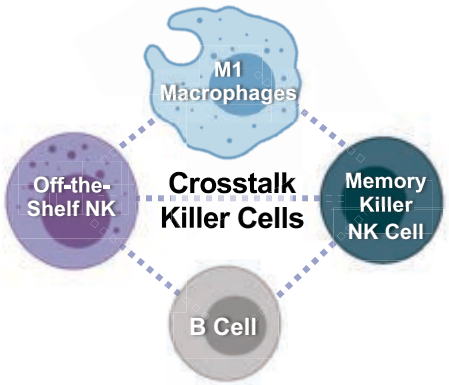
ImmunityBio: The Purpose
The Adaptive Immune System

The System	The Triangle	The Platforms	The Purpose	The Company
Adaptive Immune System	DAMPs + Dendritic Cell CD4+ T Helper Cell CD8+ T Helper Cell B Cell	**DAMPs:** Abraxane Aldoxorubicin (Ph II) **The Triangle:** GPS Neoepitope Discovery (510k) RP-182 Mannose Receptor (Pre-Clinical) 2nd Gen Ad5 Vaccine (Ph II) Yeast Vaccine (Ph II) IL-15 Superagonist (N-803) (Ph II)	**Driving to Memory T & B Cell**	**ImmunityBio**



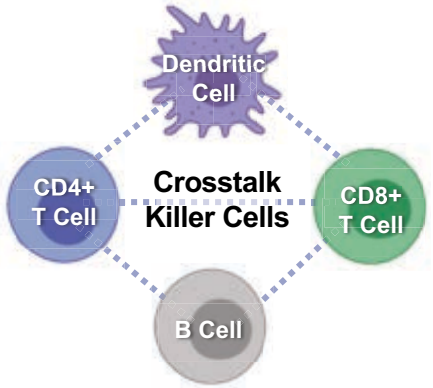
Adaptive Immune System

NantKwest: The Purpose
The Innate Immune System

The System	The Triangle	The Platforms	The Purpose	The Company
Innate Immune System	Overcome Myeloid Suppressor Cells + M1 Macrophages Off-the-Shelf NK Memory Killer NK Cells  **Innate Immune System**	**Overcome MDSCs** PD-L1 t-haNK (Ph II) **The Triangle:** CD-16 haNK (Ph II) PD-L1 t-haNK (Ph II) HER2 t-haNK CD-19 t-haNK Memory Like NK Cells GMP-in-a-Box	**Driving to Memory T & B Cell**	**NantKwest**

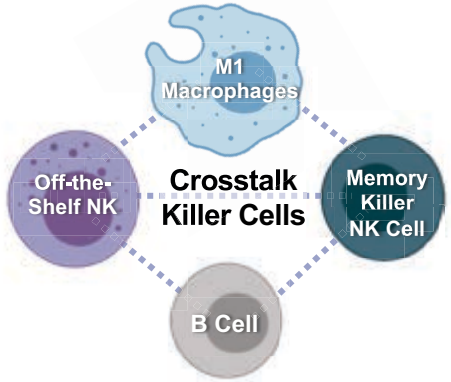
The Purpose: Orchestrating the Innate and Adaptive Immune Systems

ImmunityBio



Adaptive Immune System

NantKwest



Innate Immune System

2016 - 2019

Phase I Proof of Concept: Common Treatment Arms
Driving to the Memory T Cell

Metastatic Pancreatic Cancer:
Durable Complete Remission

Triple Negative Breast Cancer:
Durable Complete Remission

Head & Neck Cancer:
Durable Complete Remission

Merkel Cell Carcinoma:
Durable Complete Remission

Bladder Cancer:
Durable Complete Remission

2020-2025

The Path Forward: Registrational Intent
Driving to the Memory T Cell

Non-Muscle Invasive Bladder Cancer
N-803 + BCG
Breakthrough Therapy Designation Status
Primary Endpoint Reached
BLA Filing 2021

1st & 2nd Line Metastatic Pancreatic Cancer
PD-L1 t-haNK + N-803
Complete Response >6 Months
IND Authorized 1st Line
IND Authorized 2nd Line
Activating Sites

3rd Line Triple Negative Breast Cancer
PD-L1 t-haNK + N-803
Complete Response >12 Months
IND Q3 2020

3rd Line Lung Cancer
PD-L1 t-haNK + N-803
IND Filed Q2 2020

3rd Line Merkel Cell Carcinoma
haNK (CD-16 NK)
Complete Response >4 Years
Trial Recruiting

hAd5: From Oncology to Vaccinology to COVID-19 Driving to the Memory T Cell

Colon Cancer (CEA) - 2010

Cancer – 2009-2013

MUC1, Brachyury, CEA - 2019

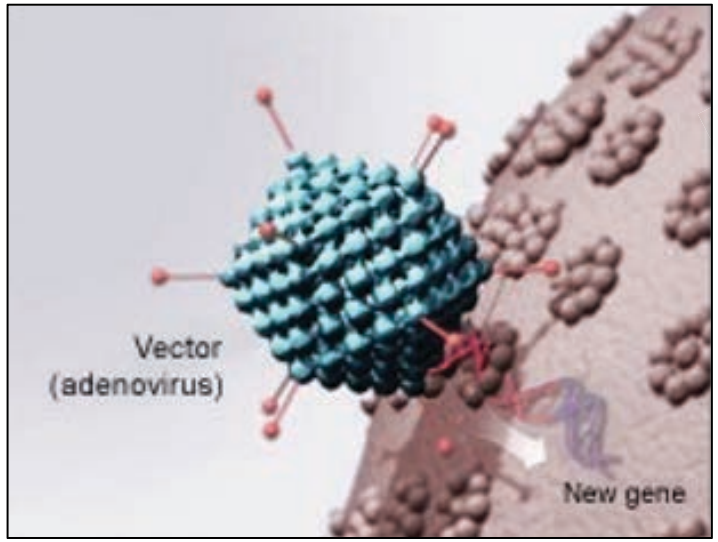
PSA, MUC-1, Brachyury - 2019

Neoepitope - 2019

Oncology
NANT Cancer Vaccine

2009-2019
13 Ph I / II Clinical Trials
in Over 125 Patients

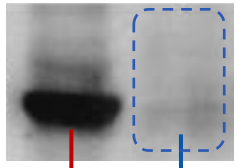
- Ph II: Colon Cancer (CEA)
- Ph I: Advanced Tumors (MUC1, Brachyury, CEA)
- Ph I: Prostate Cancer (PSA, MUC1, Brachyury)
- All Tumor Types (Neoepitope)



1st Gen Adeno
E1, E3 Deletions

2nd Gen Adeno
E1, E2b, E3 Deletions

Intracellular generation of adeno fibers in dendritic cell with shortened duration of RNA production by APC



No generation of adeno fiber in dendritic cell with long duration of RNA production by APC

Limitations of 1st Gen With Adenoviral Immunity:
Adeno fibers elicit a strong immune response against the vaccine vector itself thereby limiting its ability to elicit COVID-19 specific immunity

Superiority of 2nd Gen Human Adenovirus:
Reduction of fiber protein expression allows COVID-19 specific immune responses to dominate

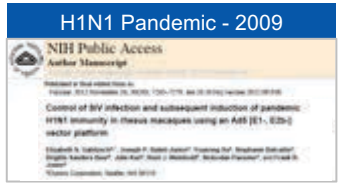
Infectious Disease
Vaccine

2009-2020
Pre-Clinical

- H1N1
- Lassa Fever
- HIV
- SIV
- Chikungunya
- Zika
- Influenza
- COVID-19

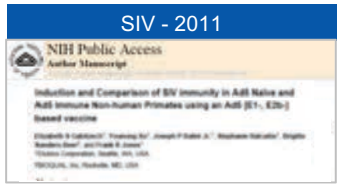
H1N1 Pandemic - 2009

H1N1 Pandemic - 2009



HIV - 2009

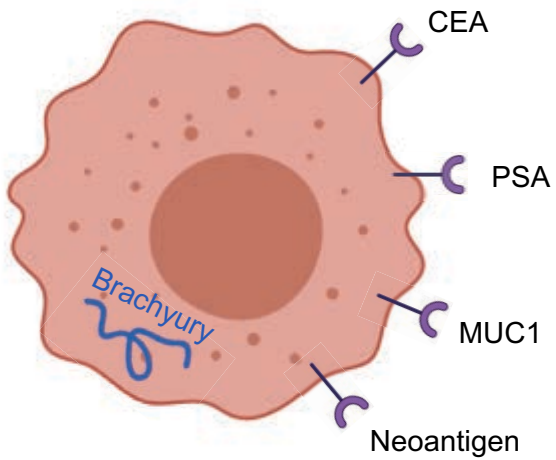
SIV - 2011



Lassa Fever - 2019

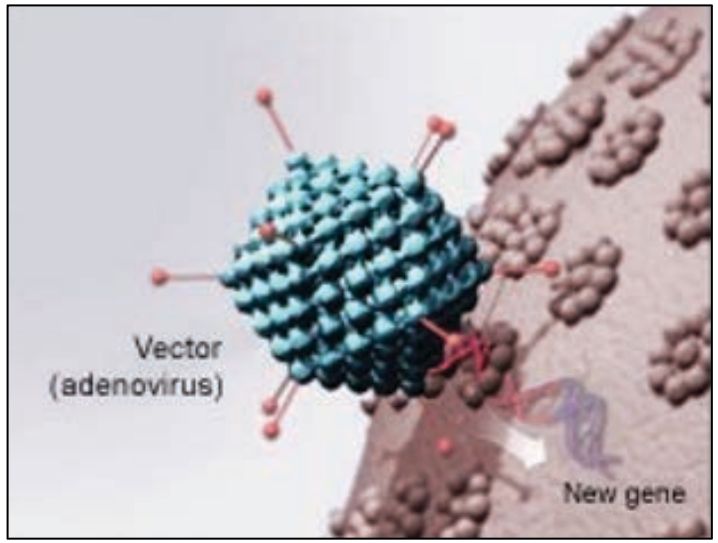
From Oncology to Vaccinology to COVID-19 Driving to the Memory T Cell

Oncology
NANT Cancer Vaccine



Tumor Associated Antigens

2009-2019
13 Ph I / II Clinical Trials
in Over 125 Patients



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E1, E2b, E3
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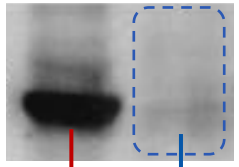

No generation of adeno fiber in dendritic cell with long duration of RNA production by APC

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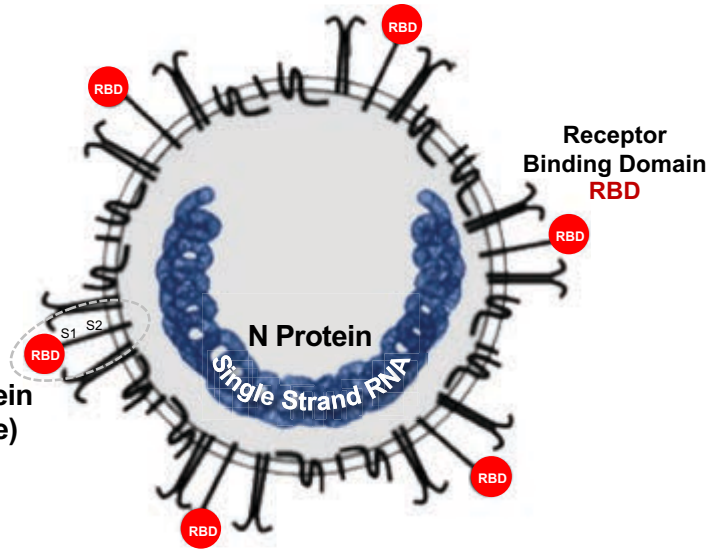
Infectious Disease
Vaccine



COVID-19 Antigens

2020
Phase Ib IND Pending

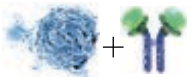
NantKwest & ImmunityBio: Driving to the Memory T Cell Clinical Development Pipeline

NantKwest ImmunityBio

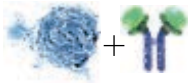
CANCER


N-803 (IL-15)

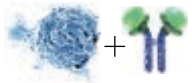
Non-Muscle Invasive Bladder Cancer
N-803 + BCG
- Breakthrough Therapy Designation Status
- Primary Endpoint Reached
- BLA Filing 2021


PD-L1 t-haNK N-803 (IL-15)

Metastatic Pancreatic Cancer
PD-L1 t-haNK + N-803
- Complete Response >6 Months
- IND Authorized 1st Line
- IND Authorized 2nd Line
- Activating Sites


PD-L1 t-haNK N-803 (IL-15)

3rd Line Triple Negative Breast Cancer
PD-L1 t-haNK + N-803
- Complete Response >12 Months
- IND Q3 2020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3rd Line Lung Cancer
PD-L1 t-haNK + N-803
- IND Filed Q2 2020


haNK (CD-16 NK)

3rd Line Merkel Cell Carcinoma
haNK (CD-16 NK)
- Complete Response >4 Years
- Trial Recruiting

COVID-19

VACCINE


Human Adenovirus hAd5

COVID-19 Vaccine
Adenovirus (hAd5)
- IND Filed
- Phase Ib Trial (Anticipated June 2020)
- cGMP Manufacturing Ready
- 100 million doses by year end

THERAPEUTICS


haNK (CD-16 NK)

COVID-19 (Moderate Disease)
haNK + Convalescent Plasma
- Pre-IND Filed


N-803 (IL-15)

COVID-19 (Moderate Disease)
N-803
- IND Authorized


Mesenchymal Stem Cells

COVID-19 (Severe Disease)
Mesenchymal Stem Cell (MSC)
- IND Authorized

COVID-19: From Prevention to Treatment

THE NANTKWEST / IMMUNITYBIO JOINT COVID-19 AGREEMENT

Green: Uninfected | **Yellow: Moderate Symptoms** | **Red: Severe & Critical**

Vaccine
Uninfected State

Therapeutic
Mild to Moderate State

Therapeutic
Critical ICU State

ImmunityBio

2nd Gen hAd5 Adenovirus Vaccine Program

T Cell Mediated Immunity
Humoral Immunity

IND Submitted to FDA

ImmunityBio

N-803: IL-15 Superagonist

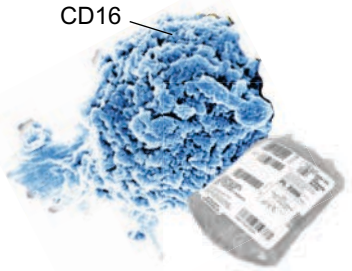
Natural Killer & Memory T Cell Activation Enhanced ADCC

IND Authorized by FDA

+

NantKwest

Off-The-Shelf Natural Killer (NK)



Enhanced ADCC with Neutralizing Antibodies

IND Submitted to FDA

NantKwest

Bone Marrow Derived Mesenchymal Stem Cell

Overcoming Cytokine Storm
Reduction of Ventilator Time

IND Authorized by FDA

ImmunityBio | **NantKwest**

ImmunityBio NantKwest

ImmunityBio & NantKwest Sign COVID-19 Joint Development, Manufacturing and Marketing Agreement; ImmunityBio Selected for 'Operation Warp Speed' to Develop Novel Adenovirus COVID-19 Vaccine

May 27, 2020 | Press Releases

Agreement to Jointly Develop, Manufacture and Market COVID-19 Therapeutics and Vaccine

On May 22, 2020, NantKwest and ImmunityBio entered into a binding term sheet to pursue collaborative joint development, manufacturing, and marketing of certain COVID-19 therapeutics and vaccines. The parties agree to jointly develop haNK, mesenchymal stem cells (MSC), adenovirus constructs (Ad5), and N-803 for the prevention and treatment of SAR-CoV-2 viral infections and associated conditions, including COVID-19. NantKwest will contribute the haNK, MSC, and certain of its manufacturing capabilities, and ImmunityBio will contribute Ad5, IL-15, and certain manufacturing equipment.

Under the terms of the agreement, the parties will share equally in all costs relating to developing, manufacturing, and marketing of the product candidates globally, and the global net profits from the collaboration products will be shared 60%/40% in favor of the party contributing the product on which the sales are based. All net profits from sales of combined collaboration products will be shared equally. This collaboration will be supervised by joint committees, comprised of an equal number of representatives from both companies.

COVID-19: From Prevention to Treatment

THE NANTKWEST / IMMUNITYBIO JOINT COVID-19 AGREEMENT

Over 100+ COVID-19 Vaccines in Development

Table 1 Advantages and disadvantages of different vaccine strategies.

From: The outbreak of SARS-CoV-2 pneumonia calls for viral vaccines

https://www.nature.com/articles/s41541-020-0170-0/tables/1

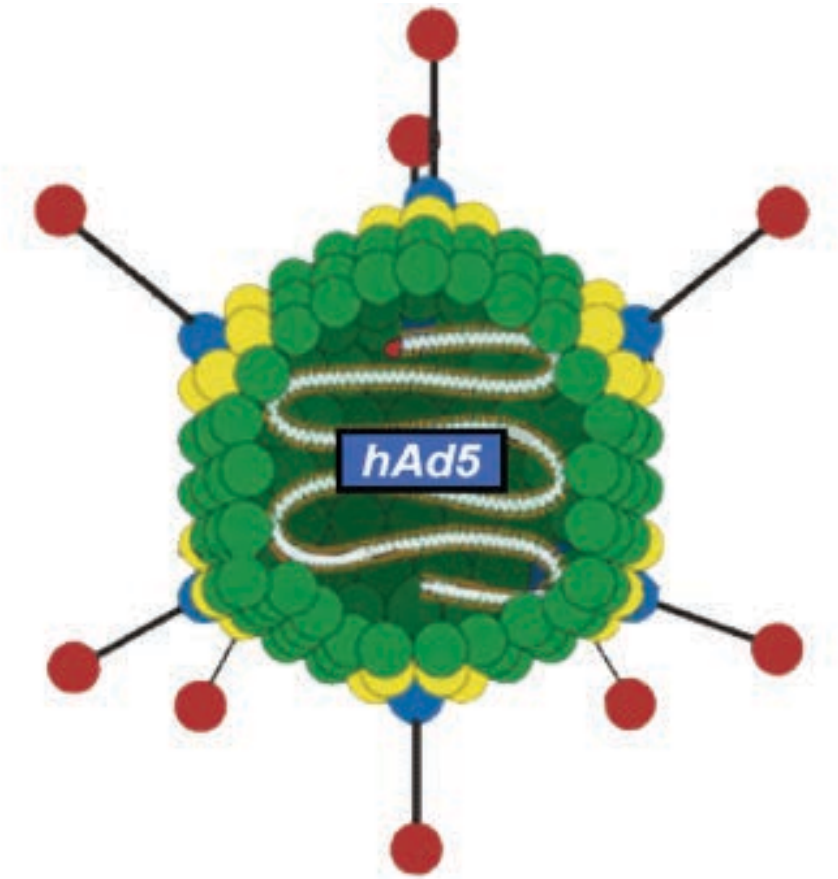
Vaccine strategy	Advantages	Disadvantages	References
Inactivated virus vaccines	Easy to prepare; safety; high-titer neutralizing antibodies	Potential inappropriate for highly immunosuppressed individuals	25
Attenuated virus vaccines	Rapid development; induce high immune responses	Phenotypic or genotypic reversion possible; can still cause some disease	25
Subunit vaccines	High safety; consistent production; can induce cellular and humoral immune responses; high-titer neutralizing antibodies	High cost; lower immunogenicity; require repeated doses and adjuvants	12,14
Viral vector vaccines	Safety; induces high cellular and humoral immune responses	Possibly present pre-existing immunity	12
DNA vaccines	Easier to design; high safety; high-titer neutralizing antibodies	Lower immune responses in humans; repeated doses may cause toxicity	23
mRNA vaccines	Easier to design; high degree of adaptability; induce strong immune responses	Highly unstable under physiological conditions	23

npj Vaccines

Key Elements of a Vaccine

- Safety
- Efficacy
- Long-Term Durability
- Universal for all SARS-CoV
- Acceptance by the Public

A Unique Vector: 2nd Generation Human Adenovirus (hAd5)



hAd5 Proven Safety in 13 Phase I Clinical Trials in Over 125 Patients

1st Gen Adeno
E1, E3 Deletions

2nd Gen Adeno
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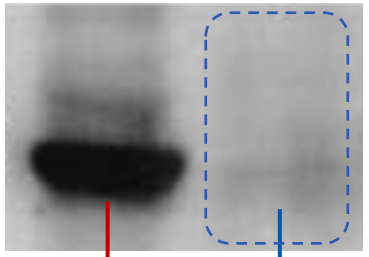
Intracellular generation of adeno fibers in dendritic cell with shortened duration of RNA production by APC



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Superiority of 2nd Gen Human Adenovirus:
Reduction of fiber protein expression allows COVID-19 specific immune responses to dominate

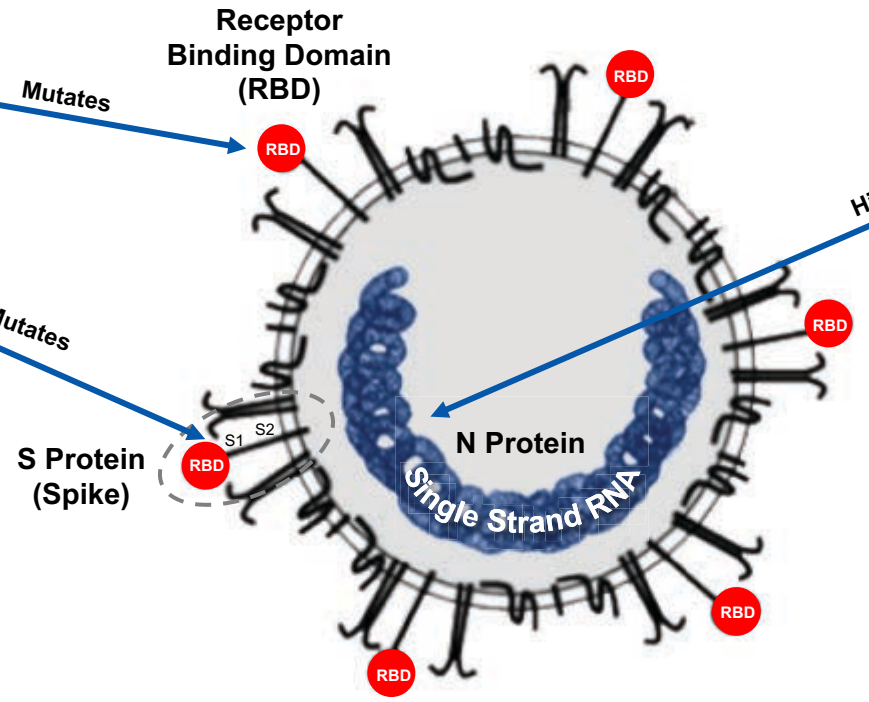
A Unique Construct Addressing SARS-CoV-1 and SARS-CoV-2 Virus

Mutates

- Receptor Binding Domain (RBD)
- Spike (S)

Universally Conserved

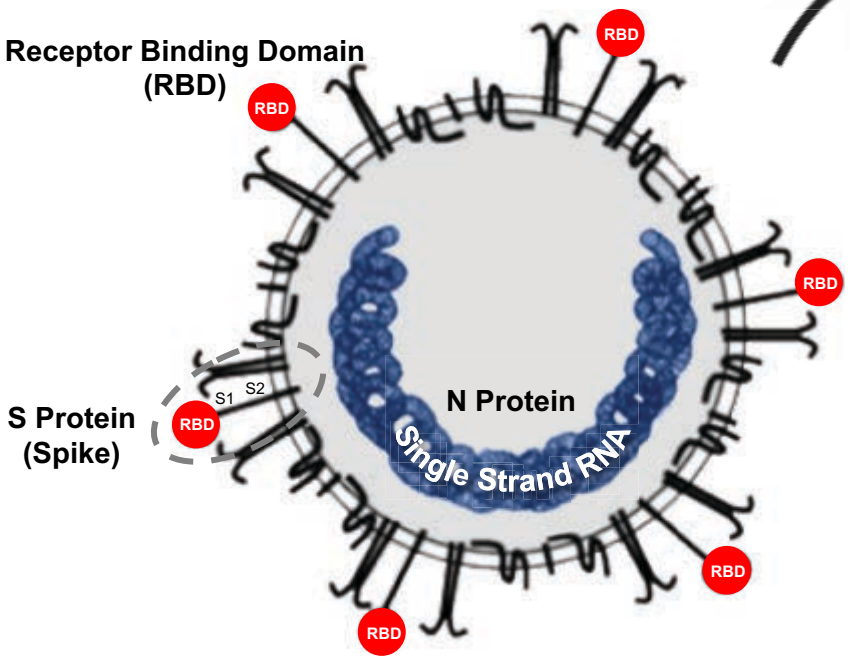
- Nucleocapsid (N)

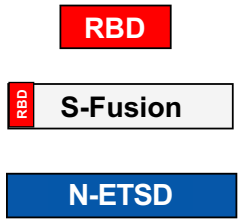


The N Protein Provides an Opportunity to Generate Durable Immunity and Immunity to Future Mutations of SARS-CoV Viruses

A Unique Construct Combining S+N for a Universal SARS-CoV Vaccine with Long-Term Durable Immunity

COVID-19
SARS-CoV-2 Virus

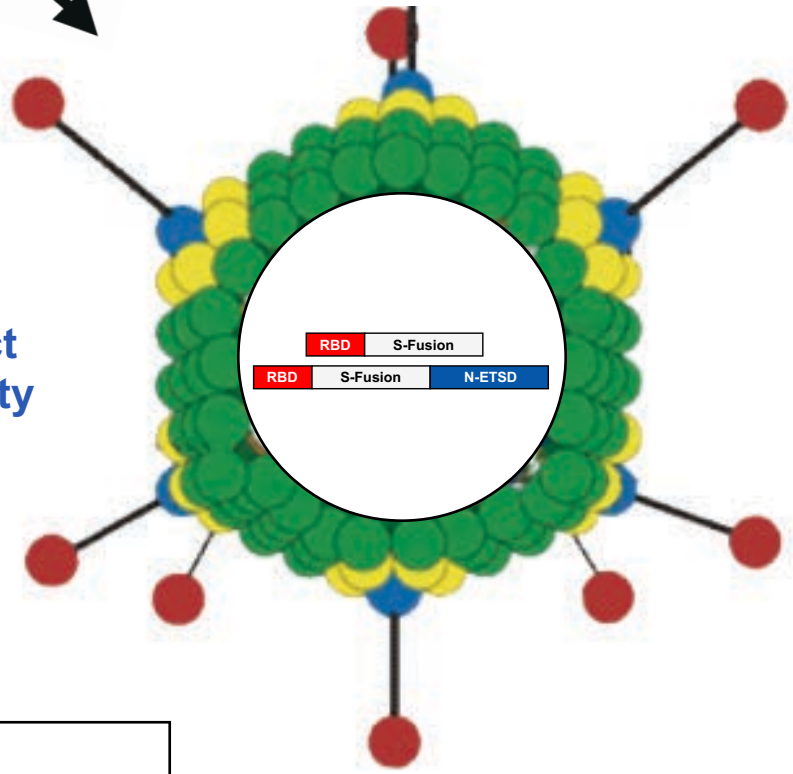




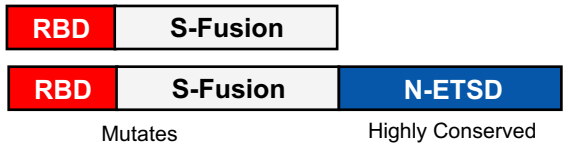
Identification of Key Constructs

Unique Vector + Unique Construct To Achieve Long Duration Immunity

2nd Generation
Human Adenovirus
hAd5



2nd Generation Human Adenovirus (hAd5) Vaccine Constructs

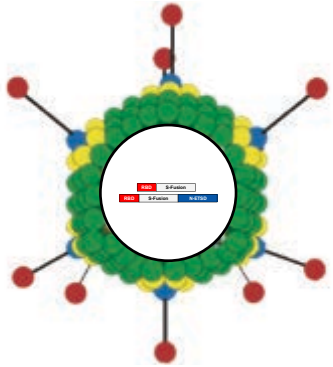


Maximizing B and T Cell Mediated Immunity to COVID-19 for Durable Immunity

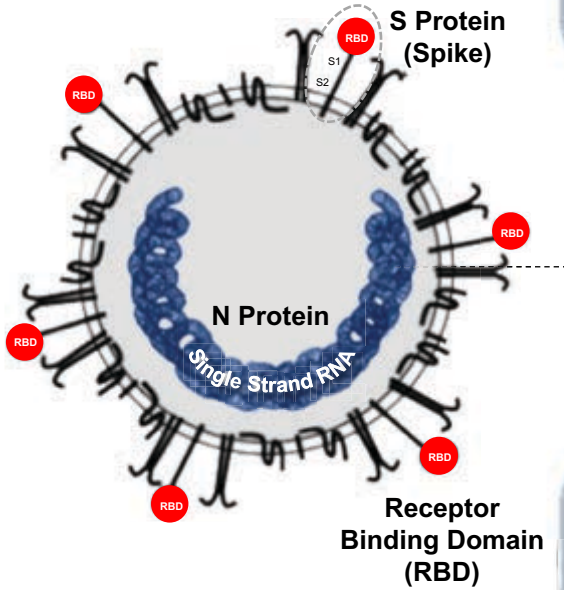
Pre-Clinical, Clinical and Manufacturing Development of COVID-19 Vaccine to Date:

- ☑ Demonstrated safety of 2nd generation human adenovirus in 13 Phase I/II trials in oncology (N = >125) with tumor associated cell mediated immunity in the presence of adenoviral immunity.
- ☑ Performed molecular dynamic modeling of trimeric spike (S) and receptor binding domain (RBD) to ACE2 receptor (>100 terabytes of data to date; 10 milliseconds)
- ☑ Identified and constructed COVID-19 sequences of proteins with maximal number of B and T cell epitopes: S, RBD, and N
- ☑ Demonstrated that Nucleocapsid (N) enhances protein expression and stimulates Th1 cell mediated cytokine responses in vaccinated mouse models
- ☑ Demonstrated that Wildtype-S is less immunogenic than S-Fusion + N-ETSD
- ☑ Demonstrated that the addition of N enhances antibody response to Wildtype S
- ☑ Developed novel intracellular trafficking construct for N to enhance T cell stimulation (N-ETSD)
- ☑ Developed novel optimized S protein (S-Fusion) to maximize RBD expression on transfected cell surface
- ☑ Confirmed proper protein folding of exposed RBD on transfected live cells using anti-COVID-19 antibodies from patient's serum recovered from COVID-19
- ☑ Demonstrated $CD4^+$ and CD8+ T cell mediated immunity (CMI) post vaccination in BALB/c mice with hAd5: S-Fusion + N-ETSD vaccine
- ☑ Demonstrated that antibodies and T cells from multiple patients recovered from COVID-19 infection recognize the vaccine antigens presented by the patient's dendritic cells following hAd5: S-Fusion + N-ETSD transduction
- ☑ Completed finished dosage form of hAd5: S-Fusion + N-ETSD and hAd5: S-Fusion
- ☑ Initiated GMP manufacture at large scale at-risk for hAd5: S-Fusion + N-ETSD and hAd5: S-Fusion
- ☑ Non-Human Primate (NHP) studies in progress with NIAID & BARDA
- ☑ IND filed: Phase 1b human trials anticipated July, 2020

2nd Generation Human Adenovirus hAd5

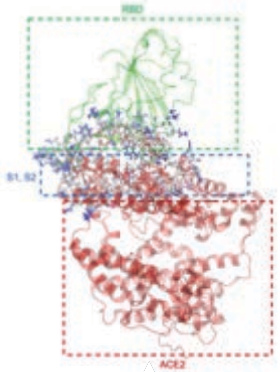


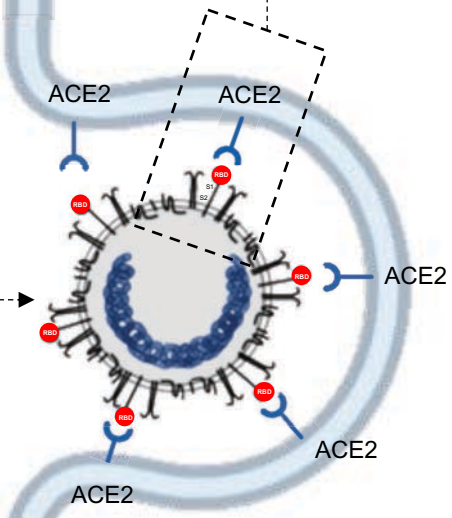
COVID-19 Proteins



COVID-19 Infection of Lung Cell

RBD to ACE2 Receptor





Key Findings to Date of 2nd Generation Human Adenovirus (hAd5) COVID-19 Vaccine:

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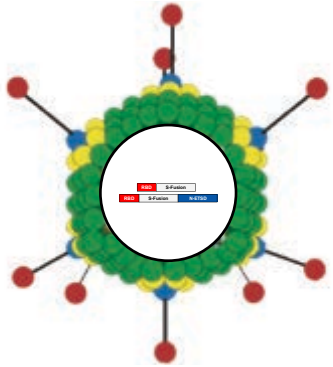
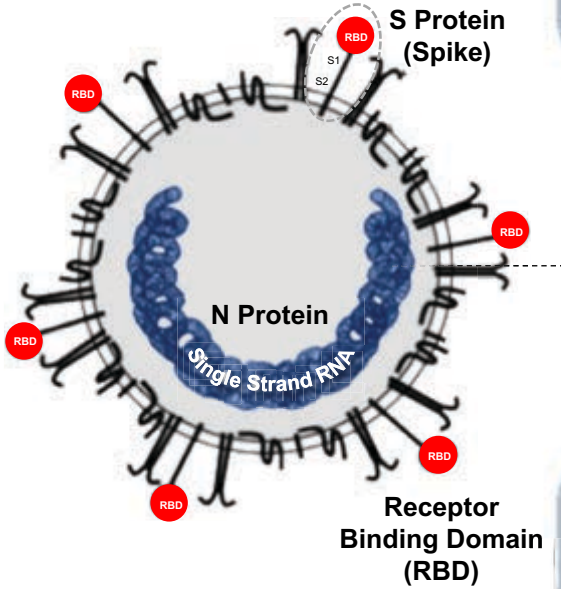
2nd Generation Human Adenovirus hAd5



COVID-19 Proteins



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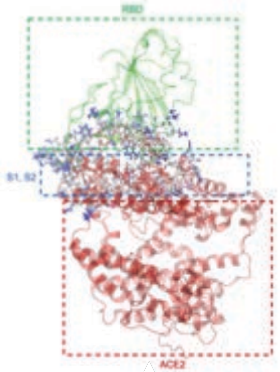

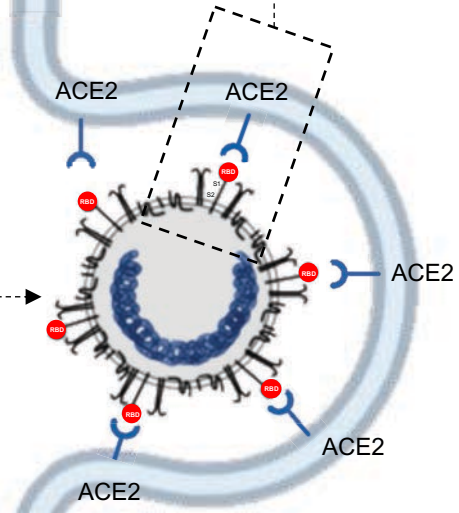

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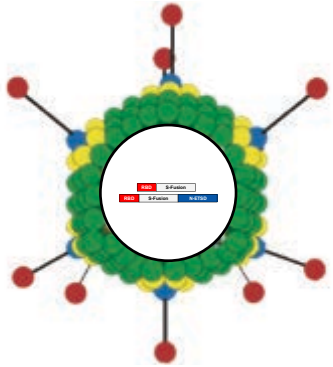

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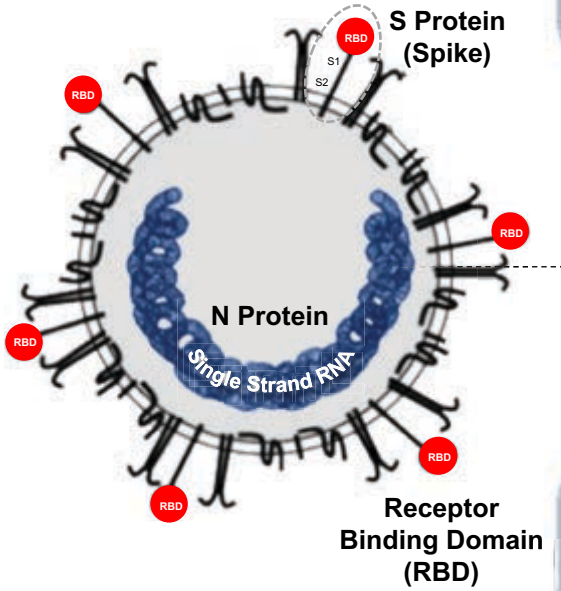

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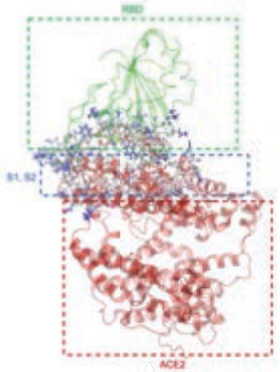
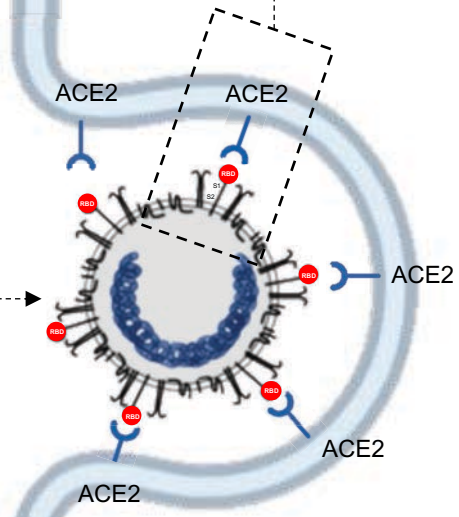
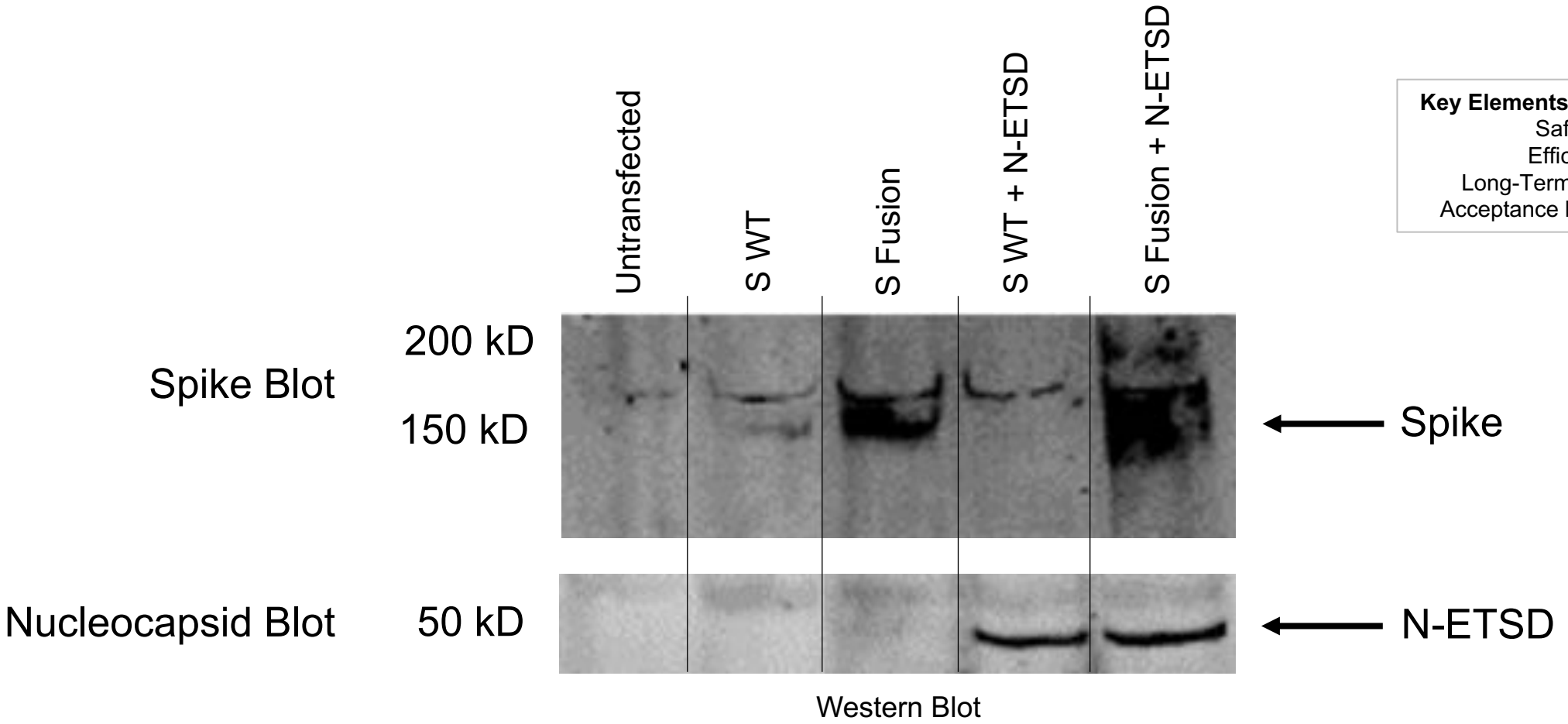




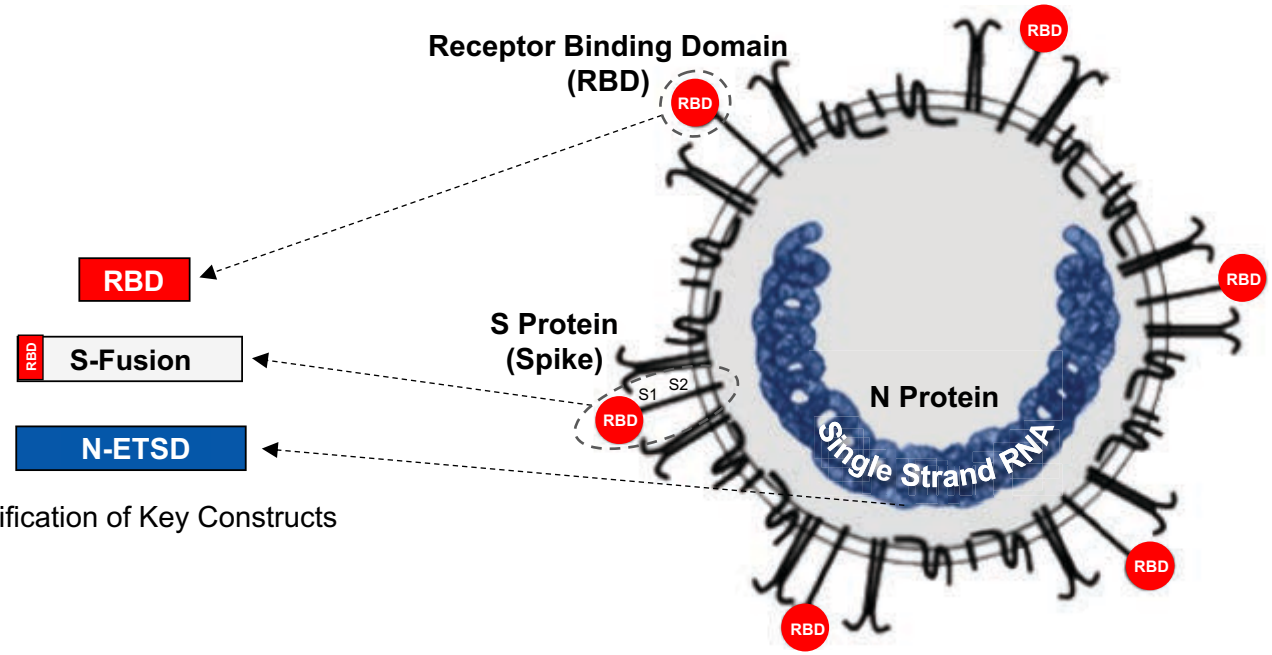
N Enhances Protein Expression When Combined with S Providing More Antigen Exposure for Longer Term Immunity



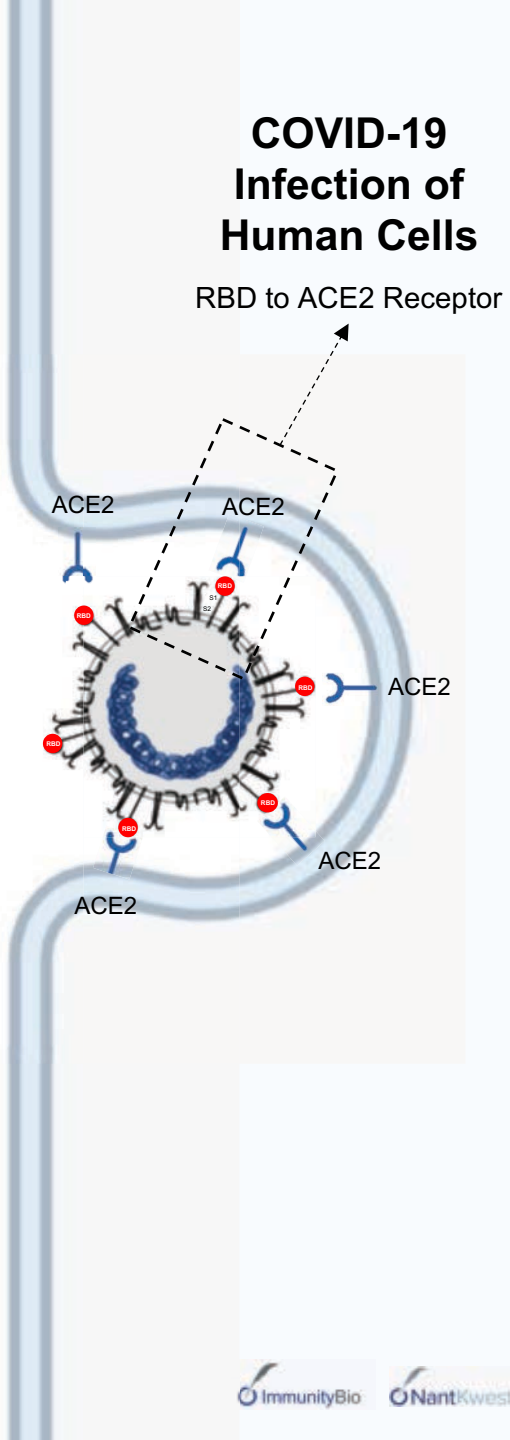
Key Elements of a Vaccine:
Safety
Efficacy
Long-Term Durability
Acceptance by the Public

ImmunityBio Internal Data – Unpublished

The Importance of RBD Expression for Generation of Neutralizing Antibodies

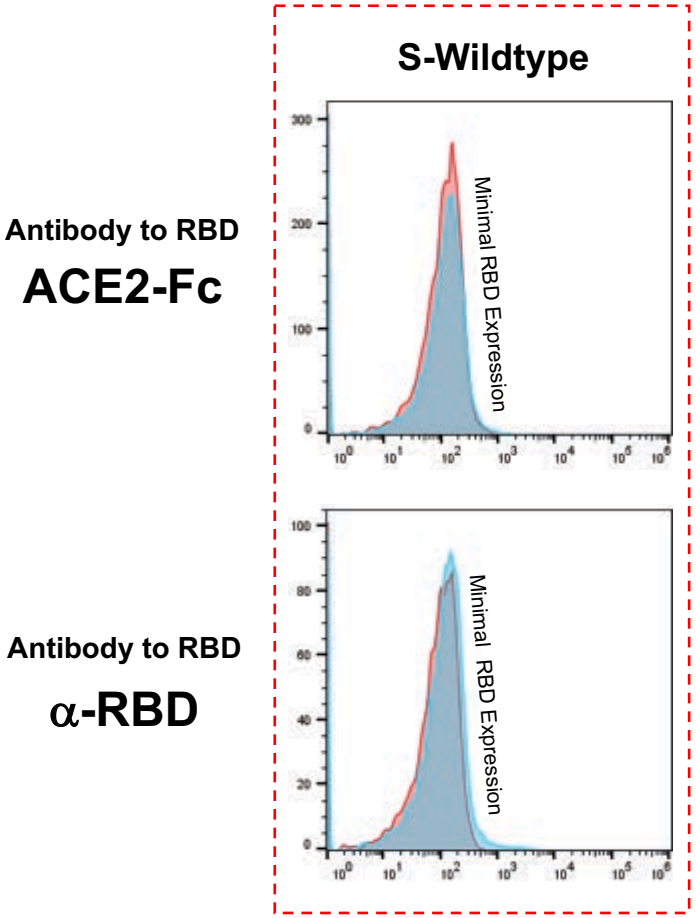


Identification of Key Constructs



2nd Generation Human Adenovirus (hAd5) Vaccine Constructs			
	RBD	S-Fusion	
	RBD	S-Fusion	N-ETSD

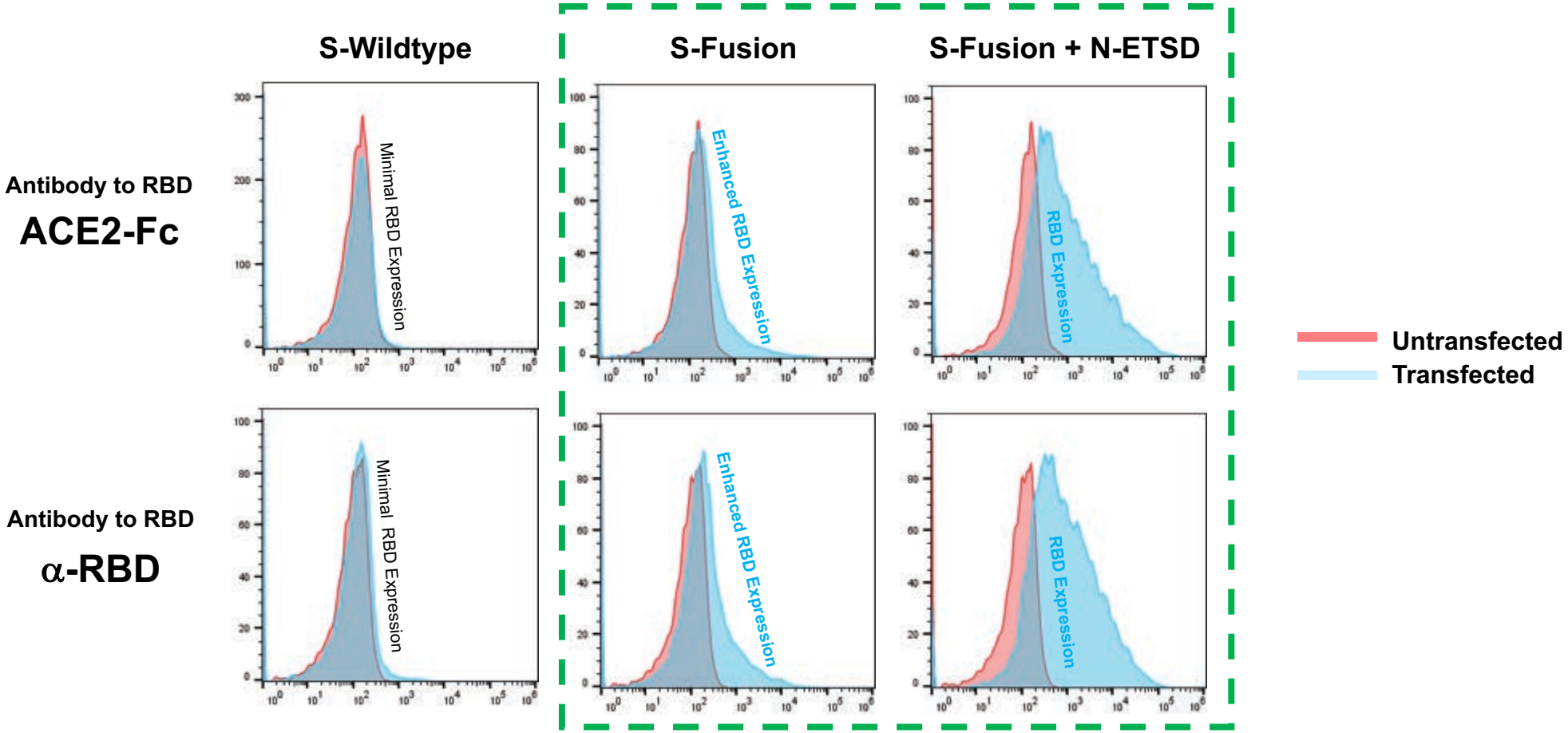
Wildtype Spike Alone is Insufficient for Cell Surface Expression of RBD With the Risk of Generating Short-Term Durability of Antibody Immunity



- Spike protein (Wildtype) alone results in minimal to no RBD expression on the surface of live cells following transfection
- RBD stable expression on the surface of live human cells is enhanced with a novel spike fusion (S) construct and by combining with nucleocapsid (N) protein

ImmunityBio Internal Data – Unpublished

N Enhances S-Fusion Expression of RBD on the Surface of Transfected 293 Cells Enhancing the Potential for Long-Term Durability of Immunity



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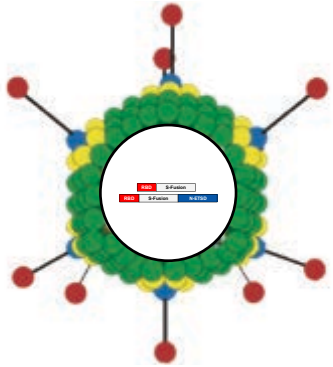
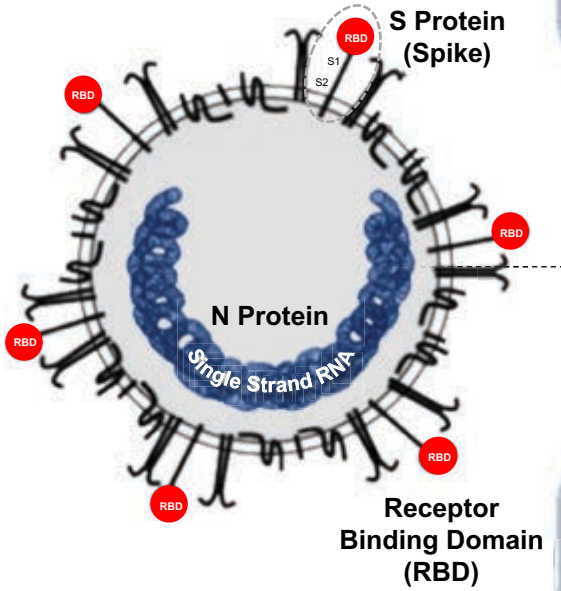
2nd Generation Human Adenovirus hAd5



COVID-19 Proteins



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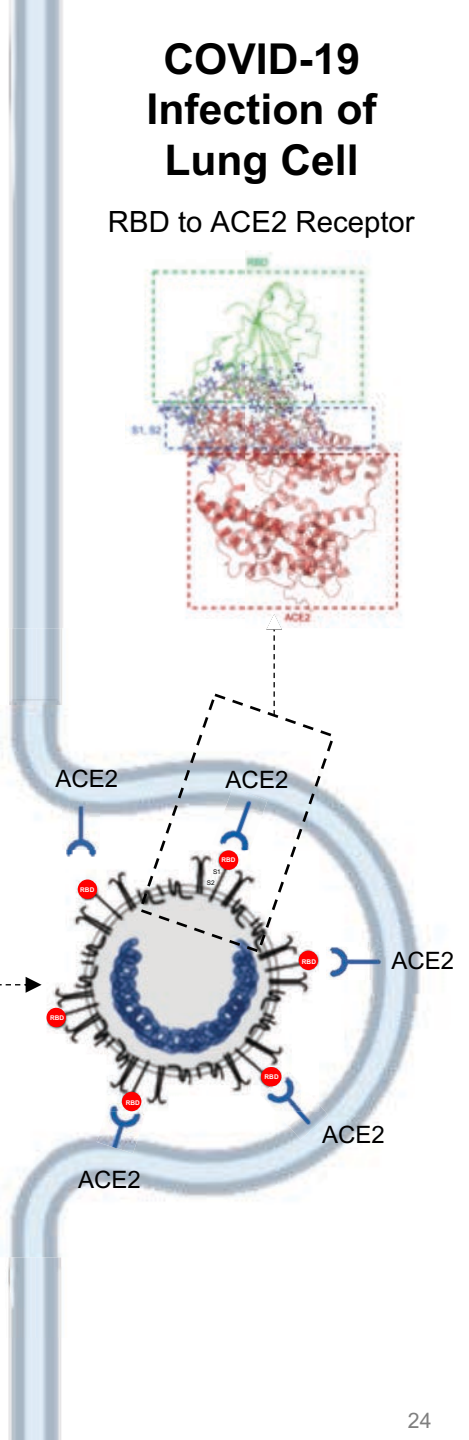

S & N Proteins Are the Targets for T Cell Responses to COVID-19 Providing the Best Potential for Long-Term Durable Immunity

CD4 & CD8 T Cells in Patients Recovered from COVID-19 Infection

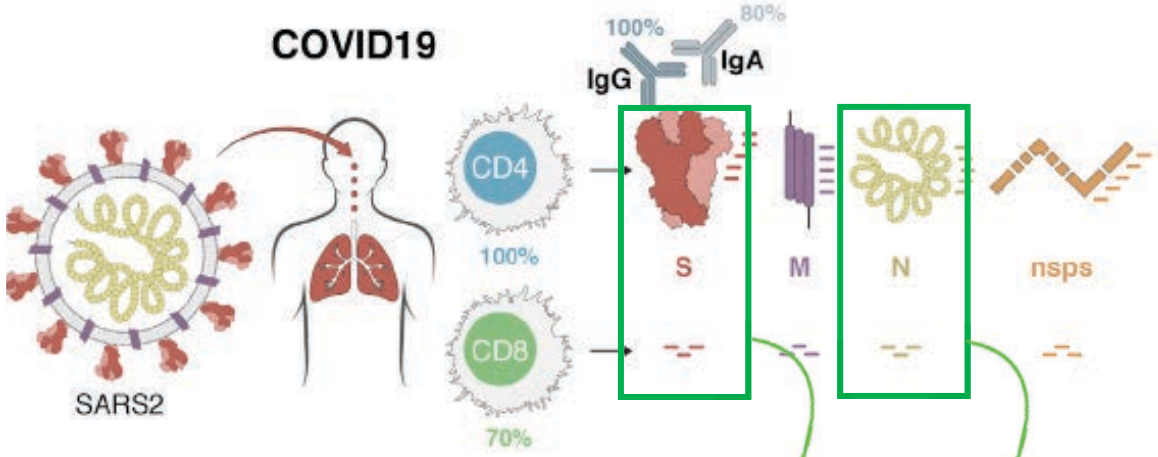

Table 3. IEDB Inventory of Coronavirus B and T Cell Epitopes

SARS-CoV Proteins	B Cell	T Cell
Spike glycoprotein	279	48
Nucleoprotein	113	33
Membrane protein	20	4
Replicase polyprotein 1ab	8	9
Protein 3a	2	7
Envelope small membrane protein	2	0
Non-structural protein 3b	2	0
Protein 7a	2	0
Protein 9b	2	0
Non-structural protein 6	1	0
Protein non-structural 8a	1	0

T cell epitope total includes epitopes recognized in humans and/or transgenic mice.

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Article

Targets of T Cell Responses to SARS-CoV-2 Coronavirus in Humans with COVID-19 Disease and Unexposed Individuals

Alba Grifoni,[1] Daniela Weiskopf,[1] Sydney I. Ramirez,[1,2] Jose Mateus,[1] Jennifer M. Dan,[1,2] Carolyn Rydyznski Moderbacher,[1] Stephen A. Rawlings,[2] Aaron Sutherland,[1] Lakshmanane Premkumar,[3] Ramesh S. Jadi,[3] Daniel Marrama,[1] Aravinda M. de Silva,[3] April Frazier,[1] Aaron F. Carlin,[2] Jason A. Greenbaum,[1] Bjoern Peters,[1,2] Florian Krammer,[4] Davey M. Smith,[2] Shane Crotty,[1,2,5,*] and Alessandro Sette[1,2,5,6,*]
[1]Center for Infectious Disease and Vaccine Research, La Jolla Institute for Immunology, La Jolla, CA 92037, USA
[2]Department of Medicine, Division of Infectious Diseases and Global Public Health, University of California, San Diego, La Jolla, CA 92037, USA
[3]Department of Microbiology and Immunology, University of North Carolina School of Medicine, Chapel Hill, NC 27599-7290, USA
[4]Department of Microbiology, Icahn School of Medicine at Mount Sinai, New York, NY, USA

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Theory

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A Sequence Homology and Bioinformatic Approach Can Predict Candidate Targets for Immune Responses to SARS-CoV-2

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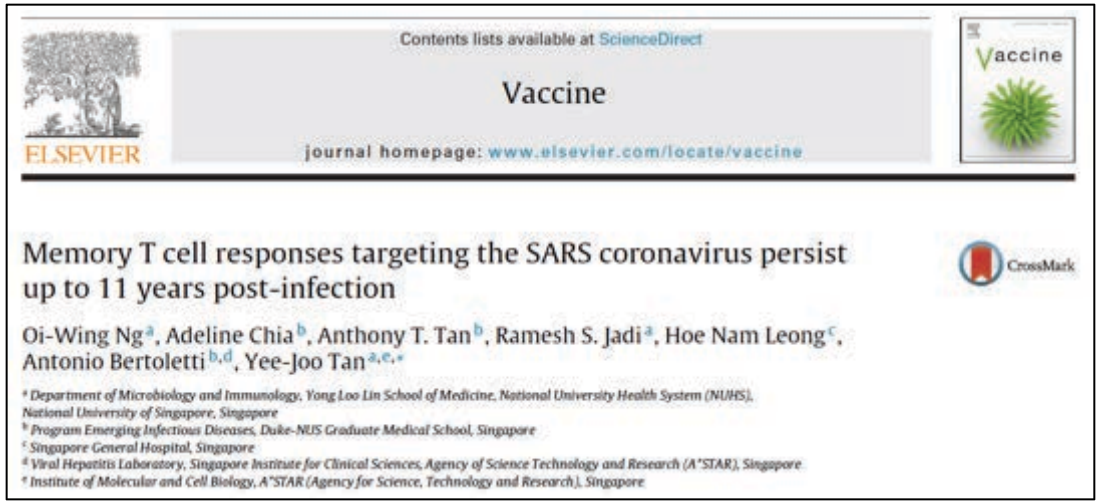
[1]Division of Vaccine Discovery, La Jolla Institute for Immunology, La Jolla, CA 92037, USA
[2]J. Craig Venter Institute, La Jolla, CA 92037, USA
[3]Department of Pathology, University of California, San Diego, San Diego, CA 92093, USA
[4]Department of Medicine, University of California, San Diego, San Diego, CA 92093, USA

Proof of Long-Term Memory T Cells (11 Years) From N Protein in SARS-CoV-1 Recovered Patients

Table 1
Summary of T cell responses in SARS-recovered subjects at 9 or 11 years post-infection, identified from screening by ELISpot and confirmation by ICS. Percentages of T cell responses represent that of $CD4^+$ or $CD8^+$ T cells over total T cell population after *in vitro* expansion in the presence of SARS peptide mixtures.

	HLA Class I		Years post-SARS infection	Peptide	Amino acid position	Type of T cell response	Percentages of T cell responses after *in vitro* expansion
SARS subject 1	A*2402	A*0206	9 years	S104	516–530	$CD4^+$	3.9%
	B*1502	B*1525		S109	541–555	$CD4^+$	3.1%
	C*0801	C*0403		N21	101–115	$CD4^+$	4.7%
				M29	141–155	$CD8^+$	1.0%
SARS subject 2	A*1101	A*3303	9 years	N21	101–115	$CD4^+$	0.2%
	B*5502	B*5801					
	C*0302	C*0303					
SARS subject 3	A*0201	A*1101	11 years	S217	1081–1095	$CD4^+$	0.3%
	B*1502	B*4001		M29	141–155	$CD8^+$	0.3%
	C*0801	C*1502					


Contents lists available at ScienceDirect
Vaccine
journal homepage: www.elsevier.com/locate/vaccine

Memory T cell responses targeting the SARS coronavirus persist up to 11 years post-infection

Oi-Wing Ng[a], Adeline Chia[b], Anthony T. Tan[b], Ramesh S. Jadi[a], Hoe Nam Leong[c], Antonio Bertoletti[b,d], Yee-Joo Tan[a,e,*]

[a] Department of Microbiology and Immunology, Yong Loo Lin School of Medicine, National University Health System (NUHS), National University of Singapore, Singapore
[b] Program Emerging Infectious Diseases, Duke-NUS Graduate Medical School, Singapore
[c] Singapore General Hospital, Singapore
[d] Viral Hepatitis Laboratory, Singapore Institute for Clinical Sciences, Agency of Science Technology and Research (A*STAR), Singapore
[e] Institute of Molecular and Cell Biology, A*STAR (Agency for Science, Technology and Research), Singapore

Further Proof of Long-Term Memory T Cells (17 Years) From N Protein in SARS-CoV-1 Recovered Patients

24 out of 24 (100%) of Patients Previously Infected with SARS-CoV-1 (2003) Develop Long-Term T Cell Memory to N protein

Different pattern of pre-existing SARS-COV-2 specific T cell immunity in SARS-recovered and uninfected individuals

Nina Le Bert, Anthony T Tan, Kamini Kunasegaran, Christine Y L Tham, Morteza Hafezi, Adeline Chia, Melissa Chng, Meiyin Lin, Nicole Tan, Martin Linster, Wan Ni Chia, Mark I-Cheng Chen, Lin-Fa Wang, Eng Eong Ooi, Shirin Kalimuddin, Paul Anantharajal Tambyah, Jenny Guek-Hong Low, Yee-Joo Tan, Antonio Bertoletti

doi: https://doi.org/10.1101/2020.05.26.115832 Pre-Print

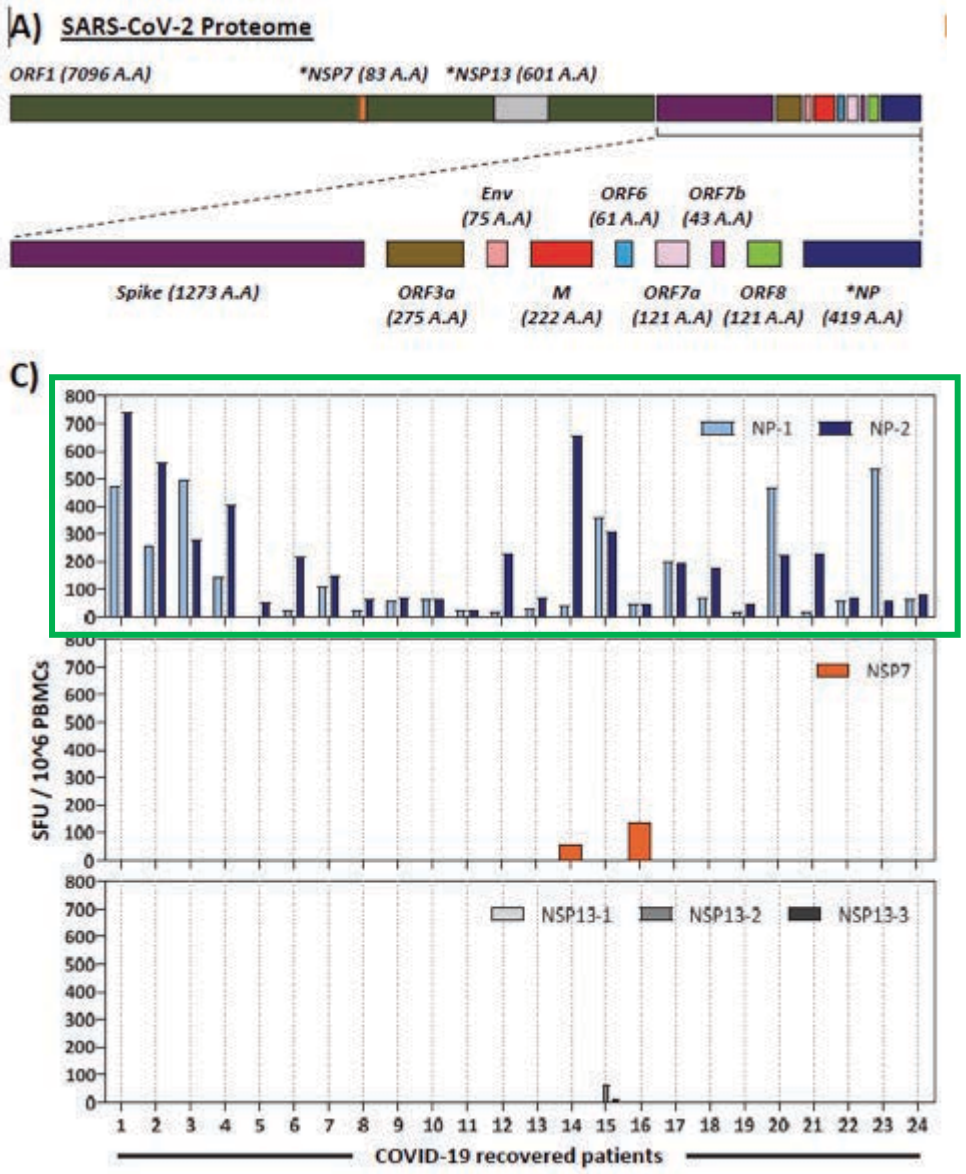


Fig 1: SARS-CoV-2-specific T cells in recovered COVID-19 patients

A: SARS-CoV-2 proteome organization; analyzed proteins are marked by *.

C: Composition of the SARS-CoV-2-specific T cell repertoire is shown as percentage of SARS-CoV-2-specific T cells reacting to NP (NP-1 = light blue; NP2 = dark blue), NSP7 (orange) and NSP13 (grey) for the individual recovered COVID-19 patients tested.

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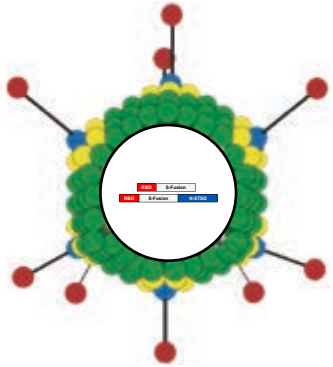

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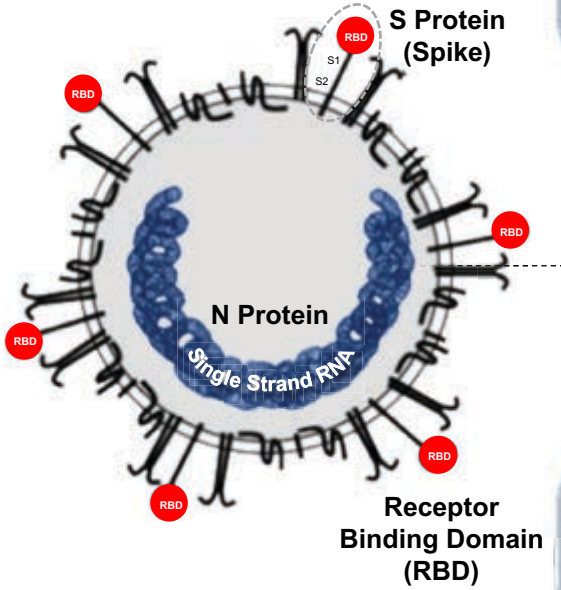

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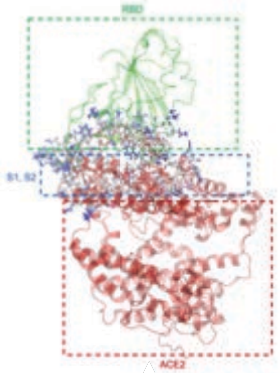
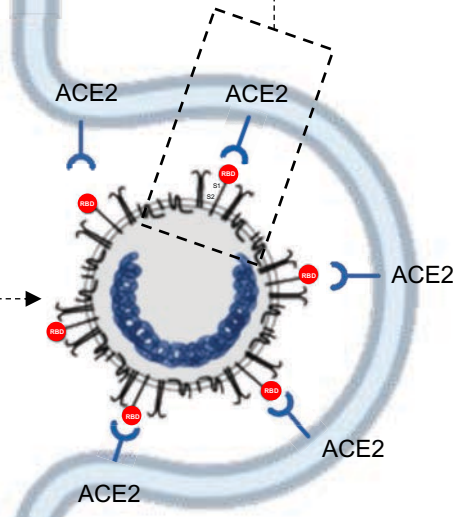
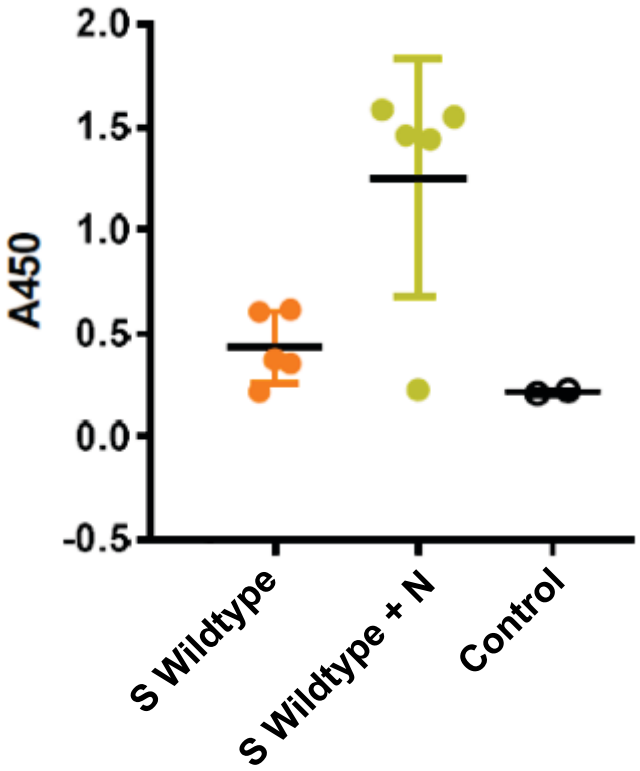


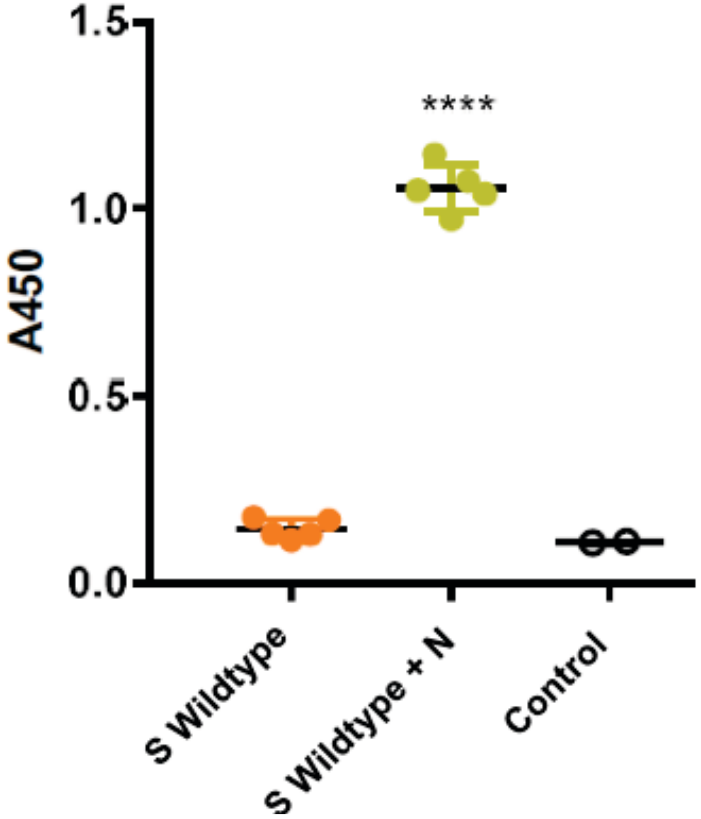


N Protein Enhances Antibody Response to Wildtype S in Immunized BALB/c Mice Utilizing Recombinant Yeast as a Vaccine

IgG Recognizing Active Trimeric S



IgG Recognizing N



Prime Day 1, Boost on Day 25, blood extracted on Day 35

ImmunityBio Internal Data – Unpublished

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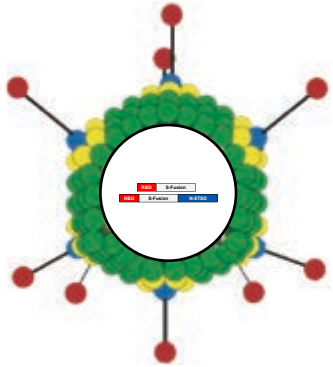

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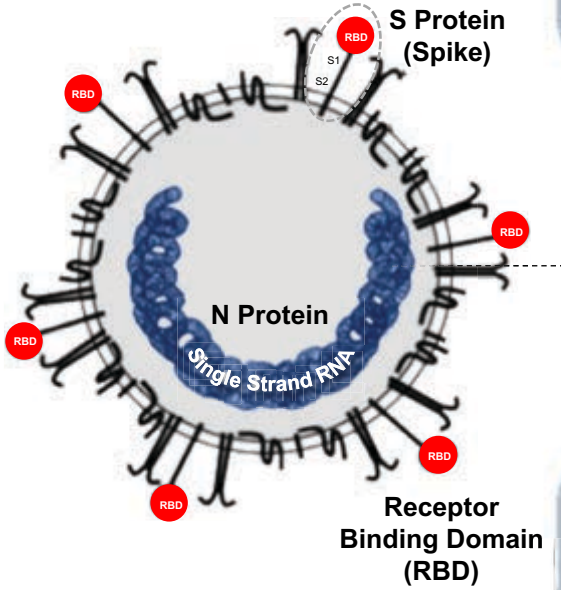

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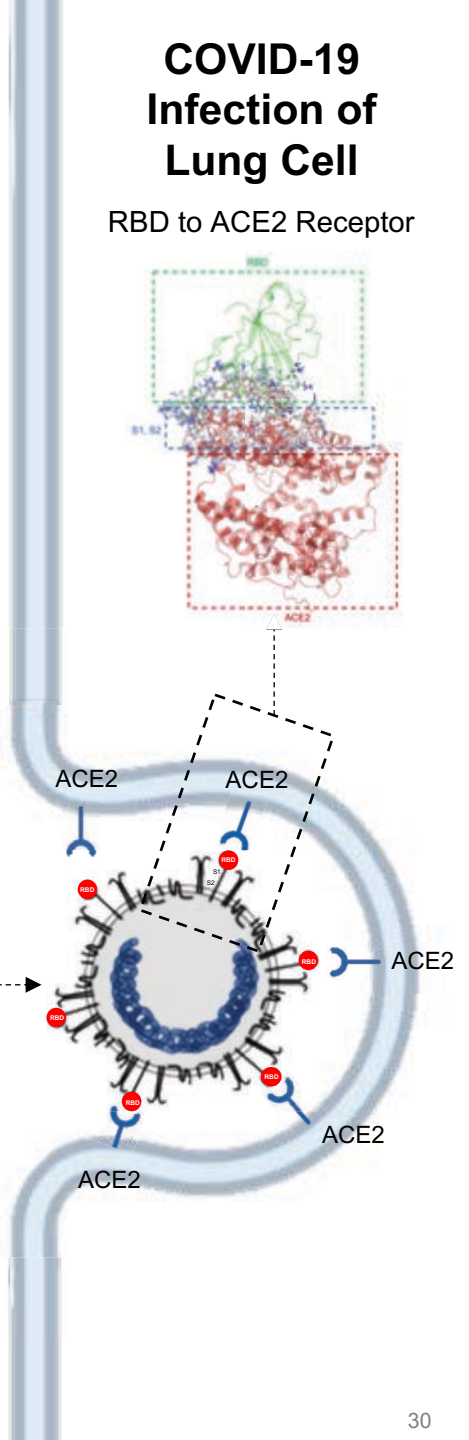
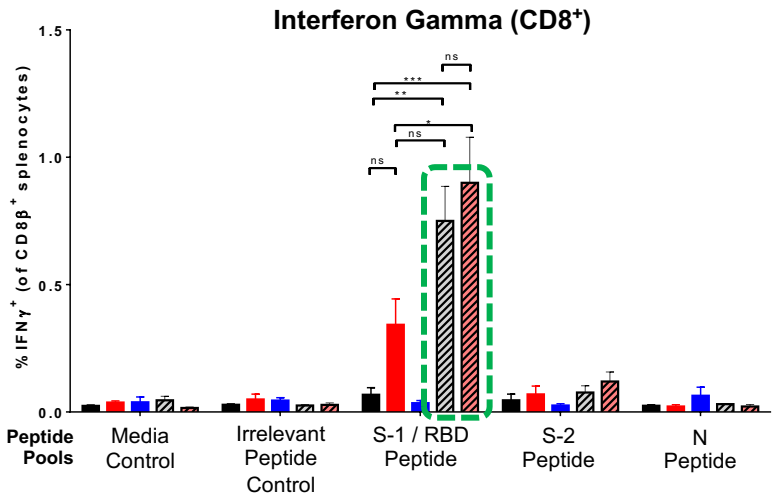
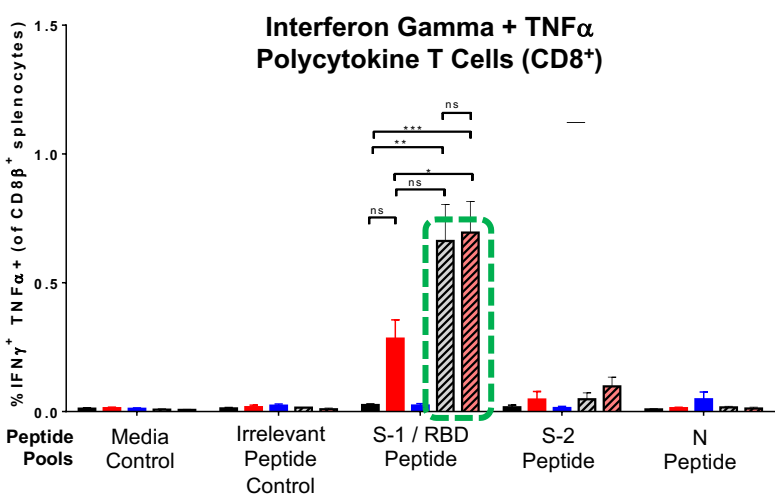


N Protein Induces Cell Mediated Immunity (14-Days Post Vaccination) Providing Evidence for the Potential of Durable Immune Response to Ad5 S + N

CD8+ Activation



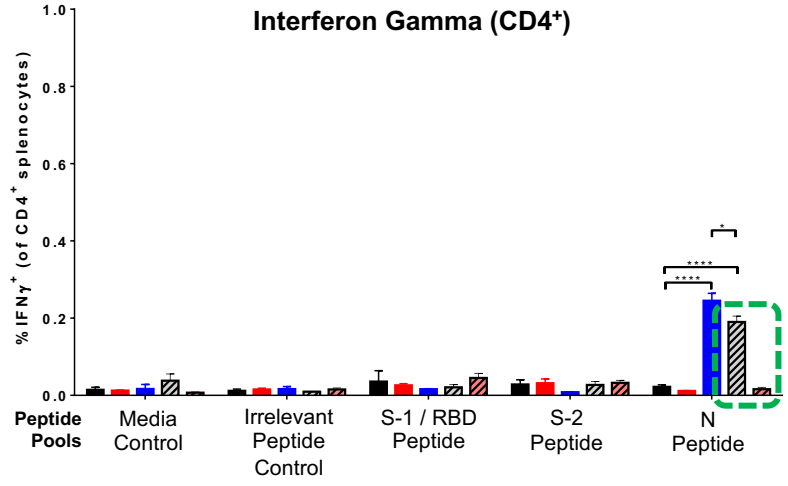


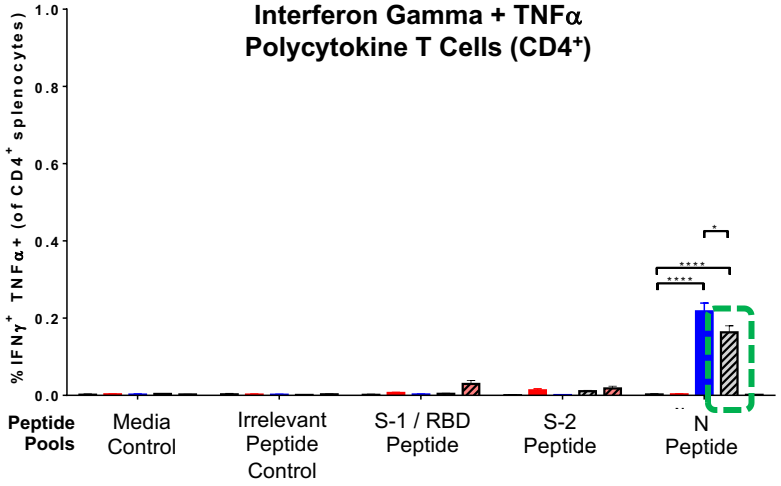
BALB/c mice

hAd5 COVID-19 Vaccines

- hAd5-Null
- hAd5-S Wildtype
- hAd5-N-ETSD
- hAd5-S-Fusion / N-ETSD
- hAd5-S-Fusion

CD4+ Activation





ImmunityBio Internal Data – Unpublished

Key Findings to Date of 2nd Generation Human Adenovirus (hAd5) COVID-19 Vaccine:

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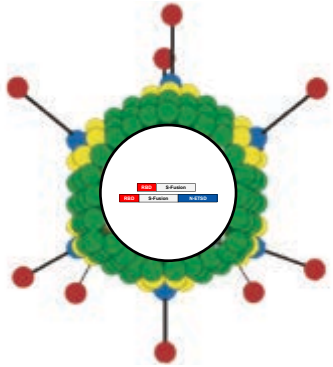
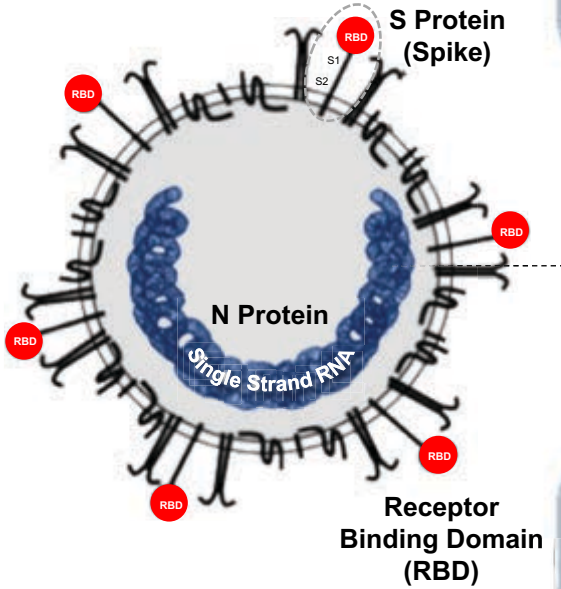
- hAd5: S-Fusion + N-ETSD vaccine potentially maximizes epitope presentation for long-term humoral and Th1 cell mediated immunity

2nd Generation Human Adenovirus hAd5

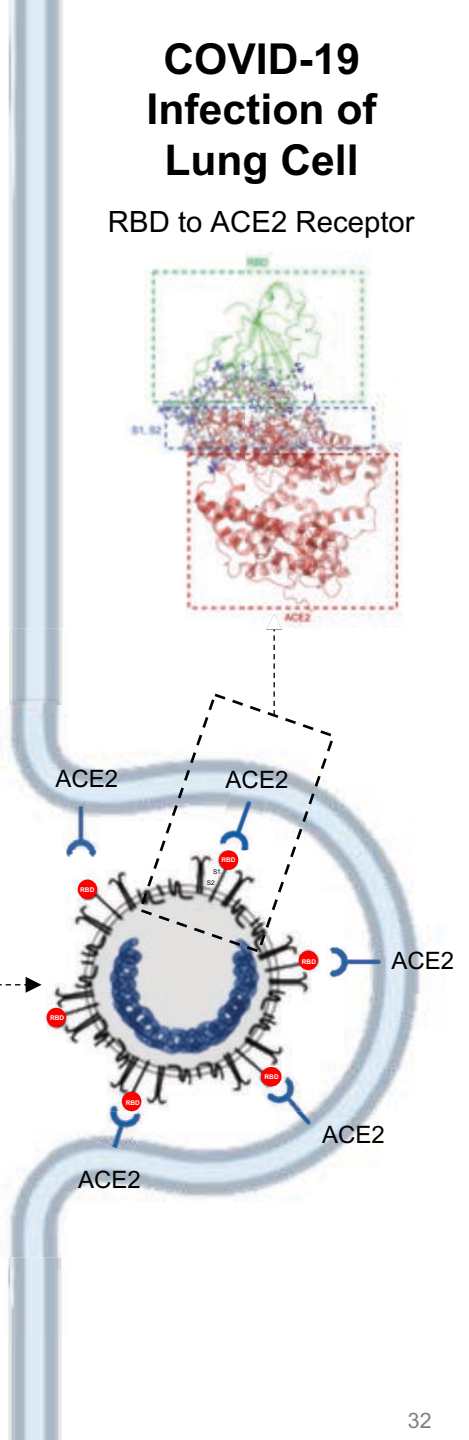


COVID-19 Proteins

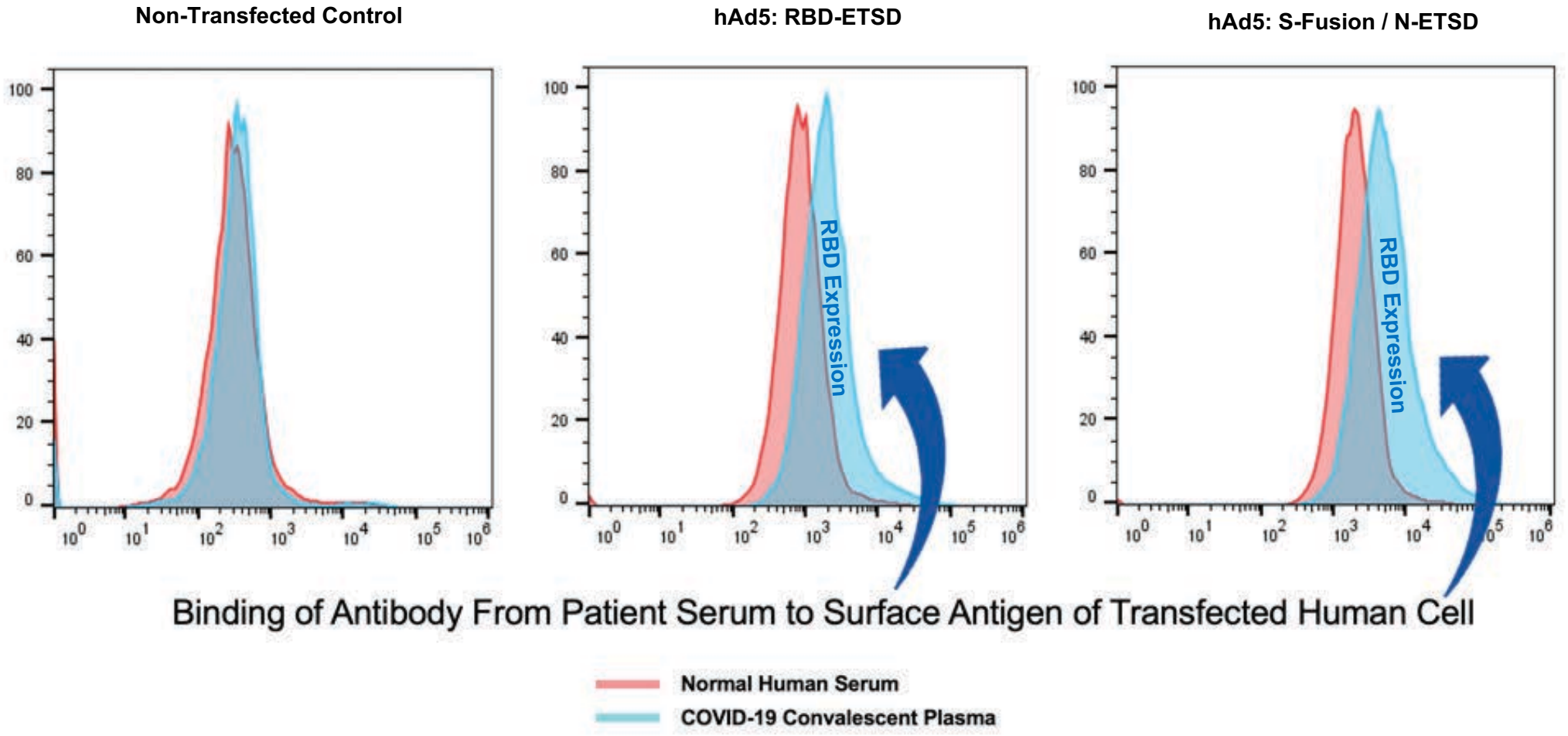


COVID-19 Infection of Lung Cell

RBD to ACE2 Receptor

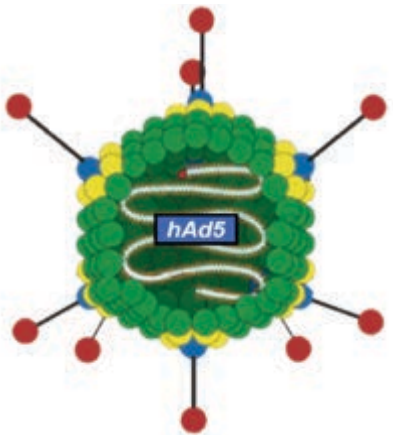


Antibodies From Recovered COVID-19 Patient Plasma Recognizes Antigens Expressed by hAd5: RBD-ETSD and hAd5: S-Fusion / N-ETSD Vaccines Transfected in HEK 293 Cells Demonstrating Effective RBD Protein Expression When N is Combined with S for Neutralizing Antibody Generation



ImmunityBio Internal Data – Unpublished

Cell Mediated Immunity Demonstrated with T Cells From Patients Recovered From COVID-19 Infection
Effective T Cell Recognition of Proteins Expressed By hAd5: S-Fusion + N-ETSD Vaccine to Induce Long-Term Immunity



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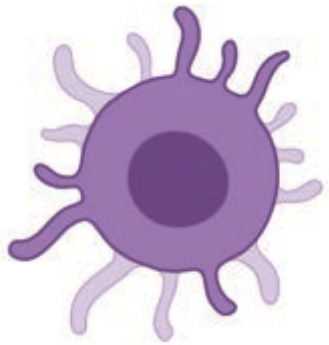

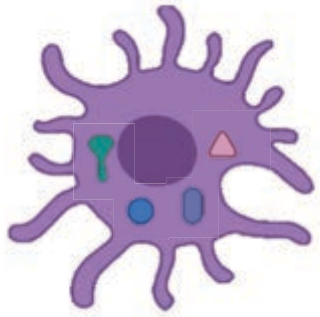

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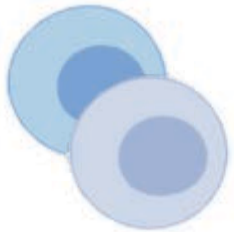

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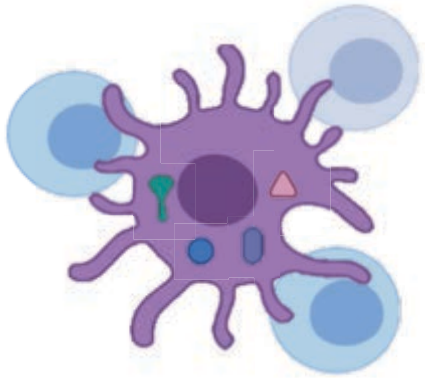


2nd Gen Human Adenovirus Expressing (hAd5):

1. GFP/null
2. S-WT
3. S-GS
4. S-GS/N-ETSD
5. N-ETSD

Dendritic Cells

Patient's Monocyte-Derived Dendritic Cells From Patient's Recovered After COVID-19 Infection

Transfected Dendritic Cells

Patient's Dendritic Cell Transfected with hAd5 #1-5 Expressing Proteins S-WT, S-GS, S-GS/N-ETSD, & N-ETSD

$CD4^+$ & $CD8^+$ T Cells

Patient's T Cells From Same Patients Recovered After COVID-19 Infection

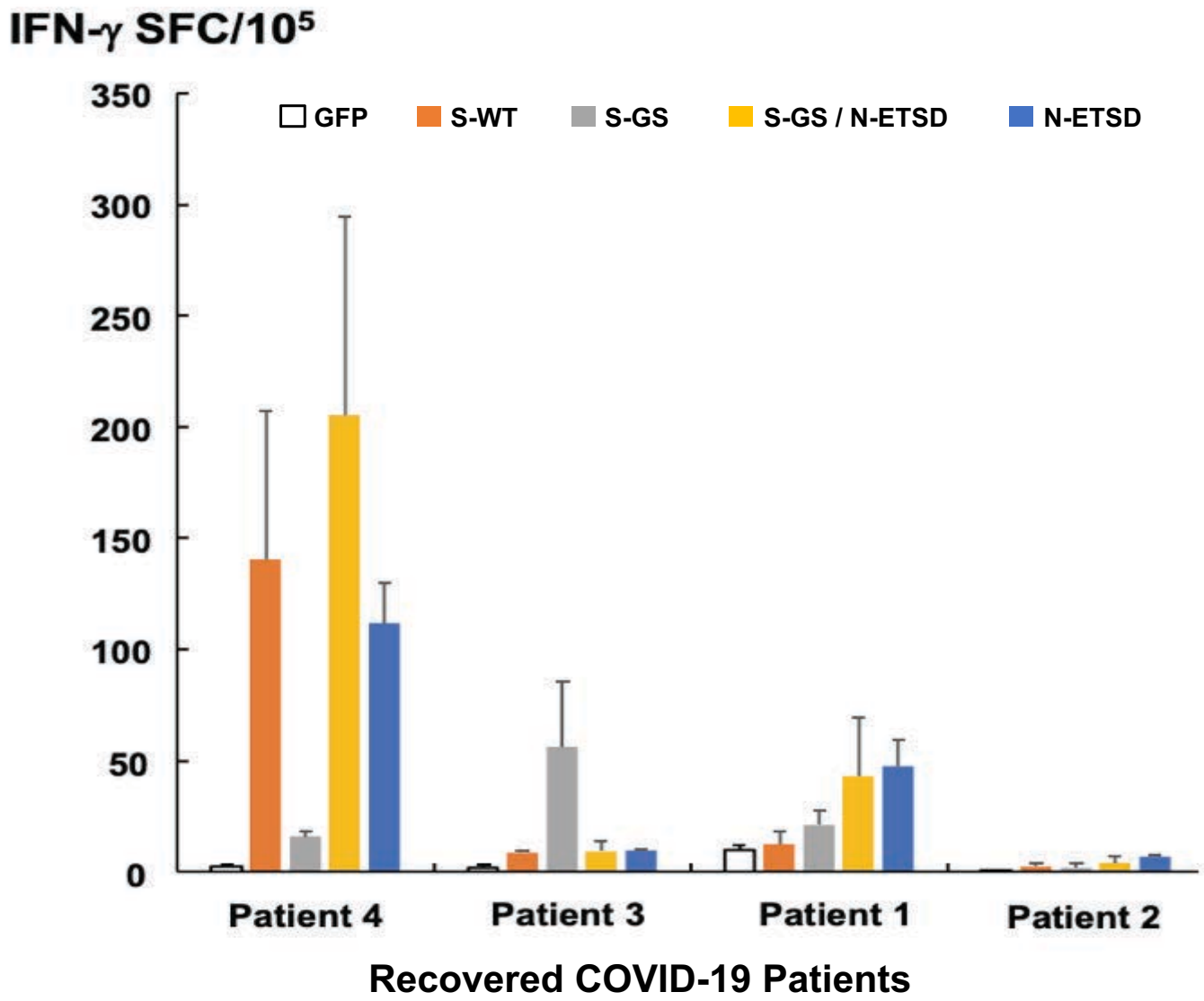
Readout: T Cell Production of IFN-γ

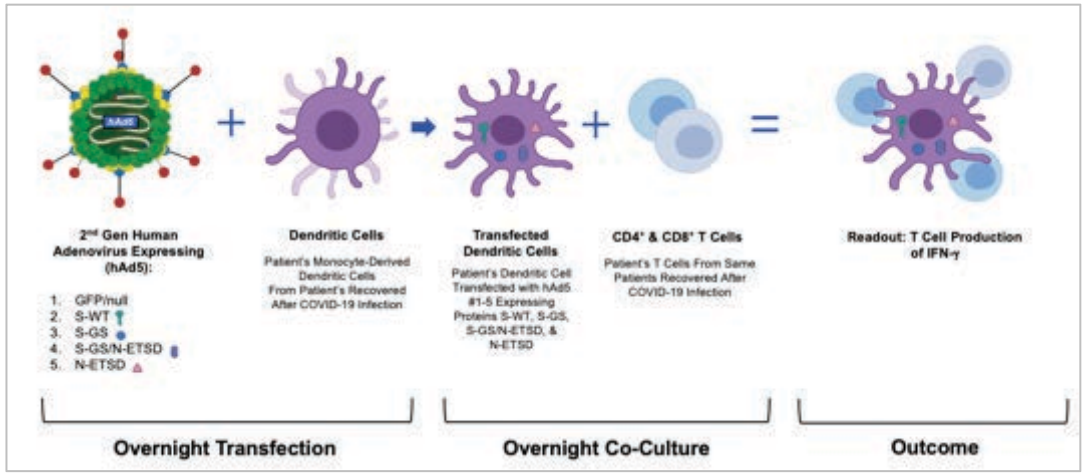
Overnight Transfection

Overnight Co-Culture

Outcome

Cell Mediated Immunity Demonstrated with T Cells From Patients Recovered From COVID-19 Infection Effective T Cell Recognition of Proteins Expressed By hAd5: S-Fusion + N-ETSD Vaccine to Induce Long-Term Immunity





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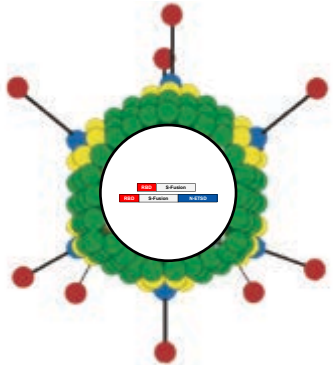
2nd Generation Human Adenovirus hAd5



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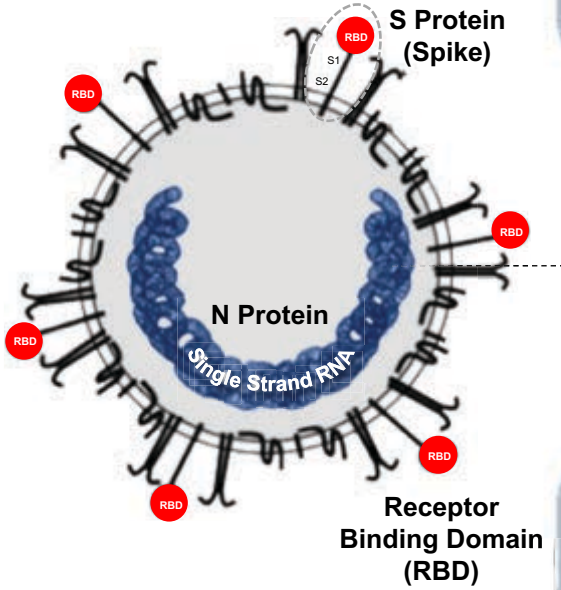

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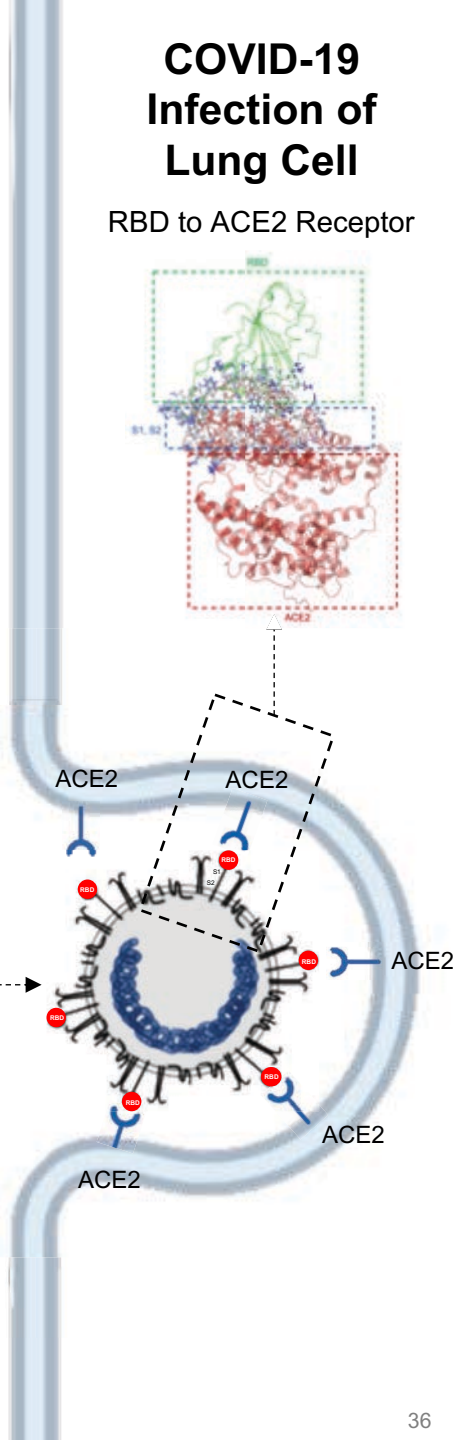
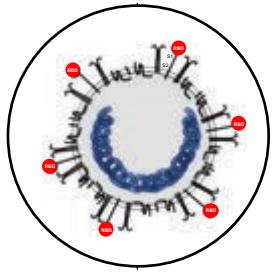


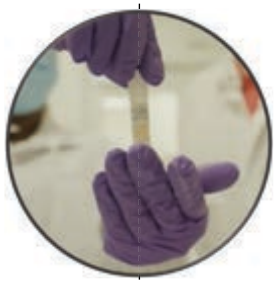
COVID-19 Vaccine Timeline

Accelerating R&D and Manufacturing in Parallel to Achieve >1 Billion Doses

Select Candidate → R&D, Scale-Up Manufacturing, Clinical Trials → Vaccine Available



January 2020
SARS-CoV-2 Sequence Shared



March 2020
Selection & Construction of Lead Vaccine Construct

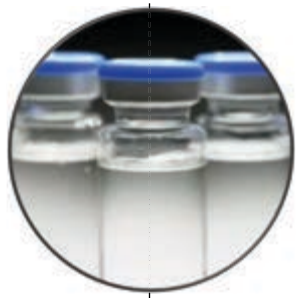
May 2020
Submission of IND Manufacturing Scale-Up Begins

July 2020
Anticipated FIH Study Phase Ib

August 2020
Anticipated Phase II

September 2020
Two (2) Drug Substance Adenovirus Plants Fully Active

January 2021
Anticipated Phase III



January – December 2021
On the Path to >1 Billion Doses

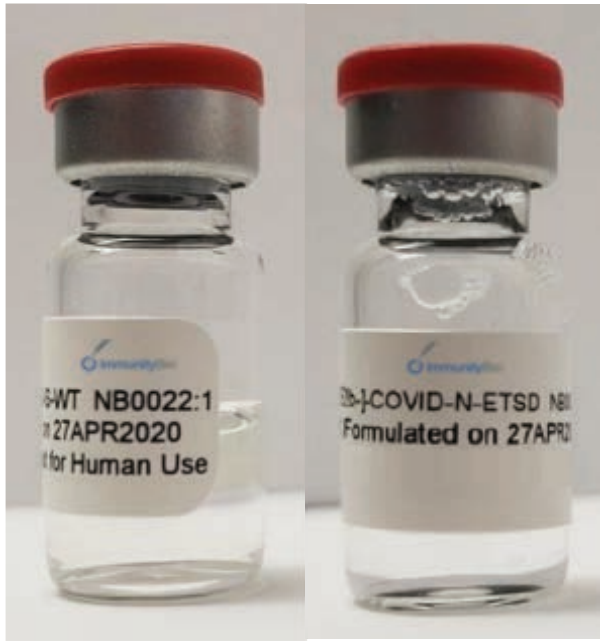
1st Human Adenovirus Construct with S Fusion + Nucleocapsid (N)

2nd Generation Human Adenovirus (hAd5) Vaccine Construct

NantKwest & ImmunityBio Manufacturing, Development and Marketing Partnership

2nd Gen hAd5 Adenovirus Vaccine Program

T Cell Mediated Immunity
Humoral Immunity



Key Elements of a Vaccine

- Safety
- Efficacy
- Long-Term Durability
- Universal for all SARS-CoV
  - Spike Mutates
  - N is Highly Conserved
- Acceptance by the Public