



Using the Danish National Biobank infrastructure as a platform to develop mass testing of COVID-19 in the population.

Karina Meden Sørensen

Nordic Biobank Conference 2022

# Conflict of interest

No Disclosures

# Karina Meden Sørensen

- Section Leader Danish National Biobank, Biochemist, Ph.D. i Molecular Genetics
- Employed in the Danish National Biobank (DNB) in 2010 with the task to build the laboratory and storage facilities and to form a laboratory group.
- Managing a laboratory of:
  - 27 laboratory technicians, project leaders, academics and student workers
  - 2 automated storage facilities
  - 180 manual freezers, and 3 walk-in-freezers
  - 21 nitrogen tanks
  - 10 liquid handlers



# Outline

- Danish National Biobank (DNB) introduction
- It all began March 25th 2020
- Plan, develop, build, go live
- Outcomes



# Danish National Biobank

STATENS  
SERUM  
INSTITUT



DANMARKS  
NATIONALE  
BIOBANK

NORDIC **Biobank  
Conference**

Automated storage



Manual storage



Total storage  
capacity: >15M

High throughput automation



High throughput analyses



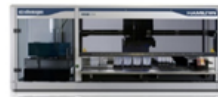
# Danish National Biobank

STATENS  
SERUM  
INSTITUT



DANMARKS  
NATIONALE  
BIOBANK

NORDIC  
**Biobank  
Conference**



DNA extraction  
1200 samples/day  
One step conc./normalisation

## Genetic analysis

- NGS-500 sequencing
- Array genotyping
- Targeted sequencing
- Mutation analysis
- Methylation
- mRNA microRNA profiling



## Metabolomics and proteomics

- Explorative and focused using mass spec.
- LC-tandem mas spec. for small analytes
- MALDI-TOF mass spec.



## Immunoassays

- Autoimmune disease diagnostics and development
- Biacore interaction analysis
- Antibody development
- Protein purification, characterization, conjugation
- MesoScale platform 10 analytes/run
- Luminex platform 30-50 analytes/run





## DNB contains 14 mio biological samples

Sample type	Samples	Individuals
Serum	3,317,536	951,521
Dried blood spot samples	2,565,821	2,091,587
Plasma	1,488,350	442,752
Whole blood	830,524	320,872
DNA	678,237	451,455
Buffy coat	346,033	126,527
Urine	320,456	126,054
Saliva	90,407	42,554
Red blood cells	85,349	41,738
Amniotic fluid	66,407	56,505
Cord blood mononuclear cells	65,032	65,032
Proteins extracted from DBSS	39,168	38,979
Spinal fluid	28,596	16,498
Other (PBMS, feces, stem cells, biopsies, etc.)	83,430	49,040

### COVID-19 samples (2020-):

#### Total samples

Throat swab 4.300.000

Blood samples 33.000

#### COVID-19 (+)

3.200.000

2.900

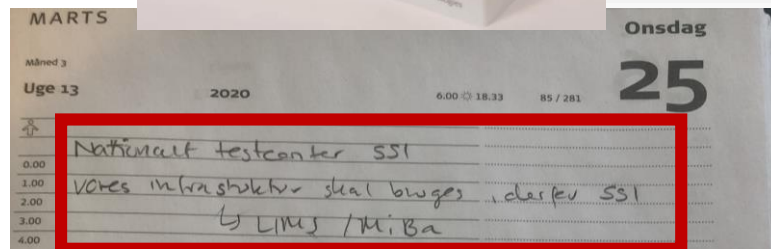
## The biobank proved great societal value serving as a platform for the Danish COVID PCR testing facility

❖ March 25th 2020:

- Brainstorm meeting key personnel SSI
- Task: establish national COVID19 testing infrastructure
- Requires manual handling  
Not scalable
- up to 10,000 analyzed lab tests / day (PCR)
- Up to 5.000 analyzed blood samples / day (Serology)
- Deadline: late April 2020



Decision Use biobank common format





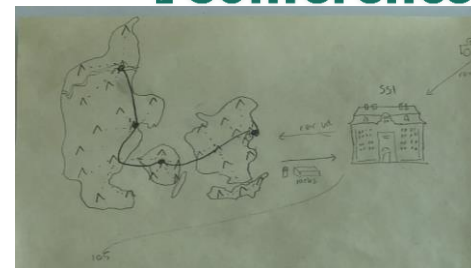
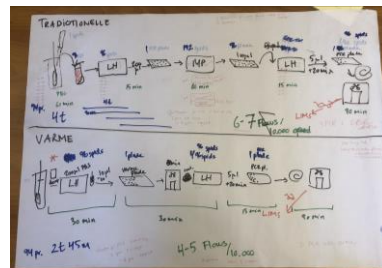


# Planning phase

## Working groups

- Needs analysis on personnel resources and equipment
- Method development (Plate preparation and RNA extraction)
- IT infrastructure
- Logistics
- Consumables

## Joint status meetings every morning



Plan og flow for hver af nedstående "bobler" skal udarbejdes. Denne skal indeholde apparatur, forbrugsvarer, personale m.m. Endvidere skal der udpeges en "bobleansvarlig" samt superbrugere for hver.

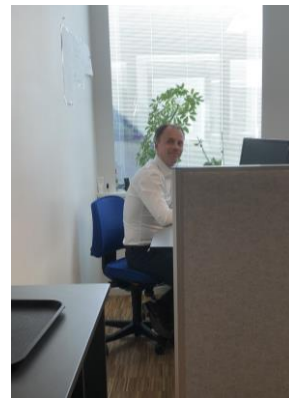
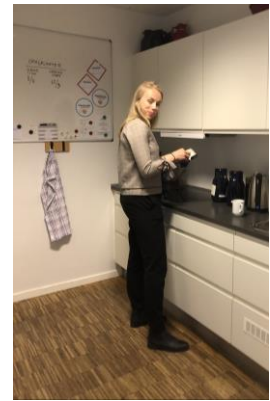
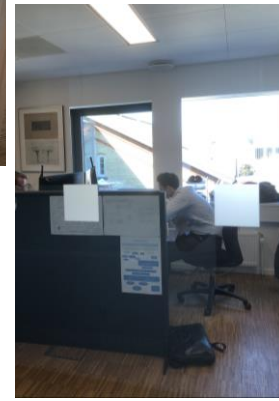
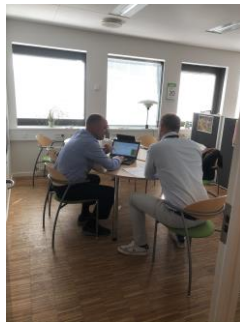
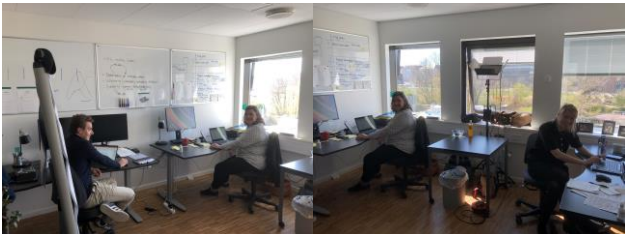
### Prøver:



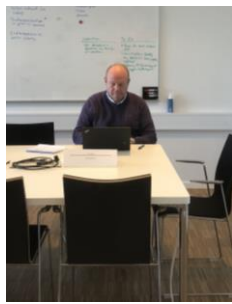
### PCR-test:



# Joining forces



**novo**  
**nordisk**  
**fonden**



**McKinsey**  
**& Company**

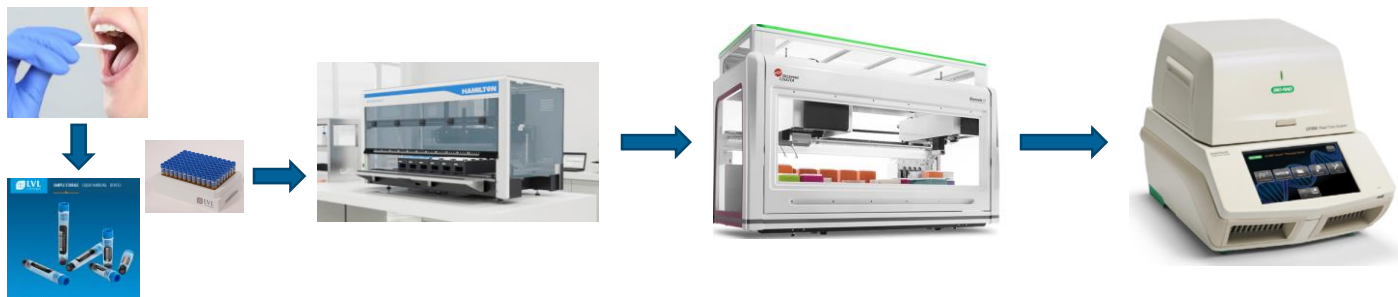



**DANISH MINISTRY OF DEFENCE**  
 ACQUISITION AND LOGISTICS ORGANISATION

SSI Virological Department



# Testcenter Denmark – IT system



To do: Urgently build an automated laboratory data flow  
Solution: Based on experiences from the automated solutions  
@ Danish National Biobank

## Testcenter Denmark – IT system

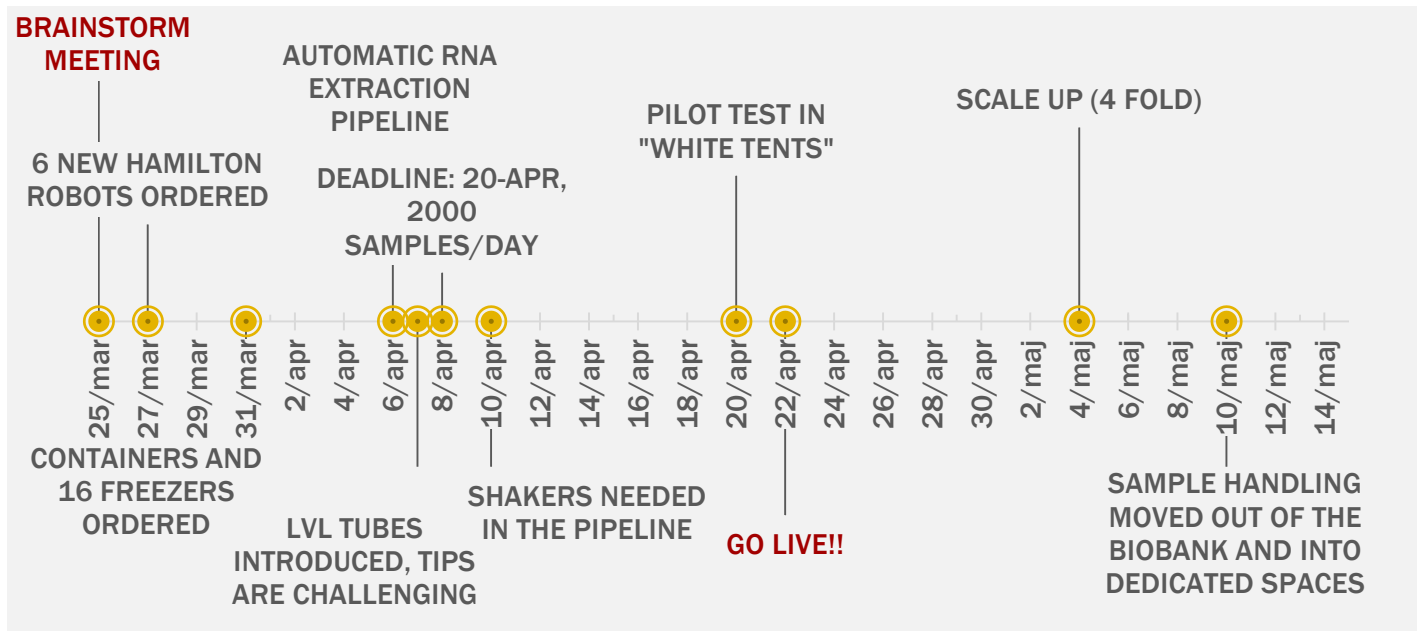
- **Automated data flow** / IT integration of liquid handlers both PCR and antibody analysis
- Double **backup of robot output files** and final test resultats
- Support of laboratory processes – eg. “**paperless log system**”
- **Integration** with biobank **LIMS** (Nautilus) for storage of Covid samples
- **App for picking** positive samples for sequencing
- Integrating **automated 4°C robot for picking** positive samples (throughput 50.000/day)
- **Internal reports** on daily results and statistics on Testcenter performance
- **External reports** to Steering Committee/Health Authorities/ National Operative Unit/ National Police



For more questions, contact Bart  
Wilkowski, DNB  
BAW@ssi.dk



## Timeline first 7 weeks – from DNB to TCDK





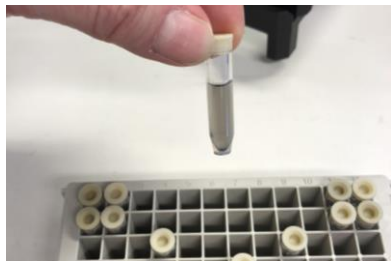
# Method development Sample preparation

Robot programming and testing

Many unknown factors, changing every 2<sup>nd</sup> hour

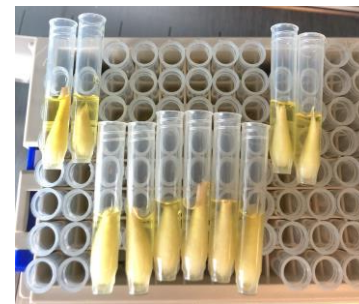
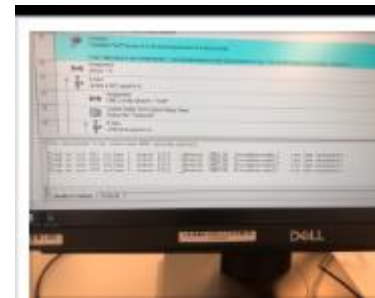
How to pipet around the swab

What volumes and how to mix



Testen opdeles i 4 spor

	Decap	500 µl PBS I hånden	Cappe	/Shake 700 rpm	Decap	Mixe robot	Over 20 µl til PCR	Robotprogram
A:	✓	✓	✓	10 min	✓	3x100ul	✓	Corona overførsel LH6 2.1B_KMS_bland.med 300 µl spids
B:	✓	✓	✓	10 min	✓	x	✓	Corona overførsel LH6 2.1B_KMS.med 50 µl spids
C:	✓	✓	✓	5 min	✓	3x100ul	✓	Corona overførsel LH6 2.1B_KMS_bland.med 300 µl spids
D:	✓	✓	✓	5 min	✓	x	✓	Corona overførsel LH6 2.1B_KMS.med 50 µl spids





Tests with virus and adjustment of speed, heights,  
liquid classes, sealing, swab types, controls



# Static electricity!



## Help from virus experts



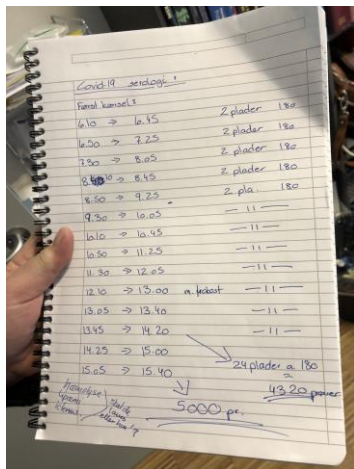
# Serology 5000 samples a day

3 new (old) Hamilton robots

1 automated decapped special build

Method programming Hamilton robots

Planning laboratory workflows and schedules





## Go live and hiring staff




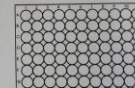
Logblad

05/05-20

1.   
 Label nr. 90015836

2.   
 Label nr. 90015833  
 (VL: 90015629 - (Bio) - KR8  
 (M) - Tabel)

3.   
 Label nr. 90015835

4.   
 Label nr. 90015834

K-RB Kontamineringsrisiko - Rør i bund  
 F-LP Fæl - Lang Rodepind  
 F-TB Fæl - Tom Bund  
 M-DW Manglende materiale - Deepwell  
 K-PS Kontamineringsrisiko - Rodepind Spids



## In parallel – Establishment of new laboratory facility

April 18



April 2nd



April  
8th



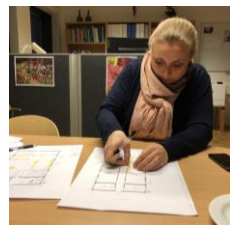
April  
9th



th



April 22nd – Well Done from  
Novo Nordisk Foundation

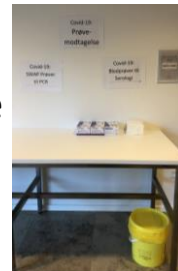


2.april,  
20:15

RNA extraction pipeline in production April 21st  
Hamilton robots for sample preparation delivered April 24th  
10. may, new lab spaces fully up and running  
Sample reception in biobank



Initial sample  
reception  
area in DNB





## Establishing storage capacity





## Moods from the hectic days



Energetic

Outstanding team effort

Frustration

Togetherness

We make a difference

Quick decisions

Hectic

Long hard days

Unrealistic deadlines and sample numbers

Inspiring

Unlimited economy

Challenging

Teamwork-common goal

Juggle hundreds of tasks

Highly political





## Outcomes of the pandemics

### EQUIPMENT

- 30 freezers with swabs and blood samples
- More Hamilton robots and decappers
- Automated +4° system picking >50.000 samples a day (later -20° storage and picking)
- Fully automated high-throughput laboratories 70+ liquid handlers ready for new tasks

## Outcomes of the pandemics

### PROJECTS

- ENFORCE
- Danish Covid Genetics Consortium



**ENFORCE**

Danish National Cohort Study of  
Effectiveness and Safety of  
SARS-CoV-2 vaccines

2 years, 7.000 participants, 5 donations  
Budget 101 mio. kr.



### Danish Covid Genetics Consortium

Genotyping 5.000 participants  
Budget 5,4 mio. kr.



## Outcomes of the pandemics

### Publications

- 14 publications
- Impact factor 21,7

Nature Communications  
PLOS ONE  
Lancet Infectious Diseases  
BMC Genome Medicine  
Eurosurveillance  
Epidemiology and Infection  
European Journal of Epidemiology  
Scientific Reports





# Outcomes of the pandemics

## IT TOOLS

Indtast en barcode og tryk Enter

Indtast et maskinenum og tryk Enter

Eksisterende kommentarer:

ID	Kommentar	Følgesider
1	Indtast en barcode og tryk Enter	
2	Indtast et maskinenum og tryk Enter	
3	Indtast en barcode og tryk Enter	
4	Indtast et maskinenum og tryk Enter	
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100	Indtast et maskinenum og tryk Enter	

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For more questions, contact  
Bart Wilkowsky, DNB  
BAW@ssi.dk

eLog (electronic log on equipment) and paperless lab log



# Thank you – Questions?

Karina Meden Sørensen, kms@ssi.dk

