



# Biobanks make a difference - why Time magazine and Forbes got it right

Mark Divers, KI Biobank, Stockholm

# Conflict of interest

None.

But... I declare a spoiler-warning: you know the main message already.

# What they said about biobanks...

2009: "One of 10 ideas on the horizon to change the world"

2019: "Biobanking is changing the world"

# Biobanking is indeed transformative

## *Clinical practice impact*

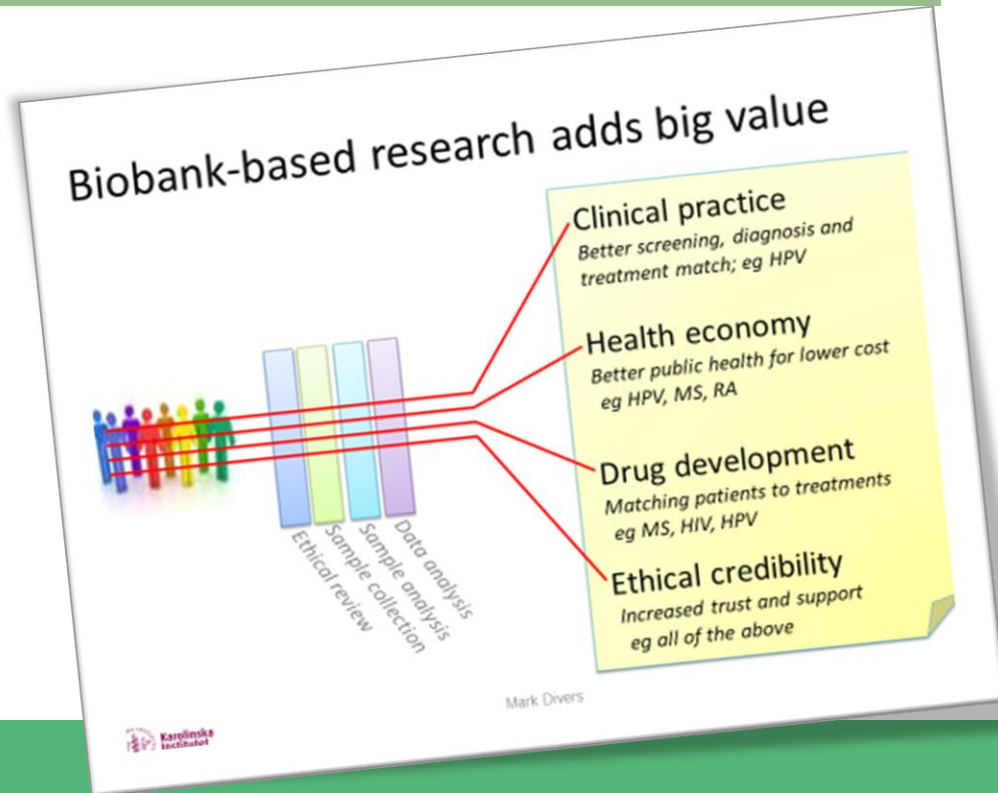
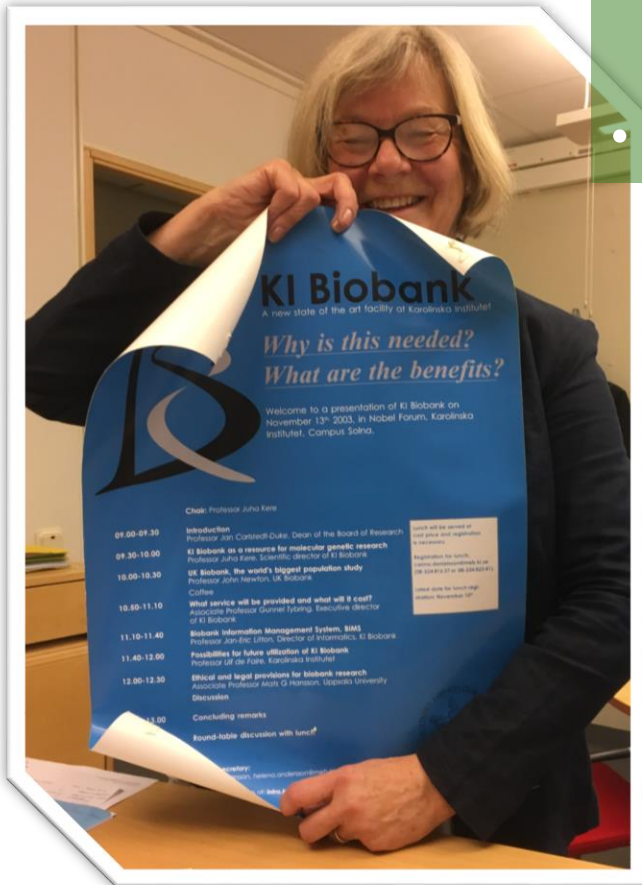
- Acute childhood leukaemia
  - Nordic Paediatric Haematology Org
- Adult leukaemias
  - FIMM Biobank, K Pittkainen
- Prostate Cancer
  - Screening (Grönberg et al)
- Pyloric stenosis
  - Danish National Biobank
- Psychological disorders
  - Swedish Twin Register
- Pancreatic cancer
  - ICB-Lübeck (Habermann et al)
- Cervical sarcoma
  - ICB-Lübeck (Habermann et al)
- Covid-19 biobank Nigeria
  - Lagos Uni (Akin Abayomi)
- Pediatric biobanking
  - EBW 2021

## *Drug development impact*

- HPV and cervical cancer
  - Vaccine (zur Hausen et al)
  - Screening program (Dillner et al)
- Multiple Sclerosis
  - Tysabri (Olsson et al)
- Breast cancer
  - Herceptin
- Leukaemia
  - Gleevec
- Lung Cancer
  - Iressa
- Transthyretin Amyloid Cardiomyopathy
  - Tafamidis
- SARS-CoV2, Covid-19 vaccine
  - Comirnaty

# Why biobank?

- Serve research with powerful infrastructure
  - Systematic, statistical, high quality
- Impact usually seen in publications
  - Biobank Sweden supports ~500 each year
- But real value comes when research serves society



# The population cohorts are fantastic examples

	HUNT, Norway
	FinnGen, Finland
	Danish National Birth Cohort
	North Sweden Health Study
	LifeGene & EpiHealth, Sweden
	Swedish Twin Registry
	deCode Health study & SAGA, Iceland
	Estonia Biobank
	Helmholtz, Germany
	Lifelines, Netherlands
	UK Biobank
	Framingham, USA
	All of US, USA
	Es Maestras, Mexico
	PACT, Africa
	Barshi, India
	Kadoori, China
	Sendai Residents and 3-Gen, Japan



Millions gladly volunteering to study  
interplay of genes and environment in  
health and disease

*Somewhat underestimated and under  
appreciated in my view*

Slow-burn success stories



# A somewhat quicker impact...

## Critical Role of Biobanks in COVID-19



### Access to the SARS-CoV2 virus genome

Vaccine Development; currently >50 programs<sup>1</sup>



### Knowledge of the virus and its pathogenesis

Development & validation: New diagnostics, therapeutics & vaccines



### Electronic Health Records (EHR)

Monitoring of disease & vaccine efficacy/safety

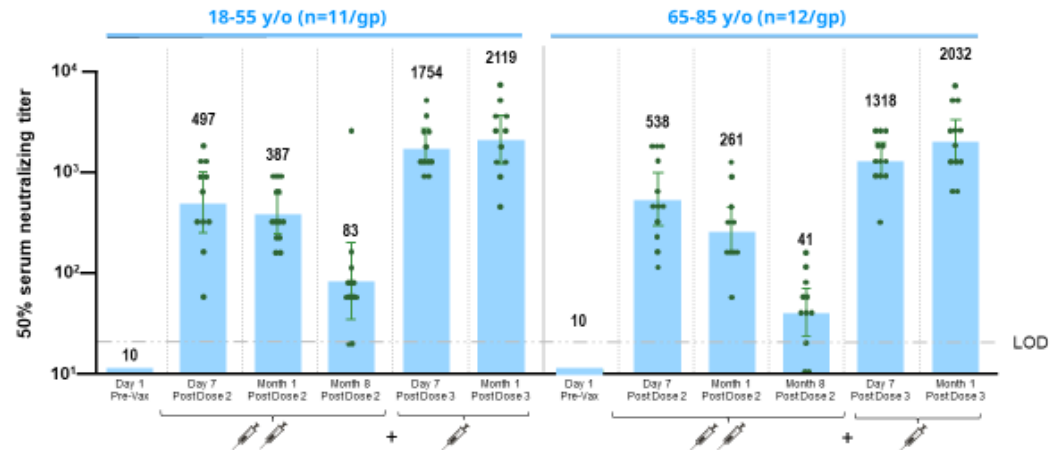


### Intersection of EHR, Biobanks & AI

Future pandemic preparedness

World Health Organization. COVID-19 Vaccines. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/covid-19-vaccines>

## Neutralization Titers Much Higher Post 3rd Dose (Booster) Than Post 2nd for Wild Type Variant<sup>1,2</sup>



1. Initial data, Phase 1 sentinel subjects received dose 1 & 2 of 30mcg BNT162b2 21 days apart, subjects then came back and received BNT162b2 30 mcg as a 3rd dose (booster).  
2. Samples were tested against each variant separately; PRNT: Plaque Reduction Neutralizing Test; GMR: Geometric Mean Ratio; WT: Wild Type; LOD: Limit of Detection.  
Falsely et al. SARS-CoV-2 Neutralization with BNT162b2 Vaccine Dose 3. N Engl J Med. Sept 2021



EUROPE  
BIOBANK  
WEEK

With courtesy of Mikael Dolsten, Pfizer

# Prevac Biobank in Guinea



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## OUR PARTNERS

PREVAC, the Partnership for Research on Ebola Vaccinations, is a research consortium with health authorities in Guinea, Liberia and Sierra Leone, and international partners [INSERM](#) in France, the National Institute of Allergy and Infectious Diseases ([NIAID](#)), the National Institutes of Health ([NIH](#)) in the United States and the London School of Hygiene & Tropical Medicine ([LSHTM](#)) in the United Kingdom. ALIMA is an implementing partner of the project for this consortium in Guinea.

*Biobanking to develop a vaccine for Ebola virus*



# Prostate cancer diagnosis just gets better...

## Prostate cancer screening in men aged 50–69 years (STHLM3): a prospective population-based diagnostic study

Henrik Grönberg, Jan Adolfsson, Markus Aly, Tobias Nordström, Peter Wiklund, Yvonne Brandberg, James Thompson, Fredrik Wiklund, Johan Lindberg, Mark Clements, Lars Egevad, Martin Eklund

### Summary

**Background** The prostate-specific antigen (PSA) test is used to screen for prostate cancer but has a high false-positive



**"Excellence in biobanking  
was core to the  
development of the  
Stockholm3 test"**

*Principal Investigator Henrik Grönberg, 2017*

# STHLM 3

Stora studien inom  
prostatacancer

## THE LANCET Oncology

Volume 22, Issue 9, September 2021, Pages 1240–1249

### Articles

Prostate cancer screening using a combination of risk-prediction, MRI, and targeted prostate biopsies (STHLM3-MRI): a prospective, population-based, randomised, open-label, non-inferiority trial

Tobias Nordström MD <sup>a, b, c</sup>, Andrea Discacciati PhD <sup>a</sup>, Martin Bergman MD <sup>a, e</sup>, Mark Clements PhD <sup>a</sup>, Markus Aly MD <sup>a, c, d</sup>, Magnus Annerstedt MD <sup>b</sup>, Axel Glassgen MD <sup>a</sup>, Stefan Carlsson MD <sup>c, d</sup>, Fredrik Jäderling MD <sup>c, f</sup>, Martin Eklund PhD <sup>a, g</sup>, Prof Henrik Grönberg MD <sup>a, h, i</sup>  
STHLM3 study group

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[https://doi.org/10.1016/S1470-2045\(21\)00348-X](https://doi.org/10.1016/S1470-2045(21)00348-X)

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### Refers to

Caroline M Moore

[An important step towards smarter screening for prostate cancer](#)

The Lancet Oncology, Volume 22, Issue 9, September 2021, Pages 1201–1202

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Caroline M Moore

[An important step towards smarter screening for prostate cancer](#)

The Lancet Oncology, Volume 22, Issue 9, September 2021, Pages 1201–1202

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### Summary

#### Background

Screening for **prostate cancer** using prostate-specific antigen (PSA) reduces prostate cancer mortality but can lead to **adverse outcomes**. We aimed to compare a traditional screening approach with a diagnostic strategy of blood-based risk prediction combined with MRI-targeted biopsies.

#### Methods

We did a prospective, population-based, randomised, open-label, non-inferiority



## EAU22 Press release: Only through international cooperation can AI improve patient lives

Under strict embargo: 01.00 CEST, Sunday 03 July

### Only through international cooperation can AI improve patient lives

The largest prostate cancer biopsy dataset – involving over 95,000 images – has been created by researchers in Sweden to ensure AI can be trained to diagnose and grade prostate cancer for real world clinical applications.

The researchers will call today, at the European Association of Urology Annual Congress ([EAU22](#)), for large-scale clinical trials of artificial intelligence (AI) algorithms and greater global coordination to ensure that AI enhanced diagnostics, prognostication, and treatment selection can help save lives.

There is a shortage of pathologists around the world, both generalists and those specialised in urology. AI can help in detecting prostate cancer at an early stage, but because of the vast differences in the way clinics prepare samples, scan images and in the diverse patient populations they serve, many algorithms do not have universal application.

The team, from Karolinska Institutet (SE), worked with colleagues from Radboud University Medical Center in the Netherlands, University of Turku in Finland and Google Health in the US to run an AI competition involving nearly 1,300 developers from around the world. The developers created algorithms able to grade prostate cancer tumours and trained them using 10,000 international biopsy images. The top performing algorithms outperformed generalist pathologists and matched the average performance of specialist uropathologists.

Dr Kimmo Kartasalo, who will present the results of the competition at EAU22, said: "Grading prostate cancer is a key step in deciding on appropriate treatment, but it's a fairly subjective process and differences between pathologists' assessments can sometimes be large. AI can provide an additional

# As does biobank-based breast cancer research and clinical practice



original reports

## Low-Dose Tamoxifen for Mammographic Density Reduction: A Randomized Controlled Trial

Mikael Eriksson, PhD<sup>1</sup>; Martin Eklund, PhD<sup>1</sup>; Signe Borgquist, MD, PhD<sup>2,3</sup>; Roxanna Hellgren, MD<sup>4</sup>; Sara Margolin, MD, PhD<sup>5,6</sup>; Linda Thoren, MD<sup>5,6</sup>; Ann Rosendahl, PhD<sup>3</sup>; Kristina Lång, MD, PhD<sup>7,8</sup>; José Tapia, MS<sup>1</sup>; Magnus Bäcklund, MD, PhD<sup>1</sup>; Andrea Discacciati, PhD<sup>1</sup>; Alessio Crippa, PhD<sup>1</sup>; Marike Gabrielson, PhD<sup>1</sup>; Mattias Hammarström, BSc<sup>1</sup>; Yvonne Wengström, PhD<sup>9</sup>; Kamila Czene, PhD<sup>1</sup>; and Per Hall, MD, PhD<sup>1,5</sup>

abstract

**PURPOSE** Tamoxifen prevents breast cancer in high-risk women and reduces mortality in the adjuvant setting. Mammographic density change is a proxy for tamoxifen therapy response. We tested whether lower doses of tamoxifen were noninferior to reduce mammographic density and associated with fewer symptoms.

**PATIENTS AND METHODS** Women, 40-74 years of age, participating in the Swedish mammography screening program were invited to the 6-month double-blind six-arm randomized placebo-controlled noninferiority dose-determination KARISMA phase II trial stratified by menopausal status (EudraCT 2016-000882-22). In all, 1,439 women were accrued with 1,230 participants accessible for intention-to-treat analysis. The primary outcome was proportion of women treated with placebo, 1, 2.5, 5, and 10 mg whose mammographic density decreased at least as much as the median reduction in the 20 mg arm. The noninferior margin was 17%. Secondary outcome was reduction of symptoms. Post hoc analyses were performed by menopausal status. Per-protocol population and full population were analyzed in sensitivity analysis.

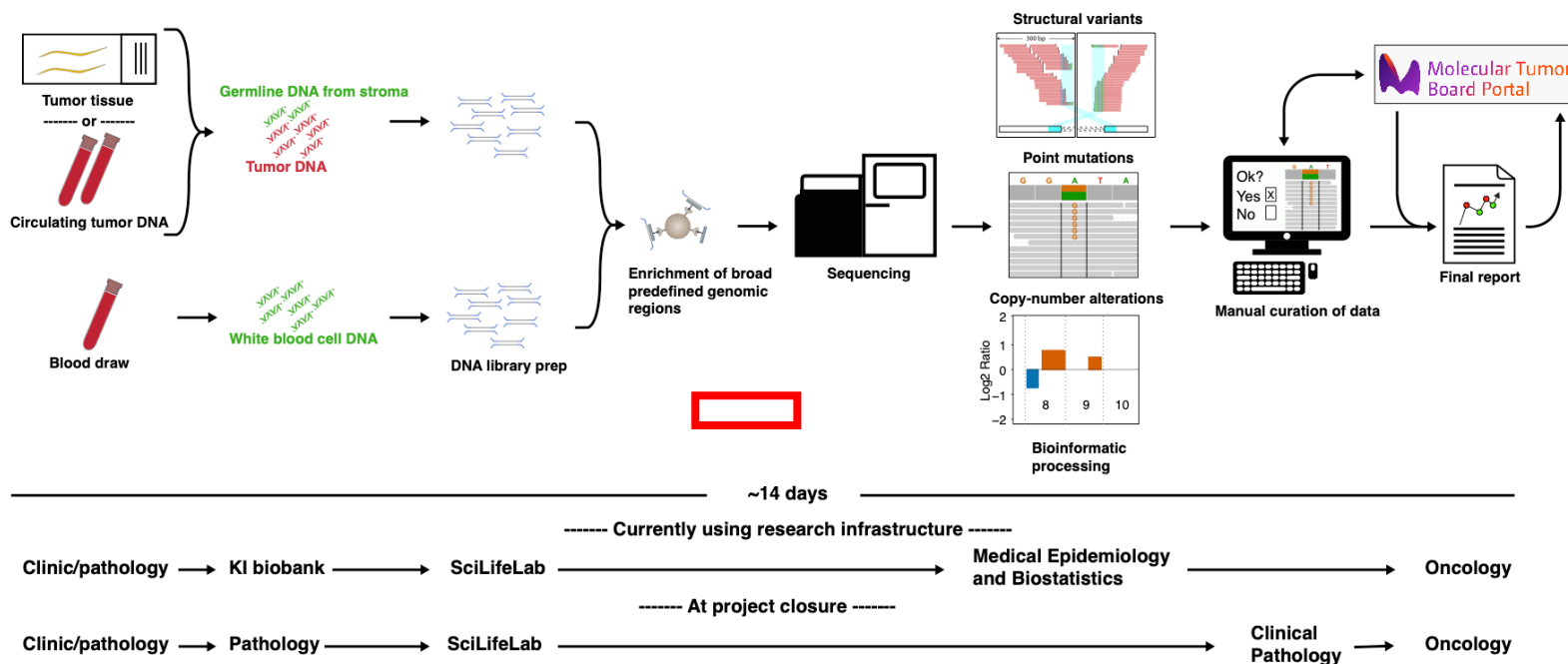
Biobanking is a great tool for precision medicine

Precision medicine is a great way for biobanks to show value

## = implementing Personalised Cancer Medicine

### Aim

- Apply existing research infrastructure to broad genomic profiling of all newly diagnosed advanced solid tumors (>2000) during one year in Stockholm
- Transfer all individual components of the infrastructure to long-term routine clinical practice



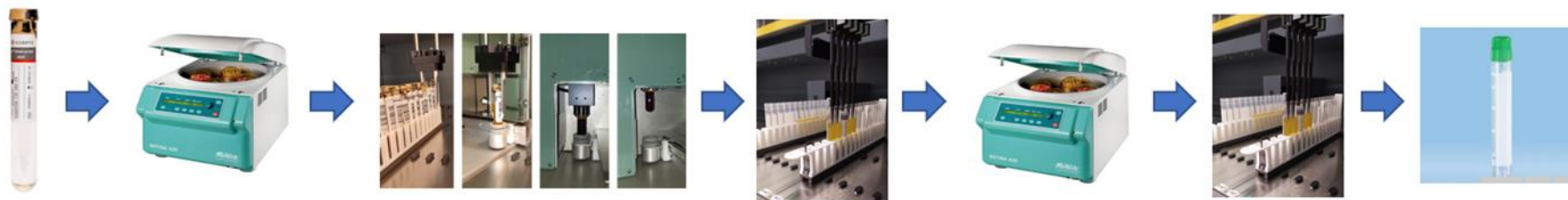
# Developing a biobank service for cfDNA (circulating free DNA)

- Simplify researcher's chosen protocol
- Include parallel EDTA blood tube for genomic DNA
- Upgrade centrifuges and liquid handlers for glass tubes
- Optimise plasma aspiration
- Adapt LIMS for sample tracking

*See the poster at NBC...*



-> 96-sample process unit, short run times, fully tracked



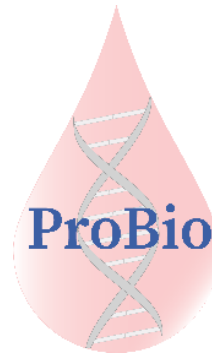




## 3 personalised medicine prospective randomised clinical trials - completely dependent on research biobanking



Launched 2016  
PI: Anna Martling  
Disease: Localized colon cancer  
Assay: Broad panel sequencing  
Tissue: Native tumour & germline DNA



Launched 2019  
PI: Henrik Grönberg  
Disease: Metastatic prostate cancer  
Assay: Broad panel sequencing  
Tissue: ctDNA & germline DNA

**PSFF program**  
( **P**re-**S**creening **F**ör **F**as-I )  
*ctDNA for patients referred to the Phase-I Unit*

Launched 2019  
PI: Jeffrey Yachnin  
Disease: Any advanced cancer  
Assay: Broad panel sequencing  
Tissue: ctDNA and germline DNA

~50 sites in 6 European countries, sending samples to Karolinska Institutet

## ARTICLE OPEN

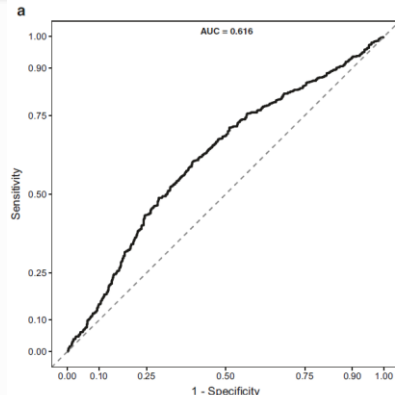
Check for updates

## Proteins associated with future suicide attempts in bipolar disorder: A large-scale biomarker discovery study

Johan V. Sandberg<sup>1,4</sup>, Caroline Hansson<sup>1,2,4</sup>, Andreas Göteson<sup>1</sup>, Erik Joas<sup>1</sup>, Joel Jakobsson<sup>1</sup>, Erik Pålsson<sup>1</sup> and Mikael Landén<sup>1,2,5</sup>

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Suicide is a major cause of death worldwide. Several biological systems have been implicated in suicidal behavior but studies of candidate biomarkers have failed to produce clinically relevant biomarkers for suicide prediction. The objective of the present study was to identify novel candidate biomarkers for suicidal behavior. We used a nested case-control study design where a large cohort of patients with bipolar disorder ( $N = 5110$ ) were followed up to 8 years after blood sampling. We included patients that attempted suicide during follow-up ( $N = 348$ ) and matched bipolar disorder patients from the same cohort who did not attempt suicide during the study period ( $N = 348$ ) and analyzed a total of 92 proteins with a neuro exploratory multiplex panel. Using a multivariate classification algorithm devised to minimize bias in variable selection, we identified a parsimonious set of proteins that best discriminated bipolar disorder patients with and without prospective suicide attempts. The algorithm selected 16 proteins for the minimal-optimal classification model, which outperformed 500 models with permuted outcome ( $p = 0.0004$ ) but had low sensitivity (53%) and specificity (64%). The candidate proteins were then entered in separate logistic regression models to calculate protein-specific associations with prospective suicide attempts. In individual analyses, three of these proteins were significantly associated with prospective suicide attempt (SCGB1A1, ANXA10, and CETN2). Most of the candidate proteins are novel to suicide research.

Molecular Psychiatry; <https://doi.org/10.1038/s41380-022-01648-x>

# Predicting suicide attempts SWEBIC-study

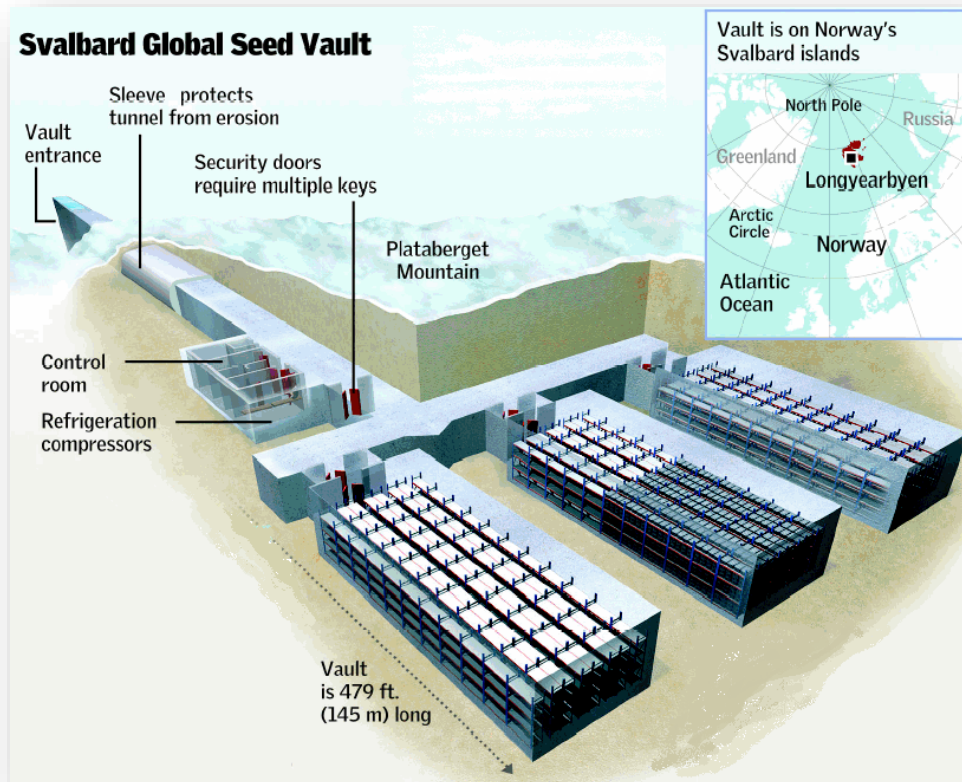
- 5110 bipolar disorder patients followed-up to 8 years after blood sampling
- 348 patients that attempted suicide during follow-up was compared with 348 matched individuals that did not.
- Neuro exploratory protein panel
- Three proteins (SCGB1A1, ANXA 10, and CETN2) associated with prospective suicide attempts

# Sustainability...



...biobanks can also address environmental challenges

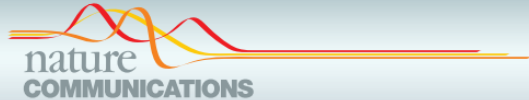
# Secure seed storage in Svalbard



\*IPK, 2021

eg rescuing Syrian seed bank from war devastation

# Rescuing rhinos using biobanks



## ARTICLE

DOI: 10.1038/s41467-018-04959-2

OPEN

## Embryos and embryonic stem cells from the white rhinoceros

Thomas B. Hildebrandt<sup>1,2</sup>, Robert Hermes<sup>1</sup>, Silvia Colleoni<sup>3</sup>, Sebastian Marilyn B. Renfree<sup>6</sup>, Jan Stejskal<sup>7</sup>, Katsuhiko Hayashi<sup>8</sup>, Micha Druk Giovanna Lazzari<sup>3,11</sup> & Cesare Galli<sup>3,11</sup>



*Ceratotherium simum cottoni*) is the most e  
males surviving. Here we adapt existin  
e Southern White Rhinoceros (SWR) oo  
eros oocytes can be repeatedly recovere  
up, matured, fertilized by intracytoplasi  
stage in vitro. Next, we generate hybrid  
and SWR. We also establish embryonic  
ts are cryopreserved for later embryo tra  
e strategy to rescue genes from the icon  
ay also have broader impact if applied w  
malian species.

STEM CELLS AND DEVELOPMENT  
Volume 30, Number 4, 2021  
Mary Ann Liebert, Inc.  
DOI: 10.1089/scd.2021.0001

## ORIGINAL RESEARCH REPORTS

## Rewinding Extinction in the Northern White Rhinoceros: Genetically Diverse Induced Pluripotent Stem Cell Bank for Genetic Rescue

Marisa L. Korody<sup>1,2</sup>, Sarah M. Ford<sup>1</sup>, Thomas D. Nguyen<sup>1,2</sup>, Cullen G. Pivaroff<sup>2,\*</sup>,  
Ifigo Valiente-Alandi<sup>1</sup>, Suzanne E. Peterson<sup>2</sup>, Oliver A. Ryder<sup>1</sup>, and Jeanne F. Loring<sup>2</sup>

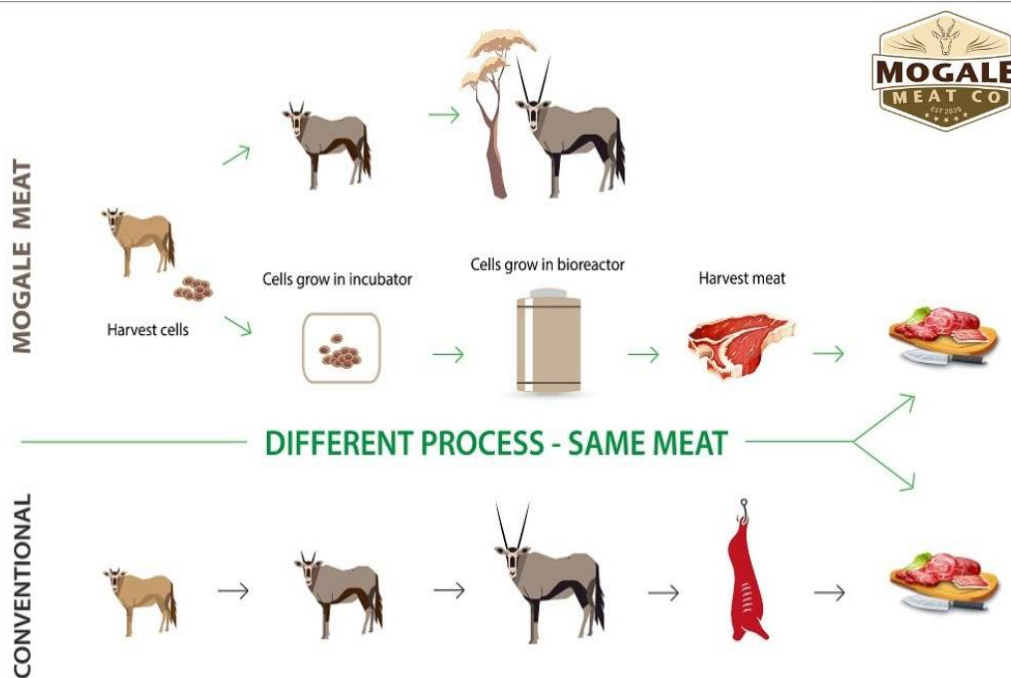
Extinction rates are rising, and current conservation technologies may not be adequate for reducing species losses. Future conservation efforts may be aided by the generation of induced pluripotent stem cells (iPSCs) from highly endangered species. Generation of a set of iPSCs from multiple members of a species can capture some of the dwindling genetic diversity of a disappearing species. We generated iPSCs from fibroblasts cryopreserved in the Frozen Zoo<sup>®</sup>: nine genetically diverse individuals of the functionally extinct northern white rhinoceros (*Ceratotherium simum cottoni*) and two from the closely related southern white rhinoceros (*Ceratotherium simum simum*). We used a nonintegrating Sendai virus reprogramming method and developed analyses to confirm the cells' pluripotency and differentiation potential. This work is the first step of a long-term interdisciplinary plan to apply assisted reproduction techniques to the conservation of this highly endangered species. Advances in iPSC differentiation may enable generation of gametes in vitro from deceased and nonreproductive individuals that could be used to repopulate the species.

**Keywords:** induced pluripotent stem cells, genetic rescue, endangered species, rhinoceros, reprogramming

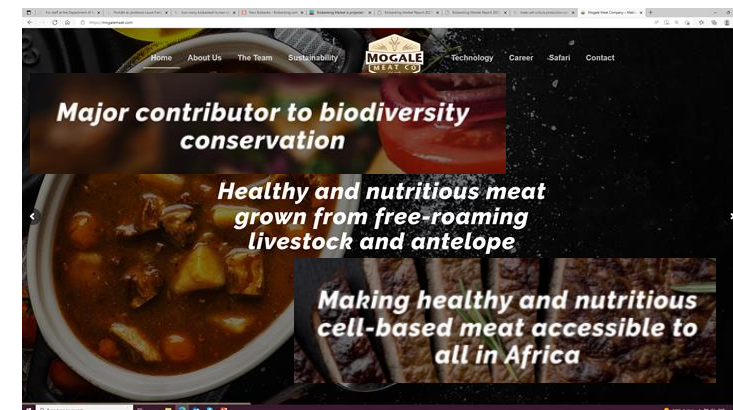
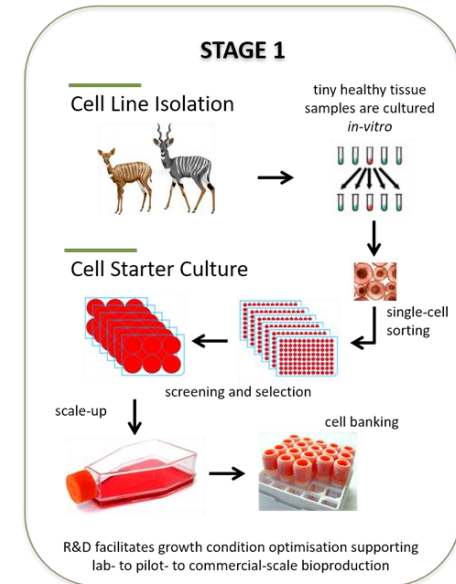


# Biobanks are helping make meat production more sustainable

*eg Mogale Meat Company*



<https://youtu.be/m9UHmTp4kmo>



# Coconut biobanking

NORDIC  
Biobank  
Conference

> J Fungi (Basel). 2022 Mar 23;8(4):335. doi: 10.3390/jot8040335.

## Morphological and Molecular Identification of Plant Pathogenic Fungi Associated with Dirty Panicle Disease in Coconuts (*Cocos nucifera*) in Thailand

Anurag Sunpapao<sup>1</sup>, Nakarin Suwai  
Kanamon Riangwong<sup>4</sup>, Sunisa San

Affiliations + expand

PMID: 35448566 PMCID: PMC9025

Free PMC article

### Abstract

Dirty panicle disease in coconuts (C BioBank, Nakhon Pathom province, the total coconut plantation area. TI discoloration of male flowers. Herei on the morphological characteristic *Alternaria* (AI01) and *Fusarium* (FUC (ITS), glyceraldehyde 3-phosphate c and RNA polymerase II second larg sequences of ITS, *rpb2*, and *tef1-α* i respectively. A pathogenicity test by dirty panicle disease similar to that the first report on the novel dirty pa that it is associated with the plant p

**Keywords:** flower discoloration; fun

Horticulture  
Research

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Article | Open Access | Published: 01 October 2020

### Mining and validation of novel genotyping-by-sequencing (GBS)-based simple sequence repeats (SSRs) and their application for the estimation of the genetic diversity and population structure of coconuts (*Cocos nucifera* L.) in Thailand

Kanamon Riangwong, Samart Wanchana, Wanchana Aesomnuk, Chatree Saensuk, Phakchana Nubankoh, Vinitchan Ruanjaichon, Tippaya Kraithong, Theerayut Toojinda, Apichart Vanavichit & Siwaret Arikrit

Horticulture Research 7, Article number: 156 (2020) | Cite this article

2608 Accesses | 5 Citations | Metrics

### Abstract

Coconut (*Cocos nucifera* L.) is an important economic crop in tropical countries. However, the lack of a complete reference genome and the limitations of usable DNA markers hinder genomic studies and the molecular breeding of coconut. Here, we present the results of simple sequence repeat (SSR) mining from a high-throughput genotyping-by-sequencing (GBS) study of a collection of 38 coconut accessions. A total of 22,748 SSRs with di-, tri-, tetra-, penta- and hexanucleotide repeats of five or more were identified, 2451 of which were defined as polymorphic loci based on locus clustering in 38 coconut accessions, and 315 loci were



Supplementary Figure S1. A) KU-BEDO Coconut BioBank on the campus of Kasetsart University, Kamphagen Saen, Nakhon Pathom, Thailand. The plantation is 4.8 hectares in size and includes various coconut varieties. B) Dirty panicle disease observed in coconut plants grown in the bio bank.



Figure 1. Dirty panicle disease observed on coconuts in KU-BEDO Coconut BioBank: Discoloration of male flowers (A) and zoomed-in view of infected flowers (B), flower drop (C), and infected panicles (D,E).

### 3.2. Pathogenicity Test

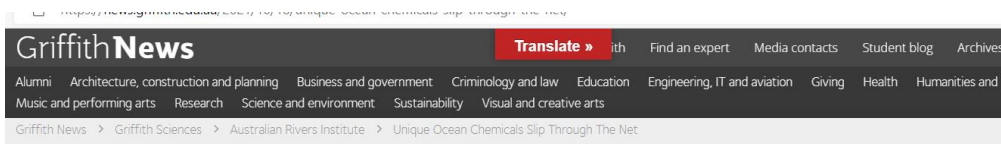
A total of 20 fungal isolates were isolated from 15 infected panicles. These 20 isolates



# Biobanks for drug discovery

**NORDIC** Biobank  
Conference

Eg Griffith Institute for Drug Discovery



## Unique ocean chemicals slip through the net



# Life on Earth can be helped by biobanking

## *Clinical practice impact*

- Acute childhood leukaemia
  - Nordic Paediatric Haematology Org
- Adult leukaemias
  - FIMM Biobank, K Pittkainen
- Prostate Cancer
  - Screening (Grönberg et al)
- Pyloric stenosis
  - Danish National Biobank
- Psychological disorders
  - Swedish Twin Register
- Pancreatic cancer
  - ICB-Lübeck (Habermann et al)
- Cervical sarcoma
  - ICB-Lübeck (Habermann et al)
- Covid-19 biobank Nigeria
  - Lagos Uni (Akin Abayomi)

## *Drug development impact*

- HPV and cervical cancer
  - Vaccine (zur Hausen et al)
  - Screening program (Dillner et al)
- Multiple Sclerosis
  - Tysabri (Olsson et al)
- Breast cancer
  - Herceptin
- Leukaemia
  - Gleevec
- Lung Cancer
  - Iressa
- Transthyretin Amyloid  
Cardiomyopathy
  - Tafamidis
- SARS-CoV2, Covid-19 vaccine
  - Comirnaty

## *Environmental impact*

- Species rescue
  - White rhino
- Crop diversity
  - Potatos
- Sustainable meat
  - Mogale
- Crop protection (non-chemical)
  - Coconut
- Drug discovery
  - Antibiotcs
  - Cyclosporin
  - Taxol

# Acknowledgements

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- Mattias Rantalainen, KI
- Mikael Landén, Gothenburg University
- Manuela Nagel, IPK, Leibnitz
- Paul Bartels, Tshwane University & Mogale Meat Company
- BiobankSweden
- ESBB
- BBMRI





# Thank you!

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