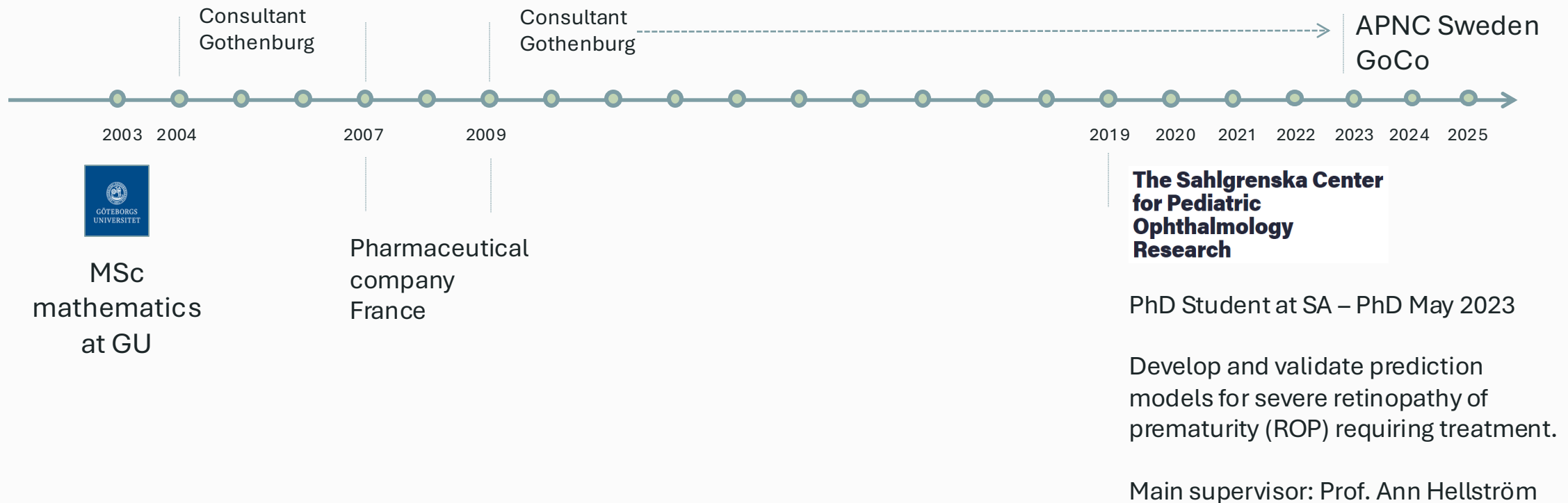# Prediction models

THE WHOLE GAME

Aldina Pivodic, PhD
SENIOR STATISTICIAN, CEO
aldina.pivodic@apnc.se

APNC

Statistics in Life Science

Statistics and programming within medical and medical device research

Agenda

- Clinical decision support tools
  - WHY, WHAT, HOW?

- Case 1: DIGIROP
  - CLINICAL NEED
  - PLANNING & GUIDELINES
  - DEVELOPMENT, VALIDATION, UPDATE
  - CLINICAL DECISION SUPPORT TOOL

  RESEARCH PHASE

  - APPLICATION
  - MDR & CE-MARKING
  - IMPLEMENTATION
  - MONITORING

  MARKET PHASE

  "THE WHOLE GAME"

- Case 2: TINYPRED

- Case 3: FRACTURE-ML

- Future perspectives

APNC
Statistics in Life Science

Clinical decision support tools

WHY?

Complex medical decisions and clinical need

Available data & powerful methods

Improve patient outcomes, save costs and use of resources

WHAT?

Prognostic tools

Diagnostics tools

Treatment recommendations

Precision medicine

HOW?

Development, validation, update

Application

CE-marking

Implementation, Monitoring

APNC
Statistics in Life Science

Preterm babies

They need timely screening and close monitoring of development.

Short- and long-term complications: brain, heart, lungs, digestive system, immune system, **eyes (ROP=retinopathy of prematurity)**.

DIGIROP

CASE 1

WHY?	Optimize screening using simple input variables. Focus on the right infant at the right time.
WHAT?	Individual predictions, screening decision tool.
HOW?	Development (Swedish), validation (International), early Birth model, and follow-up Screen model.

Clinical need DIGIROP

PATIENT-PERSPECTIVE

- Better well-being (release low-risk infants not needing exams)
- Avoid blindness (screen high-risk infants timely)
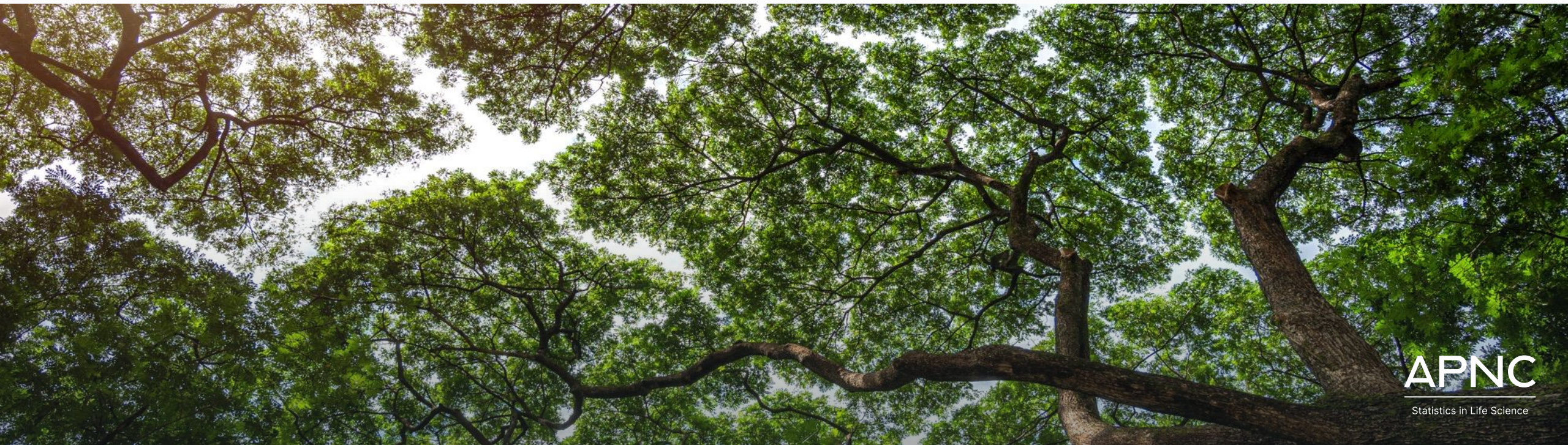
HEALTHCARE-PERSPECTIVE

- Save costs and resources
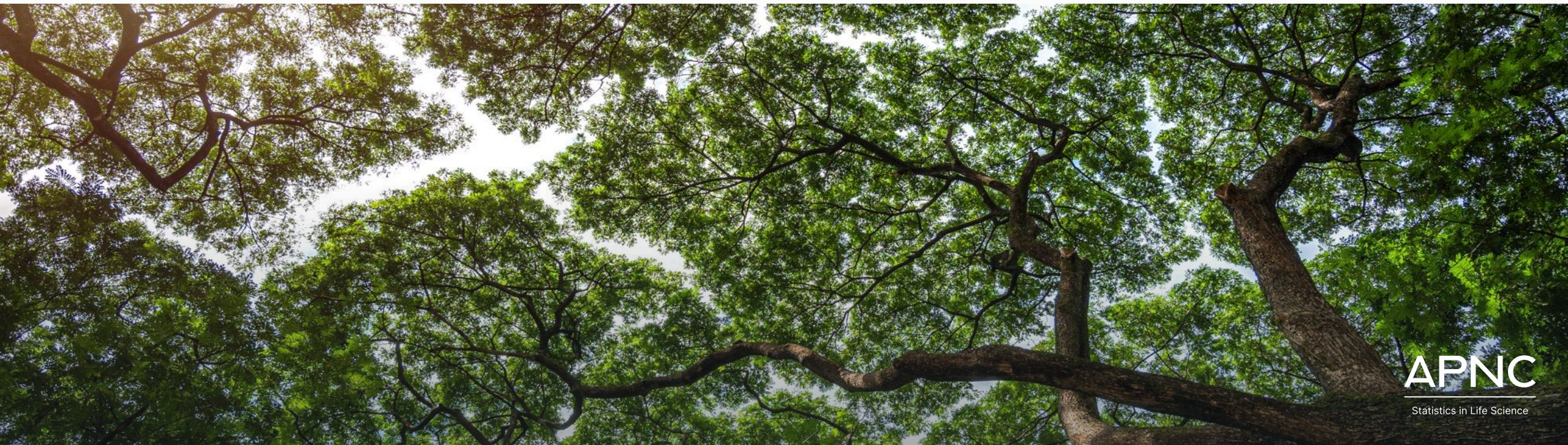- Solve logistic issues (e.g. Australia long distances)

Planning and guidelines DIGIROP

- What is already published?
- TRIPOD-AI (Reporting guidelines | The EQUATOR Network (equator-network.org))
- PROGRESS (*Prognosis Research Strategy*, Steyerberg et al 2013)
- PROBAST (*Prediction model study Risk of Bias Assessment Tool*, Moons et al 2013, Wolff et al 2019)

Development, validation and update DIGIROP (done)

SWEDROP

- Development, n=8800

- Internal Validation, cross-validation

- External Validation, n=2300 Swedish, n=1500 US, n=300 Germany

- Ongoing: Greece, Saudi Arabia, Taiwan, Australia, US, Denmark

APNC
Statistics in Life Science

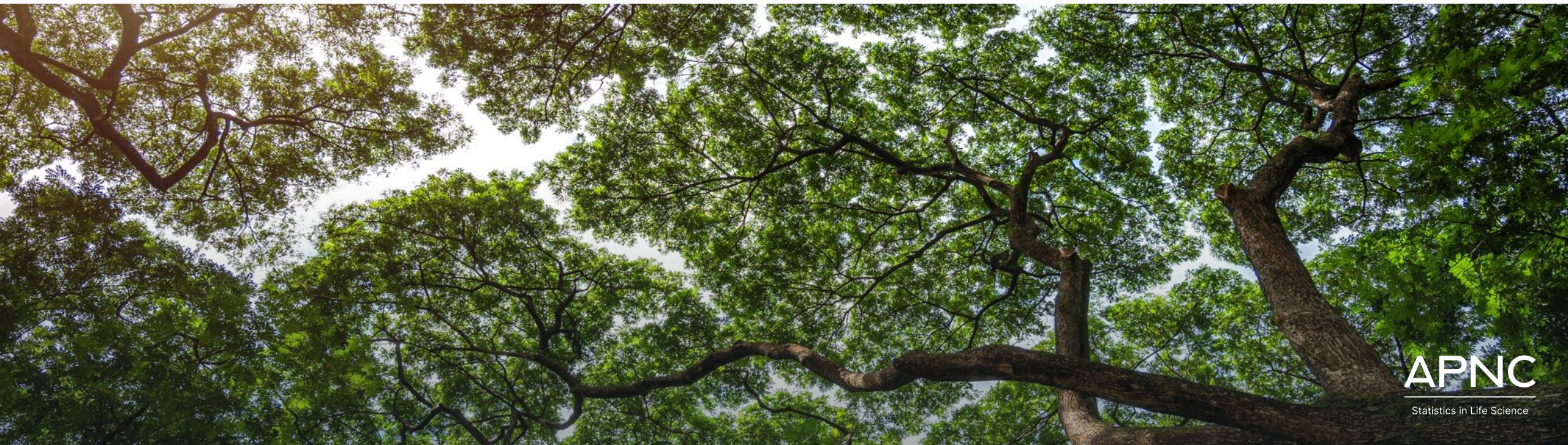# Clinical decision support tool DIGIROP (done)

SENSITIVITY

- 100%, do not miss any child, field recommendation

SPECIFICITY

- As good as possible, ~40-50% of all babies could be released from all examinations.

- Superior to other models available

RESULT

- **SCREEN** or **RELEASE**

APNC

Statistics in Life Science

Left panel

The Sahlgrenska Center for
Pediatric Ophthalmology Research

UNIVERSITY OF GOTHENBURG

Welcome to DIGIROP

This online individualized prediction system estimates % risk (95% confidence interval) for sight threatening ROP requiring treatment. DIGIROP-Birth (birth characteristics only) and DIGIROP-Screen (ROP screening information and birth characteristics) are developed by researchers at The Sahlgrenska Center for Pediatric Ophthalmology Research.

Caution: DIGIROP models are not reliable for infants diagnosed with severe congenital malformations/syndromes, hydrocephalus, and those that have performed intestinal surgery (e.g. for necrotizing enterocolitis). These infants should be screened as per routine standards.

DIGIROP-Birth ○ DIGIROP-Screen ◉

GA weeks (24-30): 27
GA days (0-6): 4

Birth weight (g): 1000
Gender: Boy ◉ Girl ○
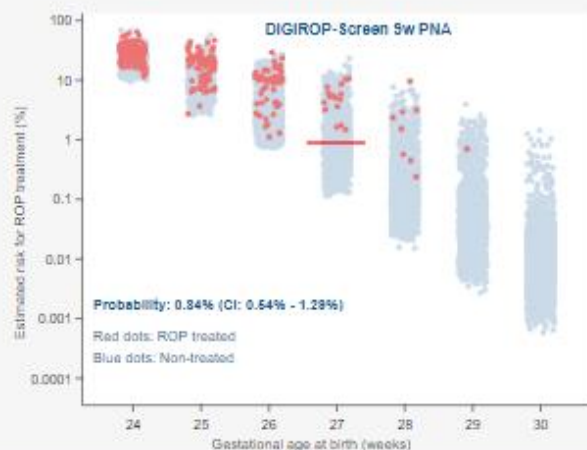
Birth date: 20230101
Date for prediction: 20230301

ROP diagnosed
No ◉ Yes ○

[Calculate] [Clear]

DIGIROP-Screen 5w PNA

Estimated risk for ROP treatment [%]

Probability: 0.84% (CI: 0.54% - 1.28%)

Red dots: ROP treated
Blue dots: Non-treated

Gestational age at birth (weeks)

RELEASE

According to the decision support tool the infant might be released from the ROP screening if the complete medical and clinical picture allows. The clinician's professional judgement should always take precedence over the DIGIROP decision support tool.

Vetenskapsrådet

Knut och Alice Wallenbergs Stiftelse

FÖRENINGEN DE BLINDAS VÄNNER

Right panel

The Sahlgrenska Center for
Pediatric Ophthalmology Research

UNIVERSITY OF GOTHENBURG

Welcome to DIGIROP

This online individualized prediction system estimates % risk (95% confidence interval) for sight threatening ROP requiring treatment. DIGIROP-Birth (birth characteristics only) and DIGIROP-Screen (ROP screening information and birth characteristics) are developed by researchers at The Sahlgrenska Center for Pediatric Ophthalmology Research.

Caution: DIGIROP models are not reliable for infants diagnosed with severe congenital malformations/syndromes, hydrocephalus, and those that have performed intestinal surgery (e.g. for necrotizing enterocolitis). These infants should be screened as per routine standards.

DIGIROP-Birth ○ DIGIROP-Screen ◉

GA weeks (24-30): 27
GA days (0-6): 4

Birth weight (g): 1000
Gender: Boy ◉ Girl ○
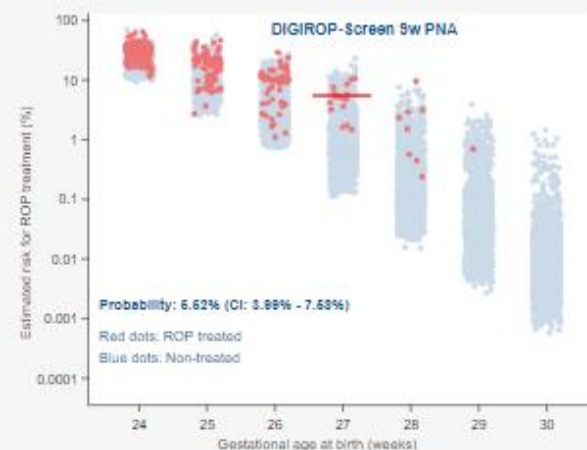
Birth date: 20230101
Date for prediction: 20230301

ROP diagnosed
No ○ Yes ◉

Date first sign of ROP: 20230222

[Calculate] [Clear]

DIGIROP-Screen 5w PNA

Estimated risk for ROP treatment [%]

Probability: 6.62% (CI: 3.89% - 7.63%)

Red dots: ROP treated
Blue dots: Non-treated

Gestational age at birth (weeks)

SCREEN

According to the decision support tool the infant should be screened as per national guidelines.

Vetenskapsrådet

Knut och Alice Wallenbergs Stiftelse

FÖRENINGEN DE BLINDAS VÄNNER

MDR & CE-marking

DIGIROP (current status)

In collaboration with

ADDI Medical

- Clinical decision support tool = medical device (Class I, IIa, IIb, III)

- Create company for the device or collaboration

- ISO 13486 certification (processes and procedures), technical documentation, etc.

APNC
Statistics in Life Science

Implementation
DIGIROP (remaining)

- Prospective implementation study before launch

Monitoring
DIGIROP (remaining)

Management responsibility

- Feedback and complaint handling
- Reporting to regulatory authorities
- Audits
- Monitoring and measurement of the processes and product/software
- CAPA
- Improvements
- Resource needs

APNC
Statistics in Life Science

TINYPRED

CASE 2

In collaboration with Prof. Ann Hellström

WHY? Extremely stressful and difficult clinical situation

WHAT? Individual survival predictions, clinical decision tool.

HOW? Development and validation using ML methods on Swedish register data, implementation in Sweden.

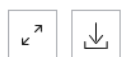# FRACTURE-ML

CASE 3

In collaboration with
Prof. Mattias Lorentzon & Dr. Kristian Axelsson

WHY? Optimize screening, monitoring and treatment.

WHAT? Individual predictions, screening decision tool.

HOW? Development and validation using ML methods on Swedish register data, international implementation.

Future perspectives

- Real-time updates and monitoring

- Merging medical charts with personal devices
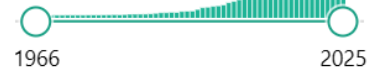
- Data sharing and standardized data formats

Prediction
~2,100,000 results

Clinical decision
~70,000 results

RESULTS BY YEAR

1842   2025

RESULTS BY YEAR

1966   2025

APNC
Statistics in Life Science

Digitalization and Clinical Decision Support Tools - Event

WHEN: **June 12, 13:00-15:30**

WHERE: **GoCo House**

WHO: **APNC, AddiMedical, VGR, Region Halland**

APNC

Statistics in Life Science

DIGITAL HEALTH ARENA.

DIGITALIZATION AT GoCo HEALTH INNOVATION CITY.

During 2024, Chalmers Industriteknik, Vectura, AstraZeneca and Mölnlycke Health Care have been successful in bringing Vinnova-funded collaborative research projects to GoCo through the program Advanced Digitalization.

The program aims to support the growth, the competitiveness and advancement of life sciences in Sweden through the application of data-driven innovation, AI and quantum computing.

Statistician experienced in academic research

Director of Biostatistics experienced in industry

Thank you!

aldina.pivodic@apnc.se
aldina.pivodic@gu.se
www.rop.gu.se
www.digirop.com