

N.AI.C.U.

Does AI help in Clinical Neonatal Practice?

BVN-GBN Meeting

Salon de Romree, Grimbergen, 8/10/2026

Dr Erica Rotunno

CHU St Pierre



Plan

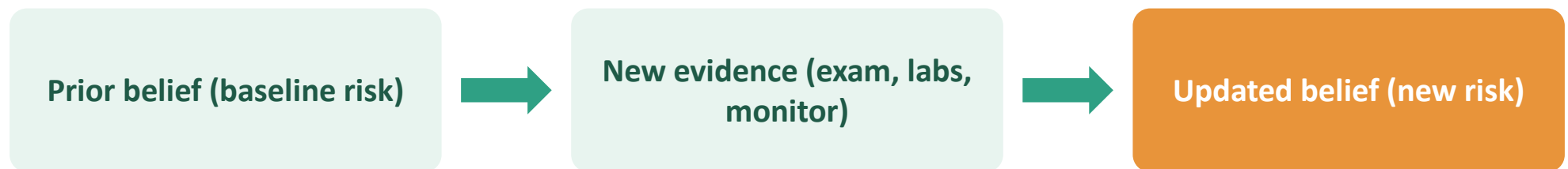
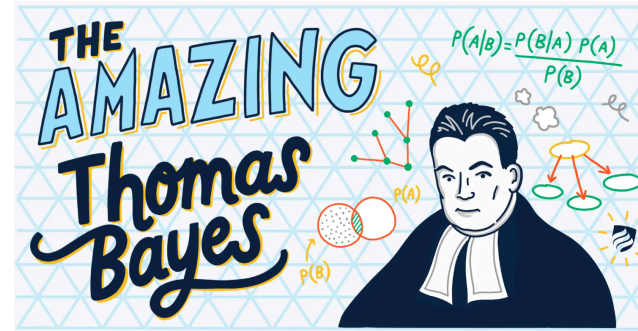
- 1 Origins and definitions
- 2 Applications for neonatology
- 3 Neonatal infectious diseases focus
- 4 Wider reflections
- 5 Conclusions & Q&A

01

Origins and definitions

Where does AI come from, and what do we actually mean by it?

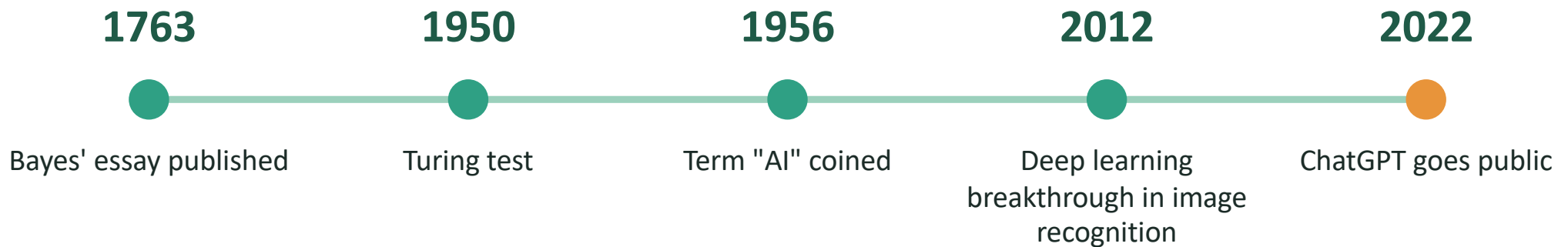
Bayes: updating beliefs with data



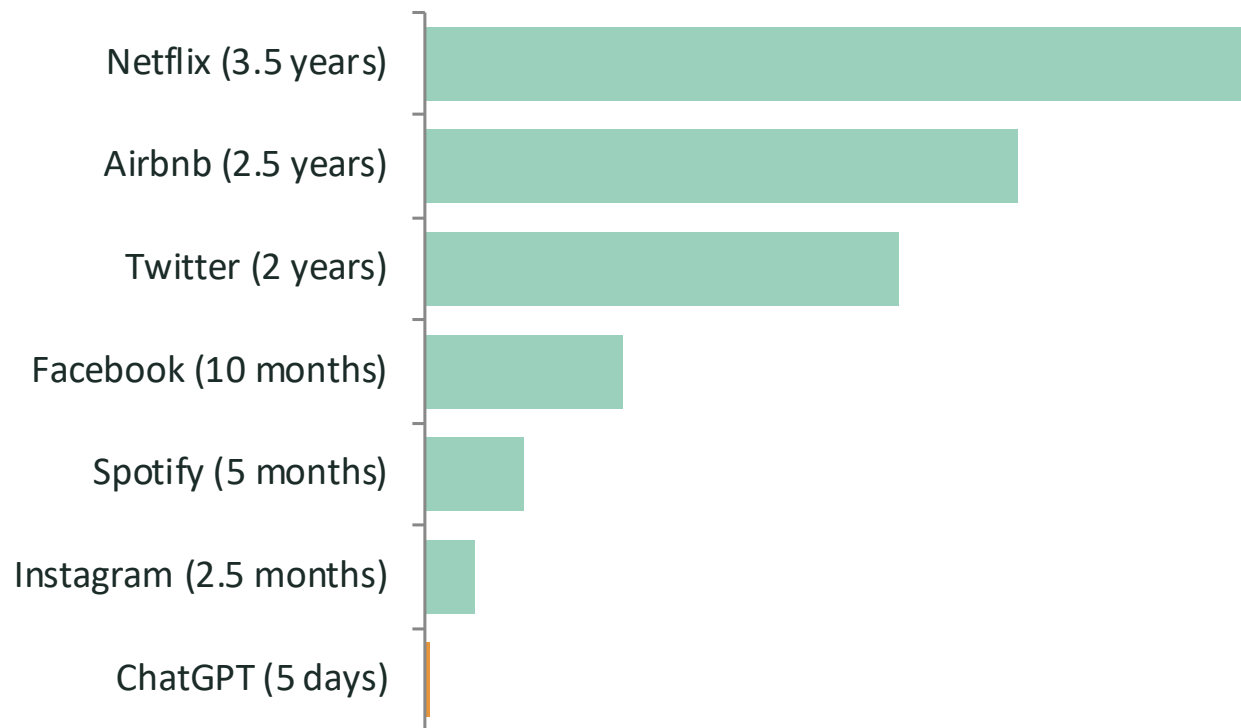
Same logic as the early-onset sepsis calculator, and the root of many modern machine-learning methods.

Turing, 1950: can machines think?

- **1950:** Alan Turing publishes "Computing Machinery and Intelligence" and proposes the imitation game (the Turing test).
- **1956:** The Dartmouth workshop gives the field its name: artificial intelligence.



How fast? Time to 1 million users



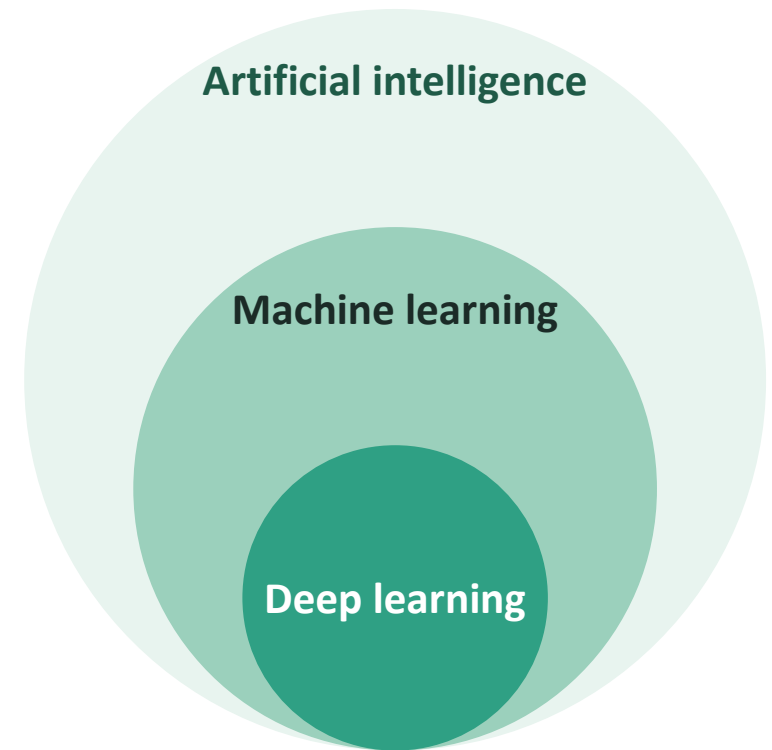
5 days

for ChatGPT to reach 1 million users (Nov 2022), versus years for earlier platforms



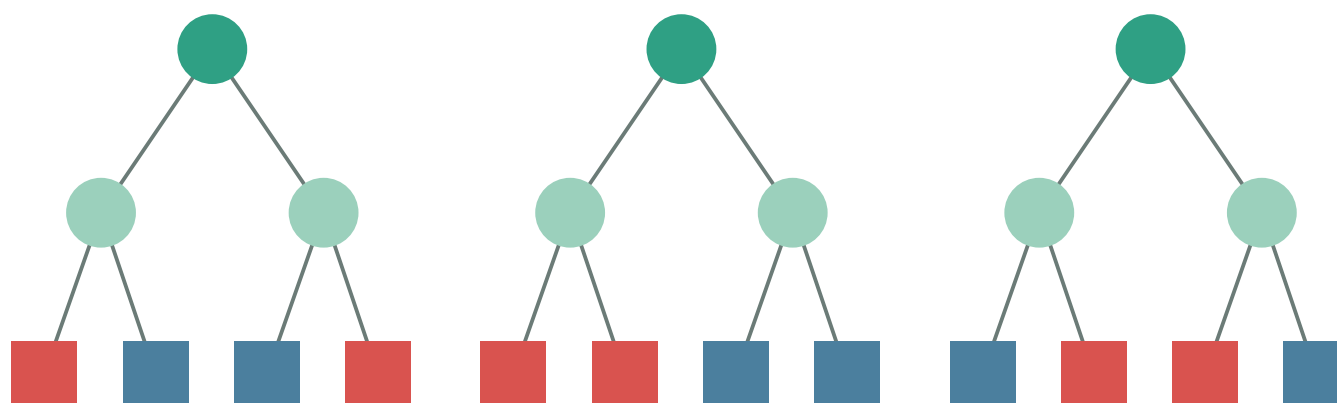
AI, machine learning, deep learning

- **Intelligence:** learning from experience, reasoning, adapting to new situations.
- **AI:** machines doing tasks that normally need human intelligence.
- **Machine learning:** algorithms that learn patterns from data instead of following written rules.
- **Deep learning:** many-layered neural networks for images, signals and language.



Random forest: a crowd of trees

What do you think when I say "Random Forest"?



Each tree sees a random sample of patients and variables

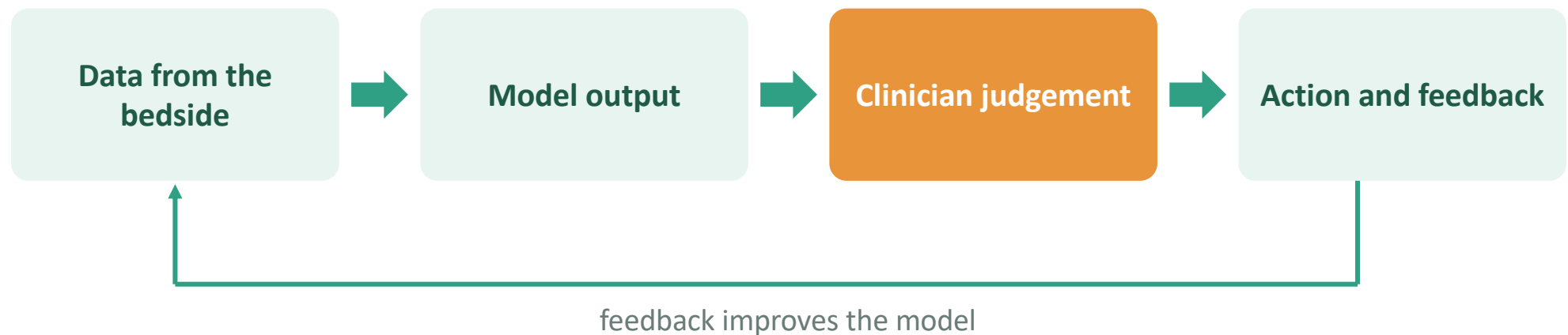


Majority vote

the forest combines all trees into one prediction (e.g. sepsis yes / no)

Most used model in VAP prediction studies (5 of 11).

Human-in-the-loop AI



AI proposes, the clinician decides.

Errors are caught, then fed back.

Accountability stays human.

From bytes to bedside



TRIPOD+AI (BMJ 2024)

Reporting guideline for prediction models built with regression or machine learning.



Not only clinical

Administrative and scientific tasks (writing, search, coding) come first.

NeoMind AI community



Who

Neonatologists, data scientists and researchers working together.



What

Annual pre-conference AI workshop at PAS; 2026 was the third edition.



Live bake-off

Models competed to predict late-onset sepsis in nearly 100,000 preterm infants (Epic Cosmos).

Goal: make sure the NICU is not left behind

02

Applications for neonatology

From the skin to the family room

Relevance 1: no more NICU?



AI is good at

Watching continuous signals, scoring risk, repetitive tasks and documentation.



AI cannot

Examine, comfort, weigh context, talk with parents or carry responsibility.



Realistic future

Fewer false alarms, earlier warnings, more time at the cot side.

Augmentation, not replacement

Relevance 2: reassess or let him rest?

Illustrative scenario: 29-week infant, day 5, stable on CPAP. The AI risk index has been rising for 6 hours; vital signs still look "normal".

Reassess

- Catch early sepsis or NEC
- Antibiotics sooner if needed
- Cost: handling, pain, instability
- Cost: extra tests, possible over-treatment

Let him rest

- Protects sleep and growth
- Avoids unnecessary work-up
- Cost: possible delayed diagnosis
- Cost: false reassurance

The score is one more input, not an order: context decides.

Why the NICU? Small groups, big data

86,400

values per vital sign per day, at one measurement per second

Small

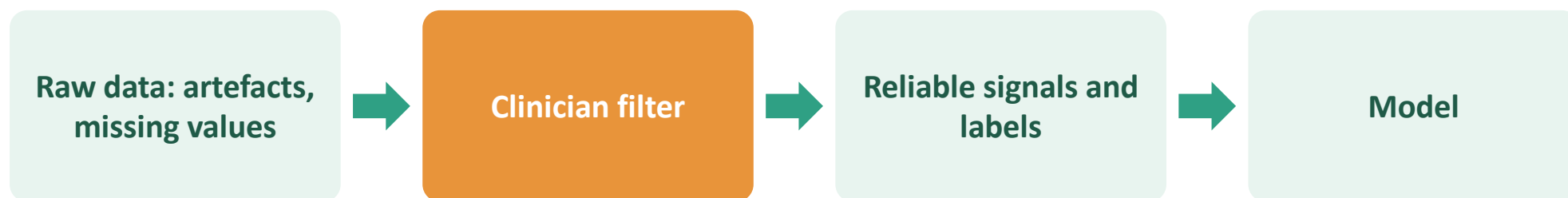
cohorts, rare outcomes, very few randomised trials

Hours

matter: sepsis, NEC, extubation timing

Dense signals + small populations = fertile ground, and a risk of overfitting

Data quality: the human filter



Artefacts

Motion or a displaced probe mistaken for a real event.



Labels

Which "sepsis" definition? It differs by centre.



Samples

Biased or unrepresentative data give biased models.

Skin first: contactless monitoring



Today: wires and adhesives

- Skin injury and pain at removal
- Entry point for infection
- Hinders handling and skin-to-skin



Tomorrow: cameras

- RGB, infrared and thermal imaging
- Deep learning extracts heart and breathing rates
- Continuous, no skin contact

Evidence: heart and respiratory rate in small NICU studies; SpO2 still at animal-model stage

Continuous wireless sensor monitoring with applied diagnostics: Clinical Sensor Pain Scale and Automated Sensor Pain Scale in the NICU

Susan Slattery ^{1,2,3} Sara Pessano,⁴ Jaeyoung Yoo,⁵ Yayun Du,⁵ Seyong Oh,⁶ Hyoyoung Jeong,⁷ John Mascari,¹ Beth F Lappin,³ Hannah Alvarez,³ Tracey M Stewart,³ Kenny Kronforst,² Erin Lonergan,³ Joely Gendler,³ Casey Rand,³ Narayanan Krishnamurthi,³ Aaron Hamvas,² John Rogers,⁵ Debra Weese-Mayer^{2,3}

Extubation: can we predict it?

25-35%

of extubation attempts fail in
infants born at 28 weeks or less

84%

of failures flagged in advance by
ML on breathing patterns (186
infants)

AUC 0.94

with SpO2 and ventilator data in
infants under 2 weeks (0.77 for
all)

Observational studies only: no trial yet shows better outcomes

Published in final edited form as:

J Pediatr. 2024 August ; 271: 114043. doi:10.1016/j.jpeds.2024.114043.

Predicting Extubation Readiness in Preterm Infants Utilizing Machine Learning: A Diagnostic Utility Study

Mandy Brasher, M.D¹, Alexandr Virodov, M.S², Thomas M. Raffay, M.D³, Henrietta S. Bada, M.D., M.P.H¹, M. Douglas Cunningham, M.D¹, Cody Bumgardner, Ph.D², Elie G. Abu Jawdeh, M.D., Ph.D^{1,*}

Who will read my EEG?

- **The problem:** continuous EEG is the gold standard, but expert readers are scarce.
- **AI as second reader:** seizure detection and background classification.
- **Sonification:** AI turns EEG into sound; accuracy on par with trained neurophysiologists.
- **Dutch 10-year cohort:** early aEEG and raw EEG to predict long-term neurodevelopment in extremely preterm infants.
- **Structured EEG reports** in the EHR can fuel seizure prediction models.



1 h → 5 s

to review an hour of EEG with
AI sonification

Early qualitative and quantitative amplitude-integrated electroencephalogram and raw electroencephalogram for predicting long-term neurodevelopmental outcomes in extremely preterm infants in the Netherlands: a 10-year cohort study

Xiaowan Wang, Chiara Trabatti*, Lauren Weeke, Jeroen Dudink, Henriette Swanenburg de Veye, Rian M J C Eijssermans, Corine Koopman-Esseboom, Manon J N L Benders, Maria Luisa Tataranno*



Nutrition optimisation



Growth

Predict faltering growth from daily data and tailor intake.



Feeding

Anticipate intolerance and support fortification decisions.



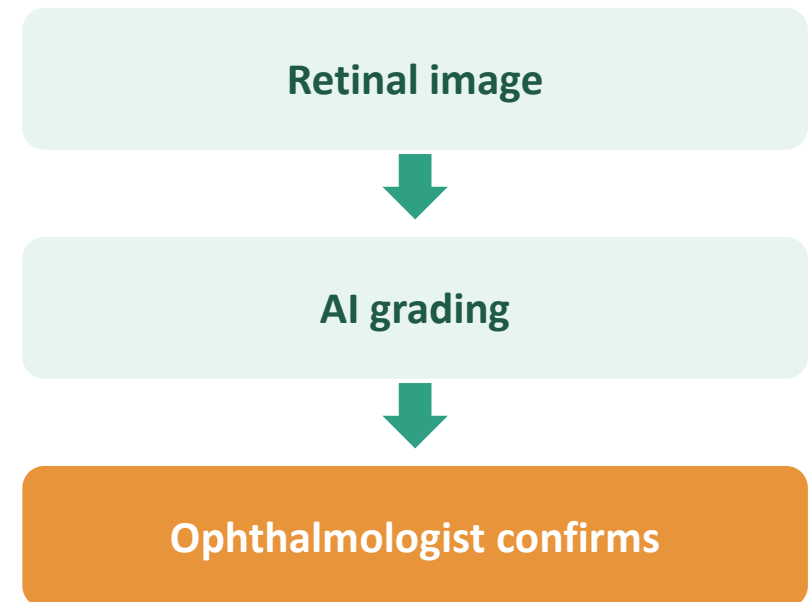
Safety

Link feeding patterns to NEC risk.

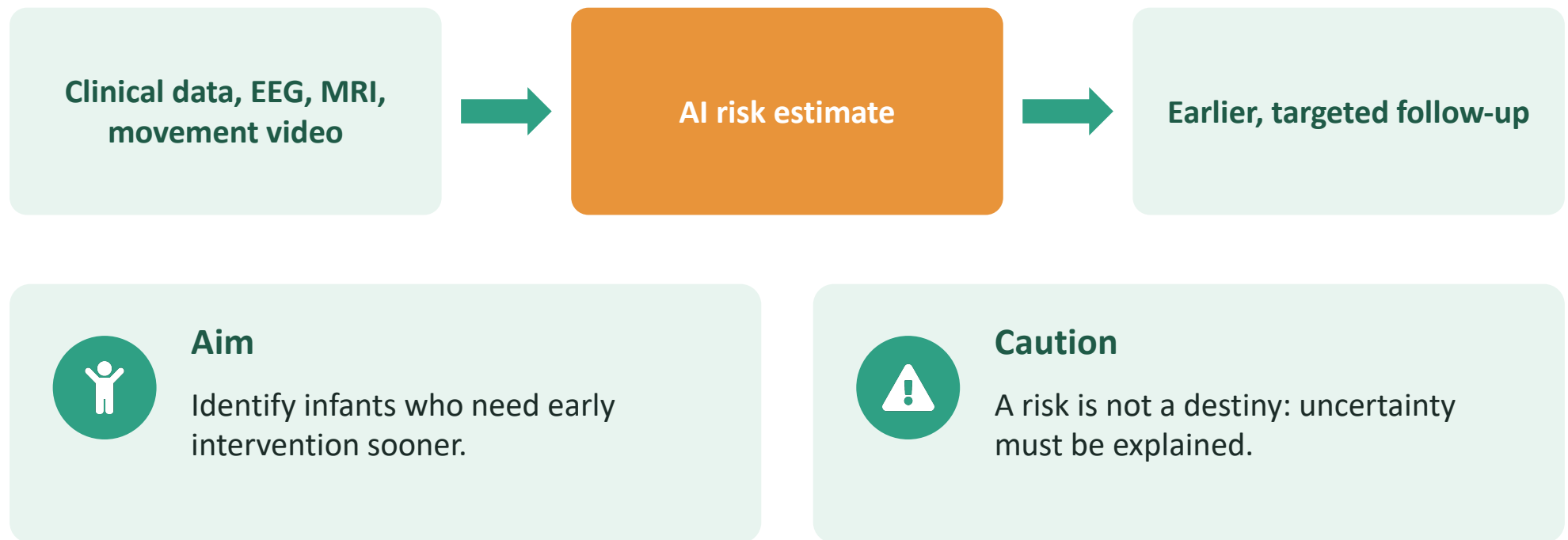
Mostly prediction models so far: prospective validation still needed

Retinopathy of prematurity

- **Deep learning** grades retinal images with expert-level agreement in studies.
- **Tele-ophthalmology + AI** extends screening where specialists are scarce.
- **Hurdles:** image quality, device variability, regulation.



Predicting developmental outcomes



Pain monitoring



Today

Intermittent bedside scores (e.g. PIPP, NIPS): subjective and observer-dependent.



With AI

Continuous wireless-sensor pain scales (clinical and automated) and multimodal signal analysis.

Parents and clinicians have been consulted on AI pain monitoring (JMIR AI)

Original Paper

Health Care Professionals' and Parents' Perspectives on the Use of AI for Pain Monitoring in the Neonatal Intensive Care Unit: Multisite Qualitative Study

Nicole Racine^{1*}, PhD; Cheryl Chow^{2*}, PhD; Lojain Hamwi², BA; Oana Bucsea², MA; Carol Cheng³, MSc; Hang Du⁴,

Doctor-parent interactions



Plain language

Clear summaries of what is happening and why.



Translation

Support for multilingual families, a daily reality in Brussels.



Less typing

Ambient documentation frees time for conversation.

Tested with NICU fathers (Cureus 2025). Risks: errors, GDPR. Always review.

Review began 09/21/2025

Review ended 10/08/2025

Published 10/12/2025

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Enhancing Neonatal Intensive Care Unit (NICU) Paternal Satisfaction: A Comparative Study of Traditional vs. Generative AI-Integrated Counseling

Aayushi Joshi ¹, Shantanu Shubham ², Syed Moiz Ahmed ², Divya Mishra ³, Richa Joshi ¹, Naini Puri ¹, Girish Gupta ²

¹. Pediatrics, Graphic Era Deemed to be University, Dehradun, IND ². Neonatology, Graphic Era Deemed to be University, Dehradun, IND ³. Obstetrics and Gynecology, Graphic Era Deemed to be University, Dehradun, IND

03

Neonatal infectious diseases focus

AI and infectious hazards

NEC: an inflammatory emergency



Imaging

Deep learning on abdominal X-rays.



Early warning

Vital signs, labs and feeding data combined.



Microbiome

Gut bacteria signatures as predictive features.

Rare event + subtle early signs = hard prediction problem

Sepsis: two diseases, two toolkits



Early-onset

Kaiser calculator: baseline risk updated with the clinical picture (Bayes in action), allowing fewer empirical antibiotics.



Late-onset

HeRO heart-rate monitoring; deep learning on noninvasive biosignals (prospective multicentre study); ~100,000-infant bake-off.

Only a few tools have reached randomised evidence



Contents lists available at ScienceDirect

International Journal of Medical Informatics

journal homepage: www.elsevier.com/locate/ijmedinf



Early detection of late-onset neonatal sepsis from noninvasive biosignals using deep learning: A multicenter prospective development and validation study

Antti Kallonen^{a,*}, Milla Juutinen^a, Alpo Värri^a, Guy Carrault^b, Patrick Pladys^{b,c},
Alain Beuchée^{b,c}



VAP prediction in the NICU

11

studies in a 2024 scoping review
of AI for VAP prediction (all ages)

0

studies addressed
implementation; all used
internal validation only

AUC 0.80

deep learning on neonatal chest
X-rays (900 images, 670 neonates)

Random forest most used (45%): prediction is not impact

Klebsiella and outbreak hazards

- **Genomics + ML** identify risk factors for carbapenem-resistant *K. pneumoniae* spread in neonatal units (2025).
- **ML prediction** of carbapenem-resistant infection in ICUs; length of stay emerges as a key predictor.
- **Aim:** earlier isolation, targeted empirical therapy, outbreak preparedness.





 | Bacteriology | Research Article

Machine learning-based evaluation of risk factors for carbapenem-resistant *Klebsiella pneumoniae* dissemination in neonatal units

Xiao Liu,^{1,2} Muxiu Jiang,³ Jinzhi Zhang,⁴ Heng Li,^{1,5} Yina Liu,¹ Jiaqi Zhang,¹ Xia Chen,³ Jun Bu,⁶ Shichang Xie,^{1,7} Menghan Zhang,⁸ Ning Dong,⁹ Qing Cao,³ Zhemin Zhou^{1,2,5}



Drug dosing and telemedicine



Precision dosing

Bayesian forecasting of antibiotic levels from few samples; ML plus metabolomics to predict vancomycin clearance in neonates.



Telemedicine + AI

Remote expert review of EEG, retinal images and echo; expertise reaches smaller units.

Another comeback for Bayes

ARTICLE OPEN ACCESS

Predicting Vancomycin Clearance in Neonates and Infants by Integrating Machine Learning and Metabolomics With Population Pharmacokinetics

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Received: 30 March 2025 | **Revised:** 23 May 2025 | **Accepted:** 18 June 2025

Infection control



Surveillance

Automatic detection of healthcare-associated infections from EHR and lab data.



Outbreak alerts

Spot clusters early in microbiology and bed-movement data.



Hand hygiene

Computer-vision compliance monitoring, with privacy limits.

Stewardship: fewer unnecessary antibiotics, less resistance

04

Wider reflections

Equity, environment and what comes next

Health equity: pros and cons



Pros

- Expertise at scale for low-resource units
- Less variability between centres
- Low-cost tools (phone, camera)



Cons

- Biased training data, e.g. pulse oximeters over-reading SpO2 in darker skin
- Under-representation of low-income settings
- Cost and digital divide

One Health: the environment



Footprint

Training and running models uses energy and water in data centres.



Benefit

Fewer unnecessary tests and antibiotics: less waste, less resistance.



Proportion

Right-sized models, and ask first: is AI needed here?

Human, animal and environmental health are one system

Future (1): what is coming



Multimodal models

Signals, images and notes read together.



Federated learning

Pool small NICUs without sharing patient data.



EHR-embedded tools

Vendors are building neonatal-specific modules.



Language assistants

Ambient documentation and LLM helpers.

Future (2): what we need



**Prospective
validation and RCTs**



**Transparent
reporting
(TRIPOD+AI)**



**Regulation: EU AI
Act, MDR**



AI literacy for teams



**Parents and
governance**

Rigorous studies first, then integration

Take-home messages

- 1 AI is a general concept
- 2 Big potential for the NICU
- 3 Data quality is everything
- 4 Already useful for non-clinical tasks
- 5 Rigorous studies needed before clinical integration

Thank you. Questions?

Dr Erica Rotunno

CHU St Pierre

BVN-GBN Meeting, Grimbergen, 8/10/2026



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