



## ZHAW Hackathon “LA4B” 27.Sep – 11.Okt.2023

@ Roche Diagnostics in Rotkreuz

Organization by  
ZHAW  
and  
Roche

# 00. Hackathon “LA4B”

## Organisation & Guests

Zürcher Hochschule  
für Angewandte Wissenschaften



### **Roche:**

Thomas Zaugg: Head of Open Innovation & External Networks RDI

Bastiaan van Holthe: Senior International Medical Affairs Manager, Critical Care, CDMA Sepsis Area Lead

Glenda Cosi: Medical Affairs Manager, RDCH

Yves Krähenbühl: Coordinator Open Innovation

Livia Albin: Intern Open Innovation & External Networks

### **ZHAW:**

Matthias Nyfeler: Programme Director, ZHAW School of Life Sciences, FG Advanced Signal Analytics

Yulia Sandamirskaya: Zentrumsleitung, ZHAW School of Life Sciences, FS Cognitive Computing in Life Sciences

### **Luzerner Kantonsspital (LUKS):**

Davide Morgillo: Leitender Arzt Neonatologie, PC LUKiS, Kinderspital LUKS

**+ Guests for the Hackathon**

# 01. Hackathon “LA4B”


Teaser



## Teaser:

Thousands of newborn babies in Switzerland are treated with unnecessarily antibiotics.

We want to change this challenging situation. Here are the inspiring topics we've prepared:

 **Biosensing:** Revolutionize newborn diagnostics with biosensing technology!  
Explore innovative devices like cobas pulse, SteadyTemp, and more wearables for newborns.  
Leverage open time series data to create transformative healthcare approaches, detecting sepsis signs and monitoring vital signs with precision.

See the future of diagnostics!

Students, it's time to access open data, recognize relevant samples, and validate your ideas using data.

Let's revolutionize newborn healthcare together.

Join us at the hackathon and unleash your potential to create impactful solutions that will save countless babies from unnecessary antibiotic treatments.

# 01. Hackathon “LA4B”

Sepsis: Motivation, Diagnostics, Hospital View

Zürcher Hochschule  
für Angewandte Wissenschaften



**-> Roche/Bastiaan van Holthe:  
Sepsis Severity and Diagnostics**

**-> LUKS, Davide Morgillo:**  **luzerner kantonsspital**  
**Hospital View and Motivation for Improvement**

A low-angle photograph of a sailboat's mast and sail against a bright blue sky with wispy white clouds. The sail is white and the mast is dark, creating a strong diagonal line across the frame.

# Sepsis and Diagnostics

**Bastiaan van Holthe**

Medical Affairs Lead Sepsis

ZHAW Hackathon

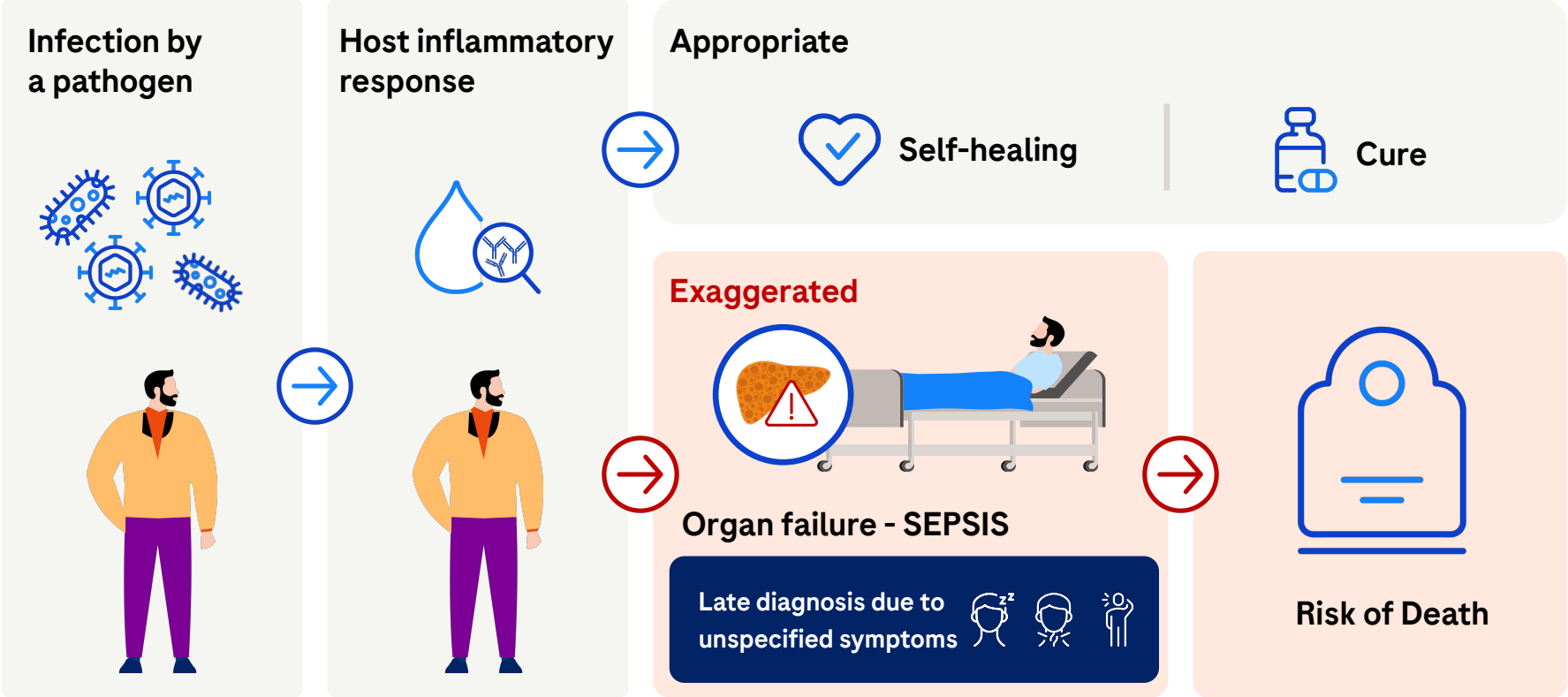
September 27, 2023



*Before signing up for the hackathon,  
had you heard about sepsis?*



# What is Sepsis?





# Neonatal sepsis is a common and frequently fatal condition

~1.3 to 3.9 million cases of neonatal sepsis worldwide every year<sup>1</sup>



Mortality rate: 17.6%<sup>2</sup>

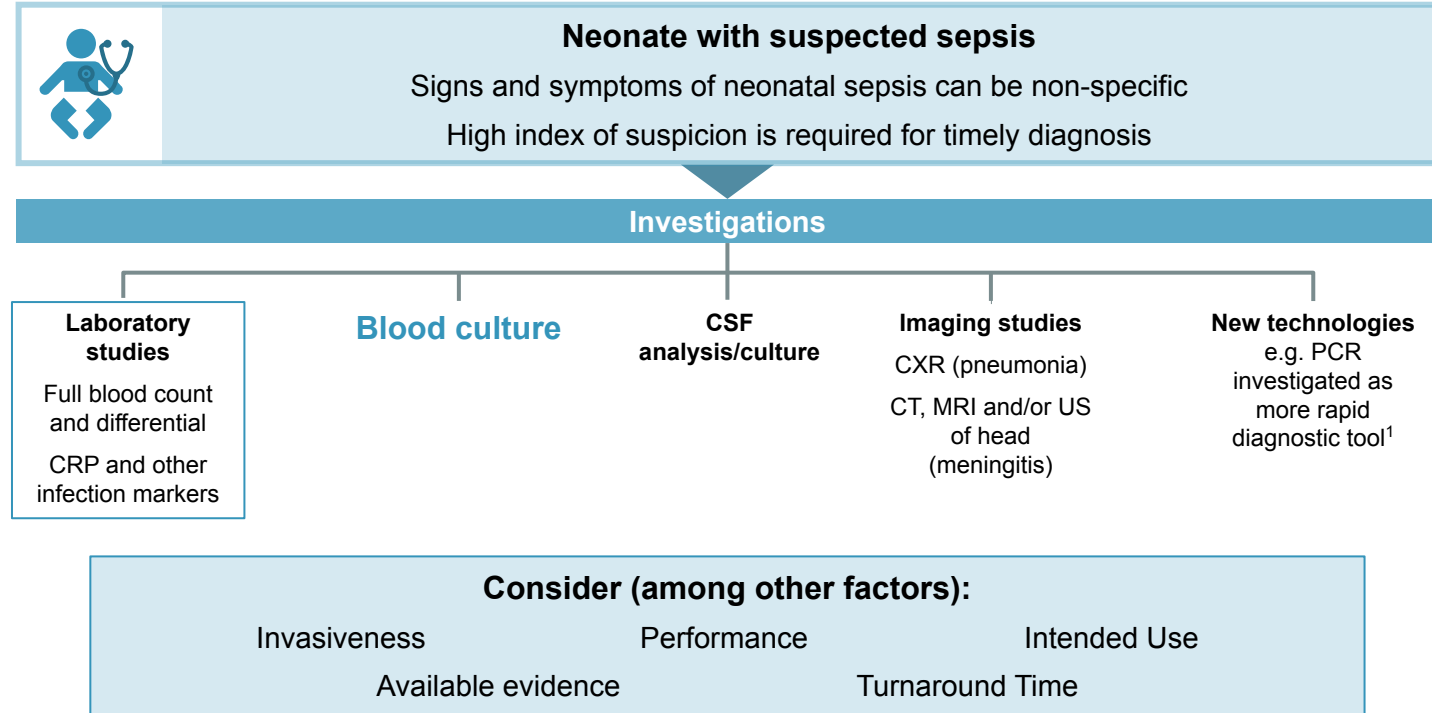
~400,000 to 700,000 deaths annually<sup>1</sup>  
(~15% of all neonatal deaths globally<sup>3</sup>)

1. Global report on the epidemiology and burden of sepsis: current evidence, identifying gaps and future directions. Geneva: World Health Organization; 2020. Available at <https://www.who.int/publications/i/item/9789240010789>;

2. Fleischmann et al. Arch Dis Child 2021;106:745–52;

3. Levels and trends in child mortality: estimates developed by the UN Inter-agency Group for Child Mortality Estimation, 2019. Available at <https://www.unicef.org/sites/default/files/2019-10/UN-IGME-child-mortality-report-2019.pdf>.

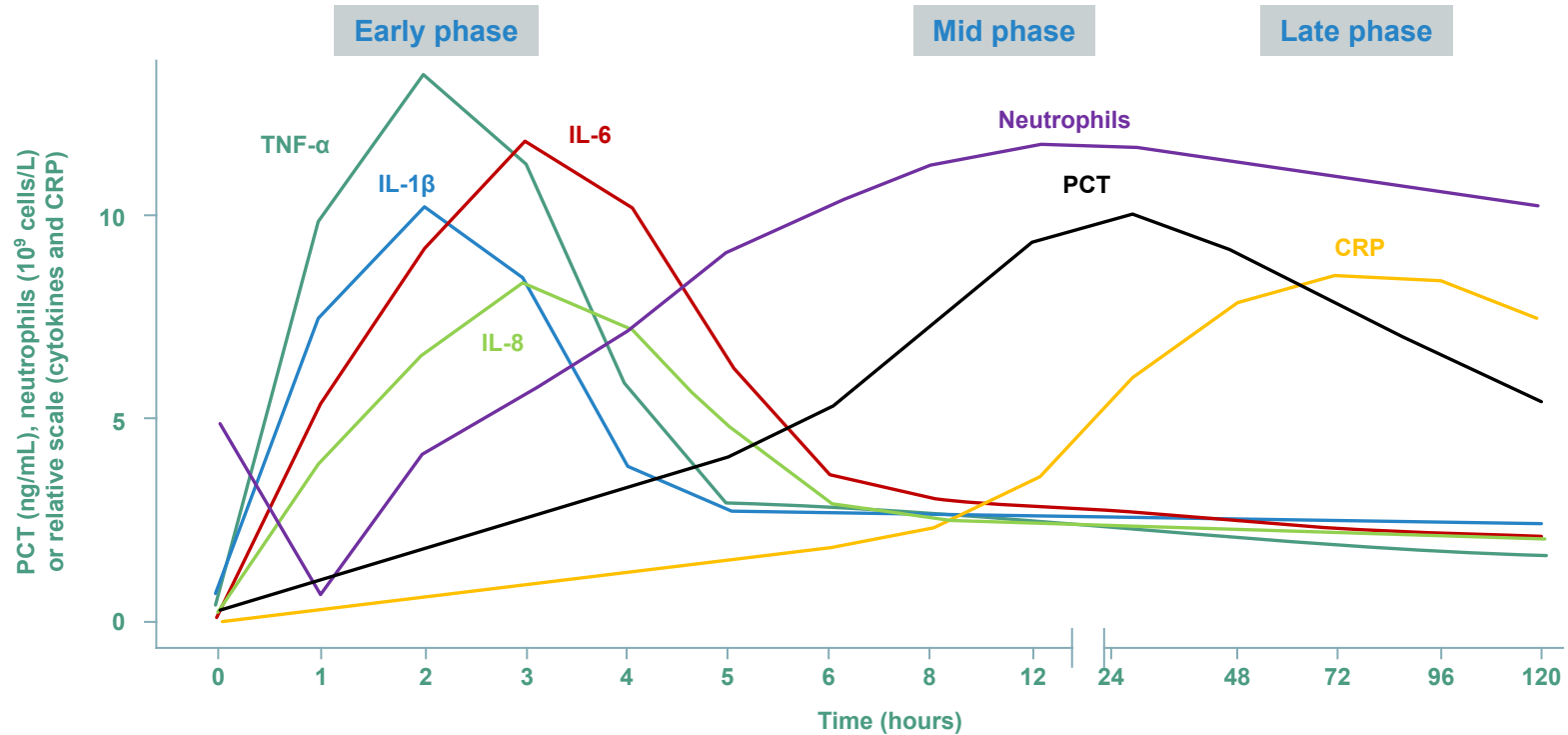
# Blood culture remains the gold standard for diagnosis



CRP, C-reactive protein; CSF, cerebrospinal fluid; CT, computed tomography; CXR, chest x-ray; MRI, magnetic resonance imaging; PCR, polymerase chain reaction; US, ultrasound

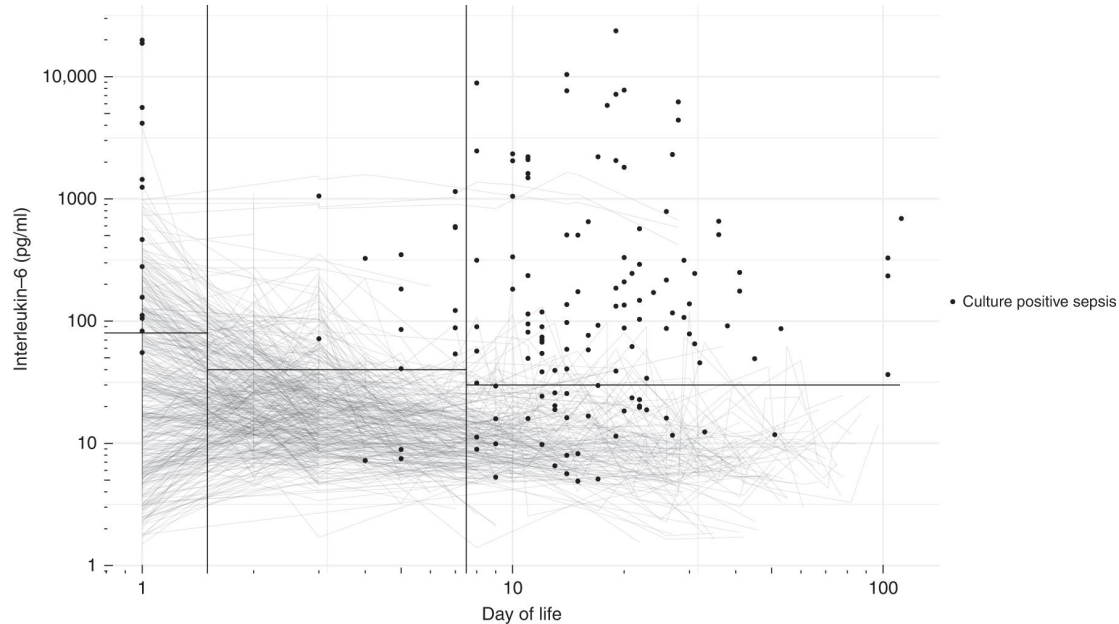
1. Simonsen et al. Clin Microbiol Rev 2014;27:21–47.

# Biomarker time courses following bacterial infection of a host



Overview of biomarker time courses following acute Gram-negative bacterial infection of a host. CRP, C-reactive protein; IL, interleukin; PCT, procalcitonin; TNF- $\alpha$ , tumour necrosis factor-alpha Thorsted et al. Int J Antimicrob Agents 2020;56:106059.

# IL-6 as aid in diagnosis of neonatal sepsis?



**4 years** routine clinical data  
**13.371** IL-6 measurements  
**8.488** values after exclusion  
**1.695** neonates



**Results in a claim extension  
for our product (Q4/2023)**

# Why this problem isn't solved yet...

... and why we need your help in this Hackathon!

non-exhaustive

## Population

- Vulnerable population
- Low obtainable blood volume
- Premature/low birthweight infants
- Immature immune system and lack of robust immune response

## Neonatal sepsis

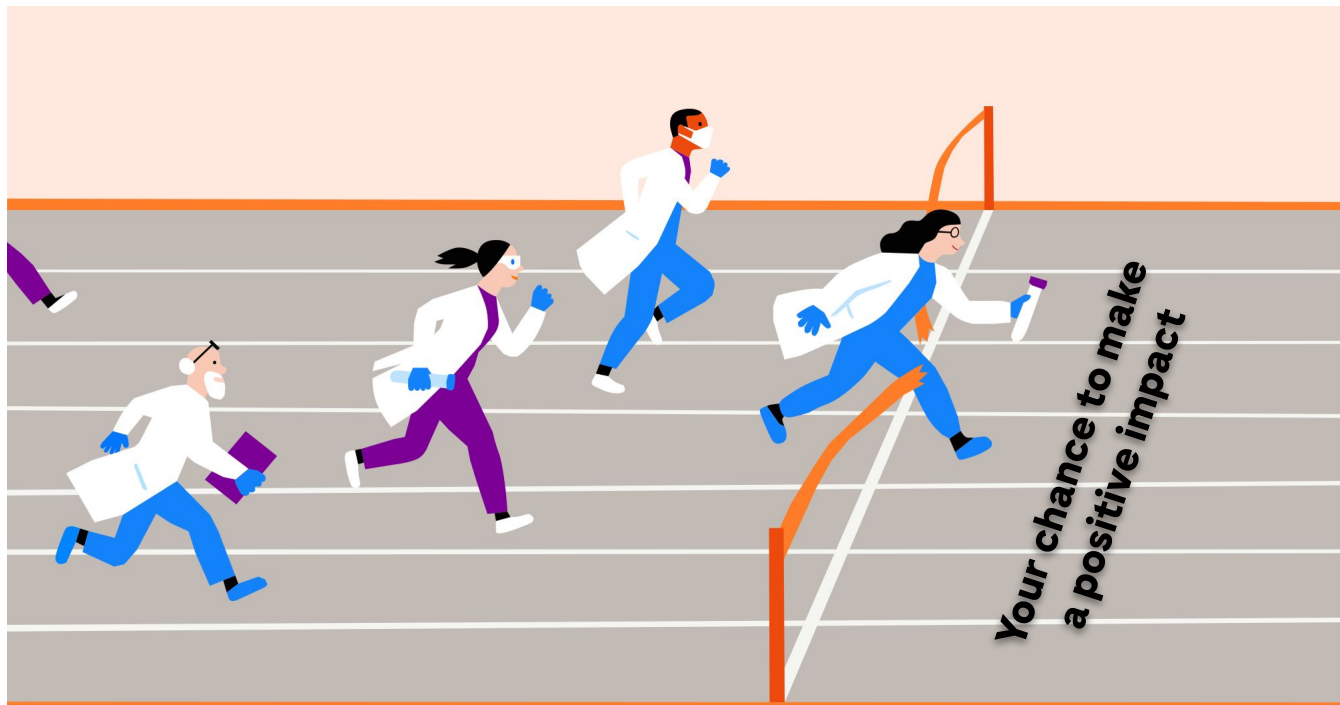
- Time is critical, fast deterioration
- Dilemma between early intervention and having full information
- Unspecific signs and symptoms
- Lack of internationally accepted definition and guidelines

## Neonatal sepsis evidence generation

- Difficulty obtaining ethical approval
- Lack of data
- Lack of a suitable gold standard/predicate device
- Geographical differences
  - Incidence
  - Access
  - Standard of care

# Good luck and enjoy

We look forward to your creative ideas!



**Your chance to make  
a positive impact**

# Hospital View and Motivation for Improvement



## Neonatal Sepsis

Davide Morgillo  
September 2023

## Decision-making process: Challenges

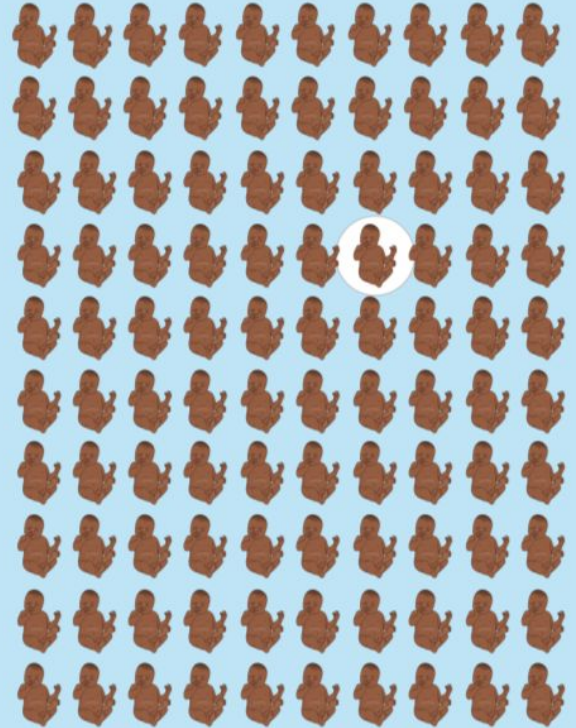
Fear of  
sepsis



Bias &  
noise

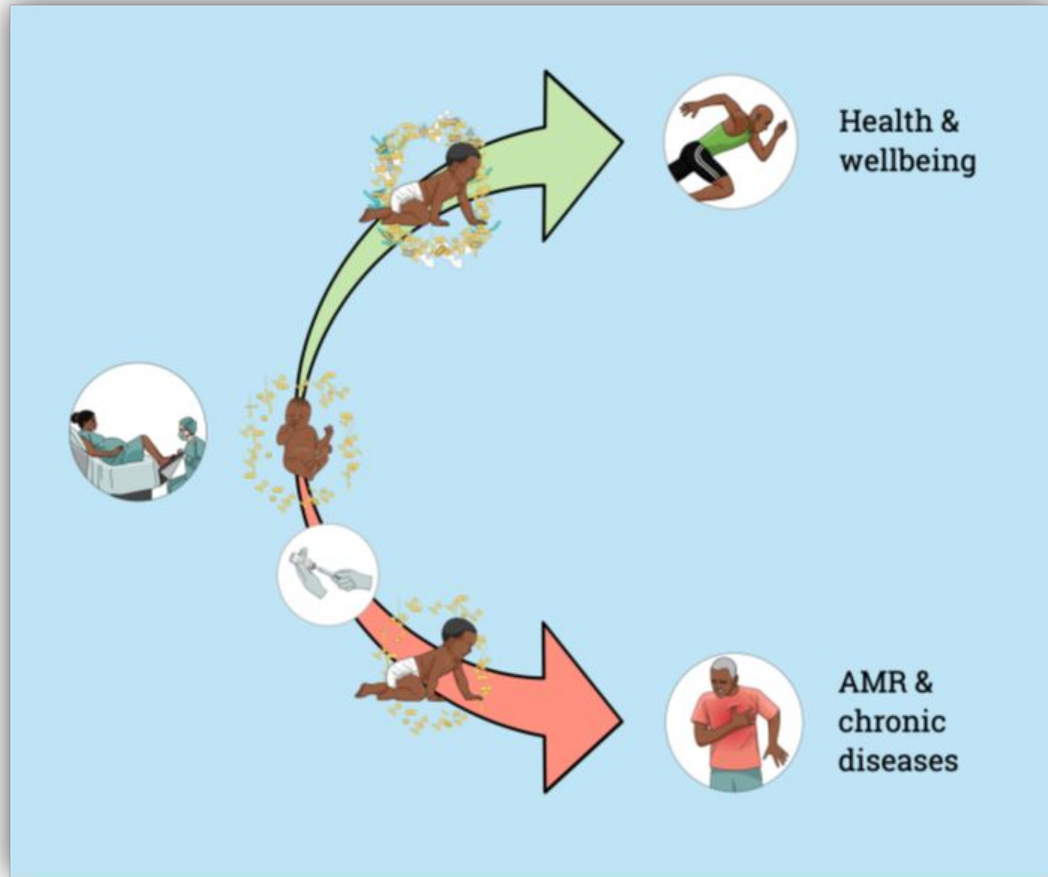


Time  
preference



\* term and late-preterm neonates





> 1.3 million people die annually caused by drug resistant infections

Worldwide incidence of chronic diseases is increasing

Obesity, Diabetes mellitus, Cardiovascular diseases, Inflammatory bowel disease, Asthma, ...



# our challenge !



\* Noah, died because of sepsis

# 1.

## Antibiotics Start: Smarter Sepsis calculator (AI) combined with serial clinical observations

Predictor	Scenario
Incidence of Early-Onset Sepsis	0.3/1000 live births (KPNC incidence)
Gestational age	40 weeks 0 days
Highest maternal antepartum temperature	37 Celsius
ROM (Hours)	8
Maternal GBS status	<input checked="" type="radio"/> Negative <input type="radio"/> Positive <input type="radio"/> Unknown
Type of Intrapartum antibiotics	<input type="radio"/> Broad spectrum antibiotics > 4 hrs prior to birth <input type="radio"/> Broad spectrum antibiotics 2-3.9 hrs prior to birth <input type="radio"/> GBS specific antibiotics > 2 hrs prior to birth <input checked="" type="radio"/> No antibiotics or any antibiotics < 2 hrs prior to birth

Calculate » Clear

Risk per 1000/births			
EOS Risk @ Birth		0.08	
EOS Risk after Clinical Exam	Risk per 1000/births	Clinical Recommendation	Vitals
Well Appearing	0.03	No culture, no antibiotics	Routine Vitals
Equivocal	0.38	No culture, no antibiotics	Routine Vitals
Clinical Illness	1.61	Strongly consider starting empiric antibiotics	Vitals per NICU

Classification of Infant's Clinical Presentation: [Clinical Illness](#) [Equivocal](#) [Well Appearing](#)

Risk factors (RF)  
Gestational age  
Maternal Temperature  
ROM  
GBS  
Intrapartum antibiotics

Incidence of EOS

Clinical signs (CS)  
Critical illness - equivocal

Tool developed from Kaiser Permanente

<https://neonatalespsiscalculator.kaiserpermanente.org/>

## 2.

**Automated, standardized data acquisition: Wearables, cameras, patches ...**



«Hackathon»

<https://tucky.us>



Considerations



**A better start  
for future  
health:  
Less Antibiotics  
for babies.**

**Questions?**

[davide.morgillo@luks.ch](mailto:davide.morgillo@luks.ch)



# 01. Scope of Biosensing

What is in focus for the Hackathon

- Not in Scope:
  - Blood Tests, as neonates have very limited blood
  - Other internal fluids
- In Scope (examples): Think beyond & out-of-box....
  - Heart rate, ECG
  - Respiration rate
  - Temperature-> STEADYTEMP patch
  - Blood pressure / Blood oxygen
  - Sleep-Parameters
  - Eyes / Iris
  - Saliva:
    - <https://salimetrics.com/analyte/salivary-interleukin-6/>
    - <https://salimetrics.com/analyte/salivary-c-reactive-protein/>
  - Vision with cameras/IR

# 01. Temperature Sensor with STEADYTEMP

Possibilities of temperature measurement

- <https://www.steadytemp.health/>

← Kurveninformationen

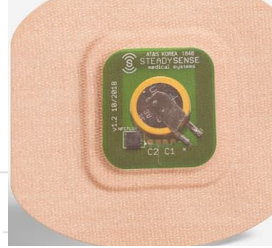
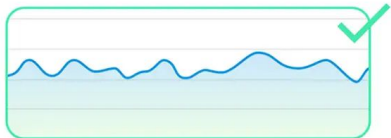
## Fieberkurven

Wenn STEADYTEMP Ihnen eine ähnlich ansteigende Kurve wie diese anzeigt, wenden Sie sich bitte an einen Arzt.

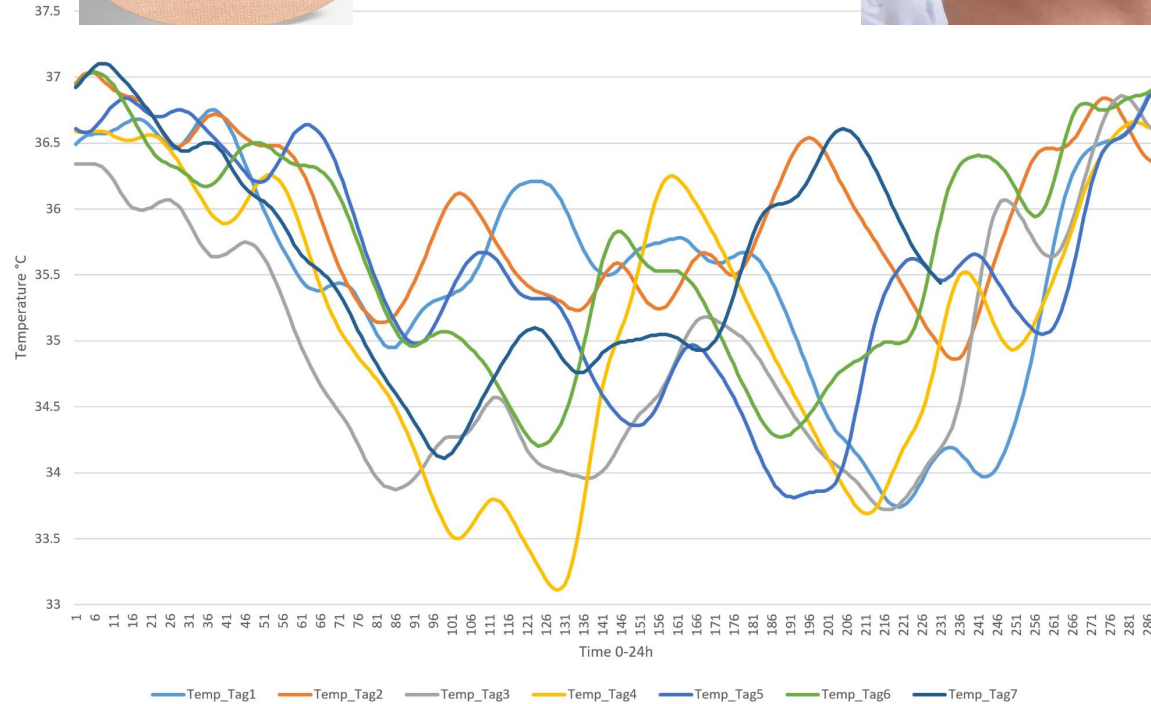


## Normale Kurven

Wenn STEADYTEMP Ihnen eine ähnliche Kurve wie diese anzeigt, liegt dies höchstwahrscheinlich an einem der folgenden Gründe:



STEADYTEMP, one week, non sick



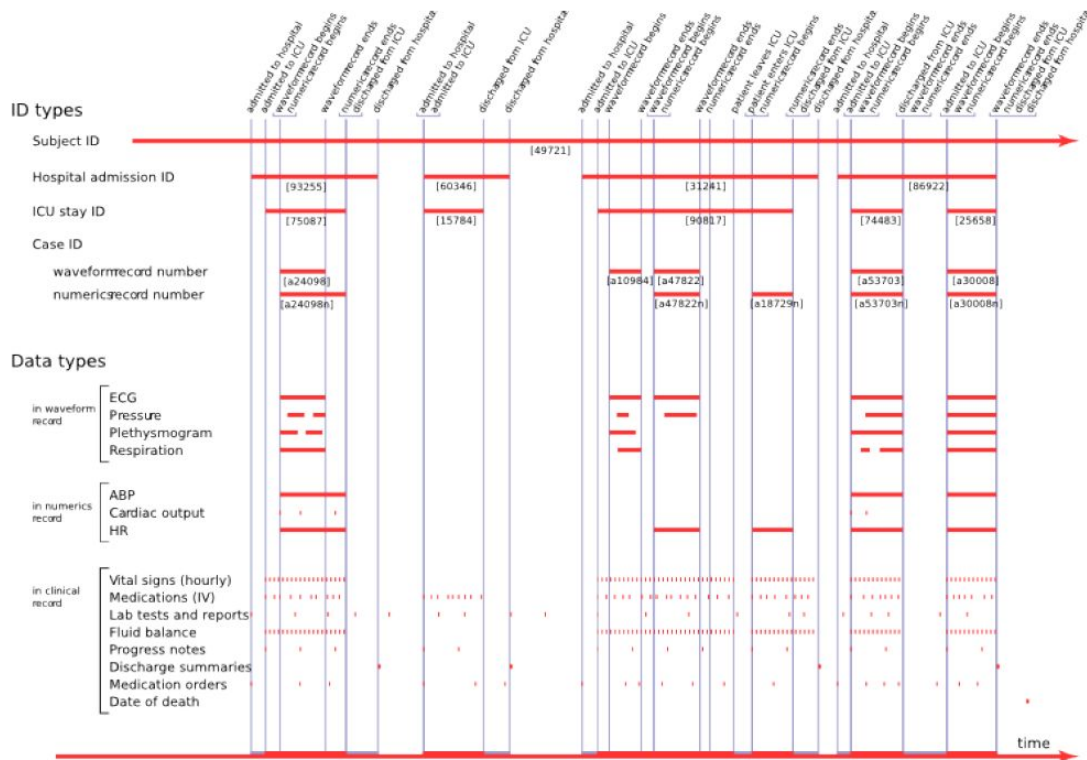


# 01. Examples of DATA & Calculator

## Different Data Approaches

- KAGGLE - Prediction of Sepsis
- Neonatal Sepsis Registry  
Time to Antibiotic Dataset, 2019
- US National Institute of Health (NIH)  
MIMIC (Medical Information Mart for Intensive Care)

<https://mimic.mit.edu>



# Timing of Sepsis

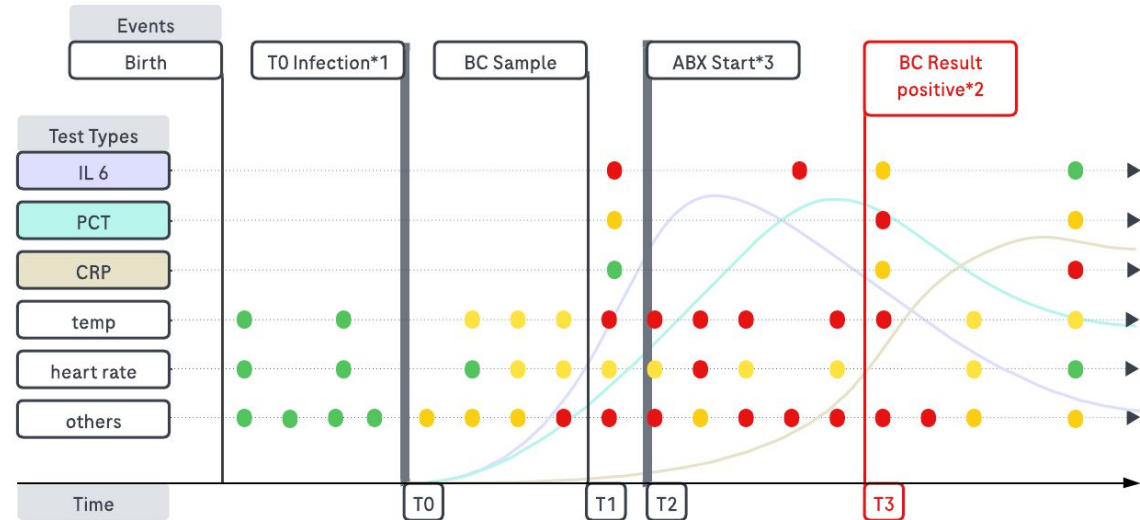
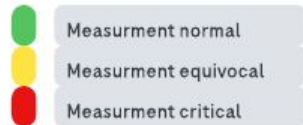
## Structure & Definition of time events

Legend:

\*1 Start of Infection varies, this is a sample representation

\*2 if BC positive, specific antibiotics must be given

\*3 ABX Start varies, empiric treatment is started after BC sample is drawn



# 01. Hackathon “LA4B”

## Problem definition

### Questions:

- Which non-invasive parameters/measurement methods describe/correlate to the condition (fever, malaise, etc.) of Neonates?  
If so, are these point determinations or are serial measurements necessary?
- Are there parameters/measurement methods that distinguish neonates with sepsis from neonates without sepsis? If so, how good is their predictive value?
- Are there parameters/measurement methods that can assess the outcome of neonates with sepsis?
- If sepsis is recognized and antibiotics are administered, could signs of antibiotic resistance be detected by above parameters/measurement methods?

# 01. Hackathon “LA4B”

Content and form

## Workflow

5 groups, teams of approx. 4 people

Work out possible hypothesis or prototypes to solve the issue

## Material

- [Papers Pre-read](#)

## Expected Results, Output:

- Slides for final presentation
- If appropriate python or other scripts

## 02. Timing

27.09.2023 – 11.10.2022



### **Pre-Reads & background information**

Will be sent beginning of September

### **Case kick-off, presentation of the case owners (tuned in virtually)**

Wednesday, 27. September,

12:00 Meeting at the reception, check-in

12:30 lunch reservation @Quadra

13:15 Roche Campus Rotkreuz, Workshop Room 102, floor 1, Building 5

Hackathon presentation

~16:00 quick Roche Info, tour around campus, open end

### **Presentation of results in groups**

Wednesday 11. October, 13:00, Roche Campus Rotkreuz, Workshop Room 102, floor 1, Building 5

13.15 - approx. 14.30 presentation (10 min presentation & 5 min Q&A)

Afterward showroom tour, drinks and snacks (14th floor), open end

**Doing now what patients need next**