

Swiss TPH



Swiss Tropical and Public Health Institute
Schweizerisches Tropen- und Public Health-Institut
Institut Tropical et de Santé Publique Suisse



Novel case management strategies including algorithm development and validation

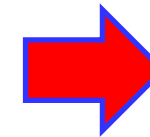
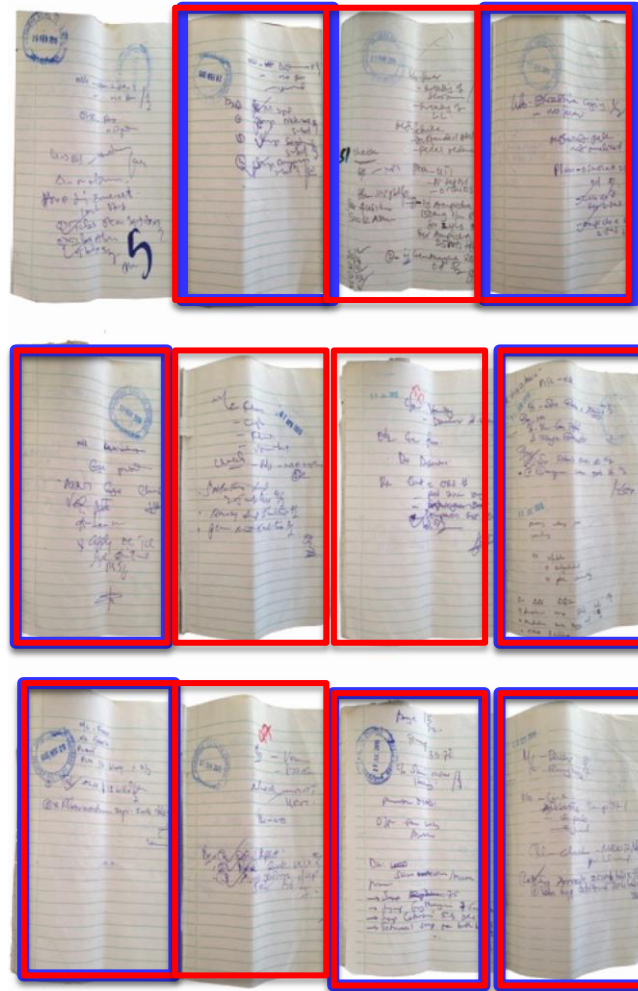
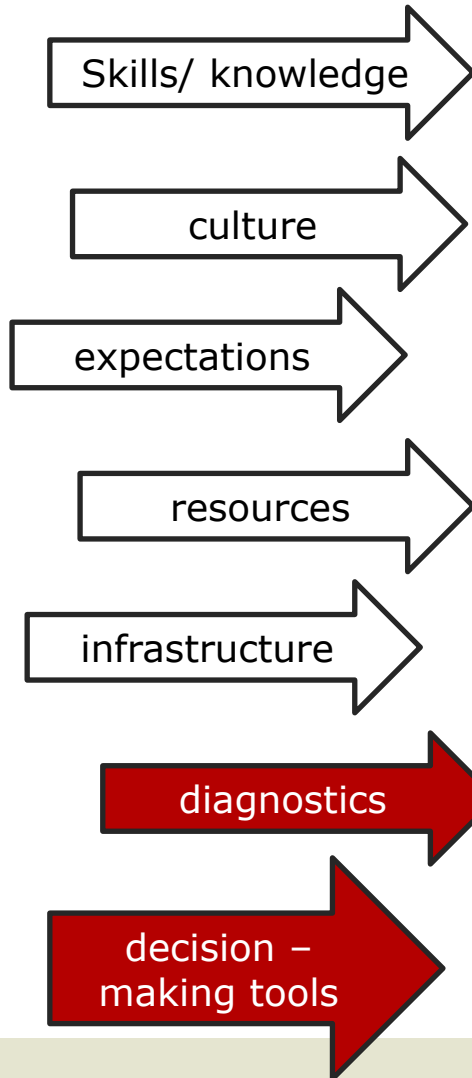
Prof. V. D'Acremont, MD, PhD

Swiss Tropical and Public Health Institute

Ambulatory care and community medicine, University Hospital of Lausanne



18 month old child



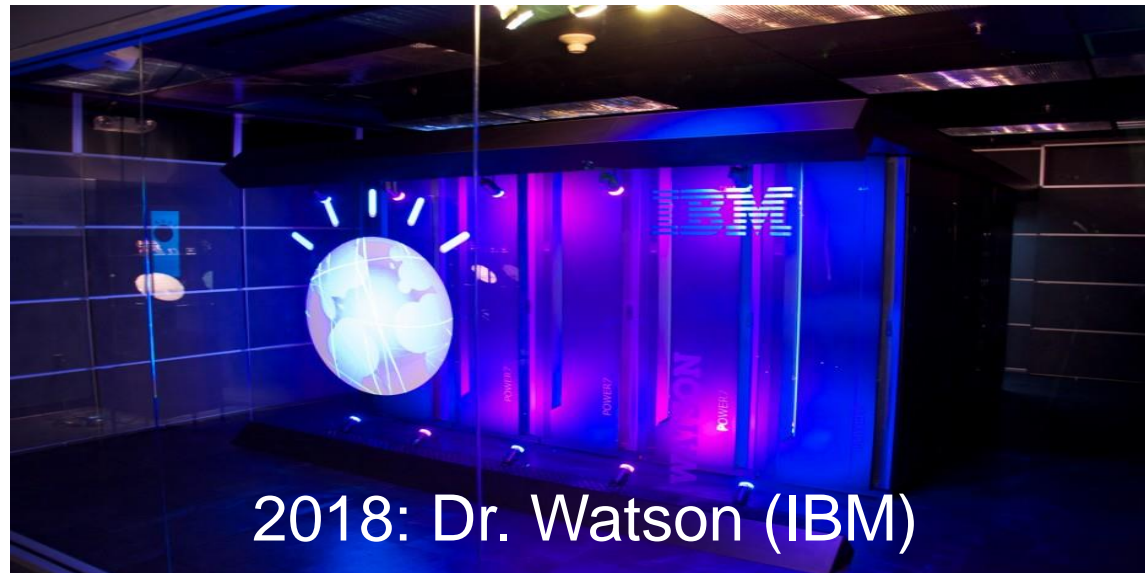
- Poor patient outcome:
- Antibiotic side effects
 - Destruction of gut flora
 - Antibiotic resistance



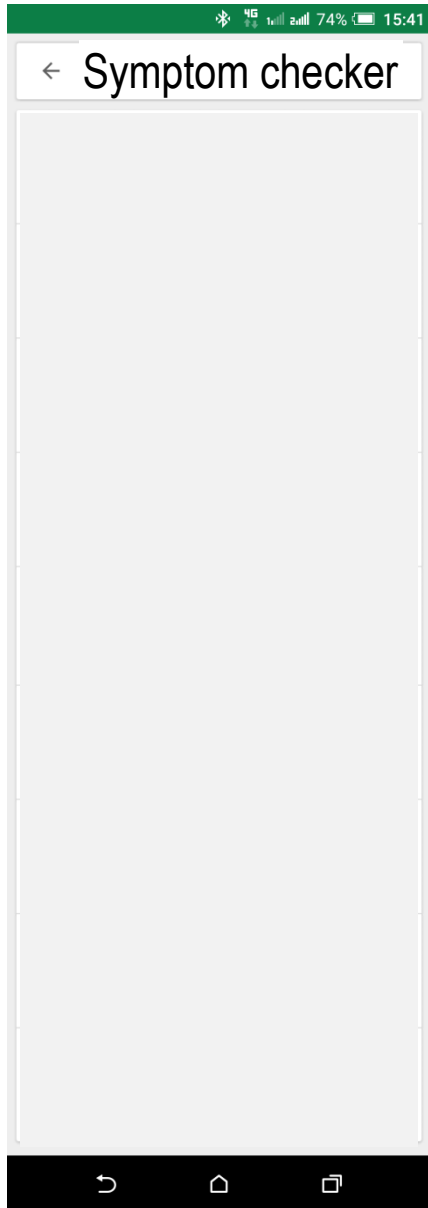
Are electronic decision support algorithms really new..?

The times have passed when a single human mind could even pretend to know all that might be useful in aiding patients.

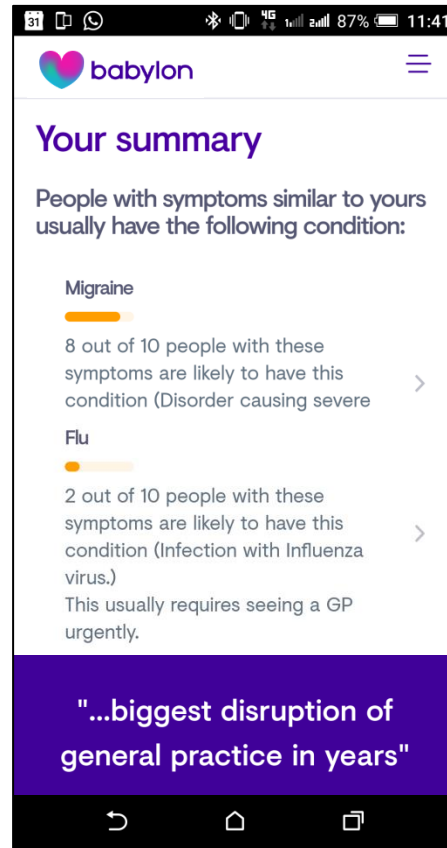
L.C. Payne, The role of the computer in refining diagnosis, The lancet **1964**



What is available on the market?



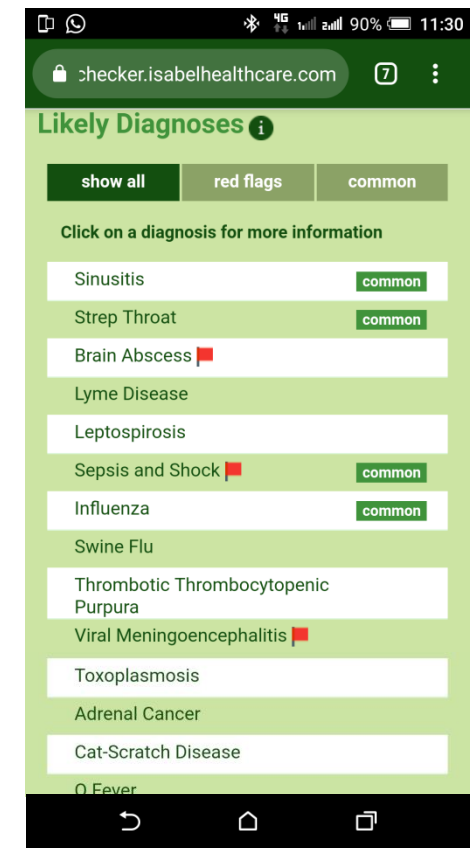
Babylon



ada



Isabel



Babylon at the heart of controversies...

Babylon sign a contract with NHS.

8 complaints filed by GPs in UK.

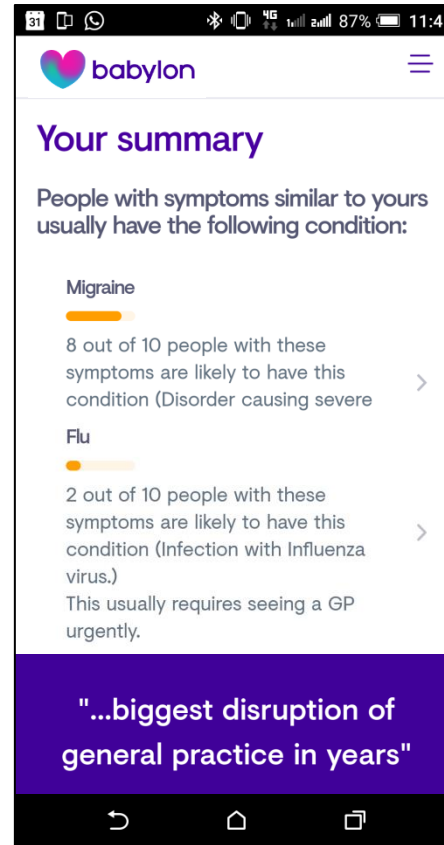
The UK Care Quality Commission concludes that in some areas Babylon is not safe. (report censured by High Court).

Letter to the BMJ: "Could Babylon please supply evidence?"

Letter to the Lancet: "serious methodological problems"



Babylon



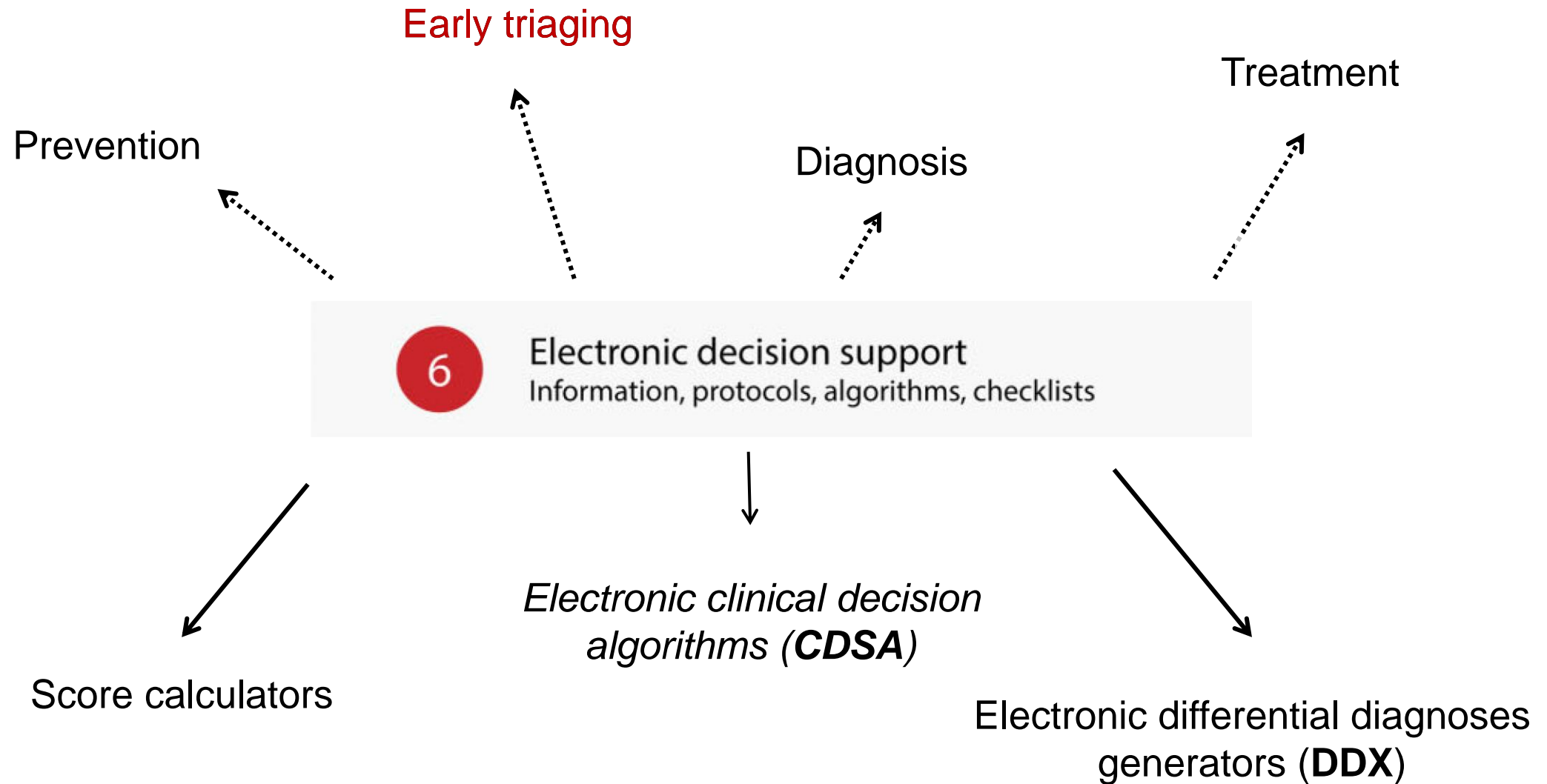
"We are one of the safest primary care provider of UK."

Some would like to see us fail and use anonymous and wrong allegations. Some even pretend to be physicians...

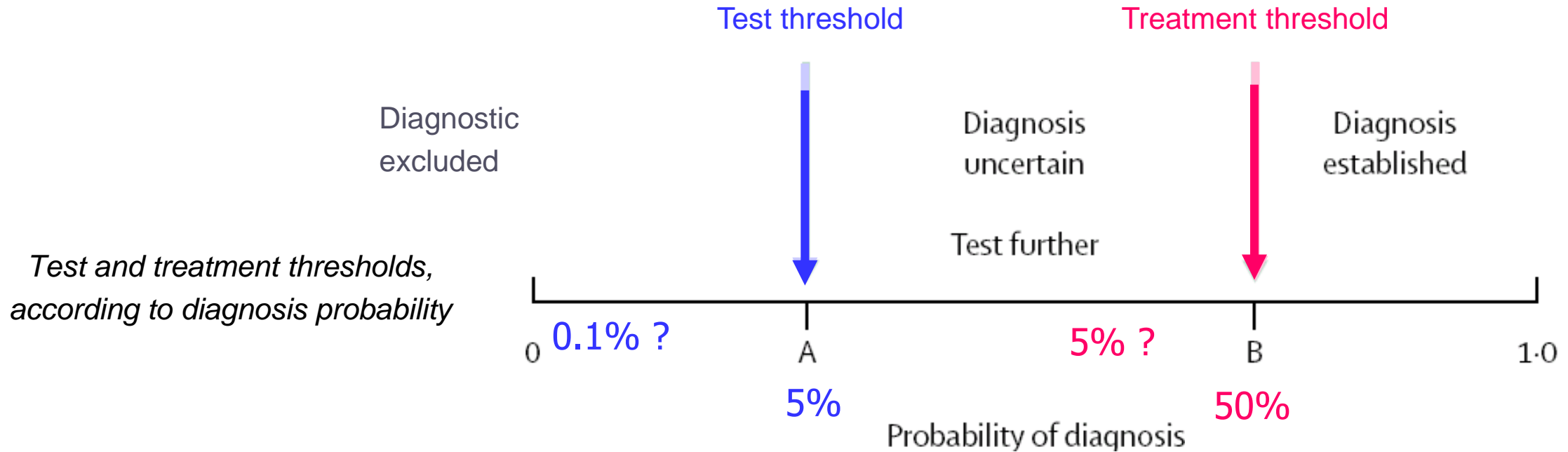
"Babylon technology is certified as a medical device." (classe 1)

Internal study with 50 case scenarios: "Babylon do better diagnosis than human beings."

2.5 millions people in UK, Rwanda and Ireland are presently using Babylon...



Malaria Pneumonia



First step: Define target user and patient



Community health worker



Drug vendor



Child 2 months – 5 years
with history of fever
or high temperature



Primary care health worker



Physician at hospital

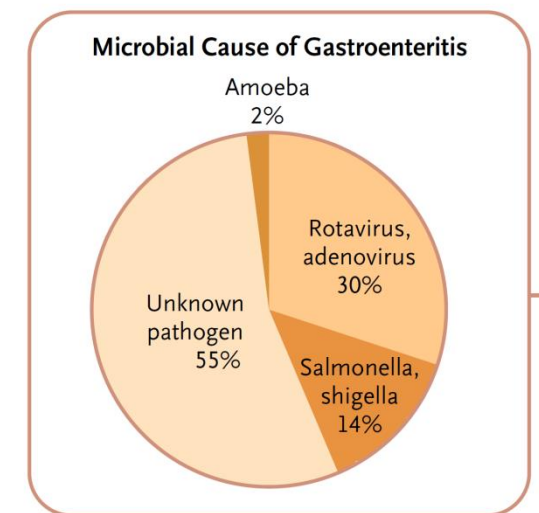
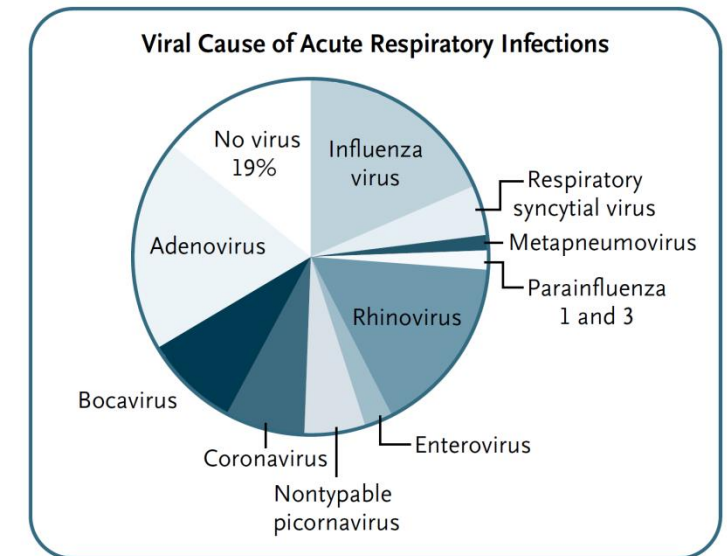
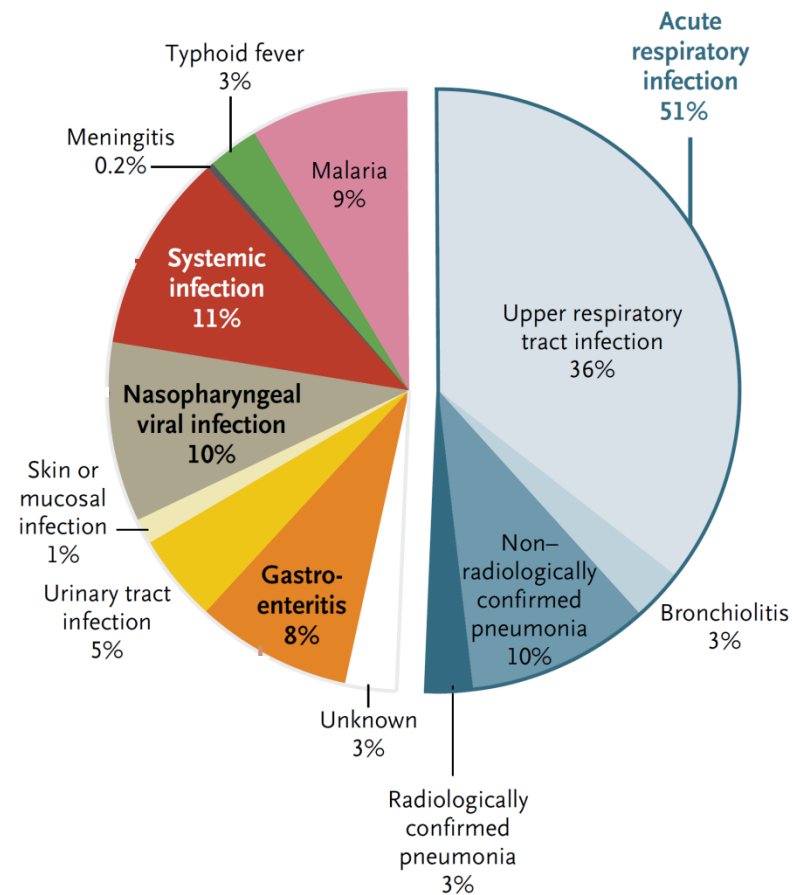
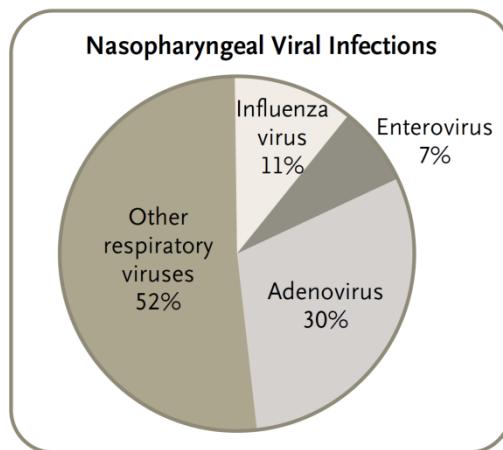
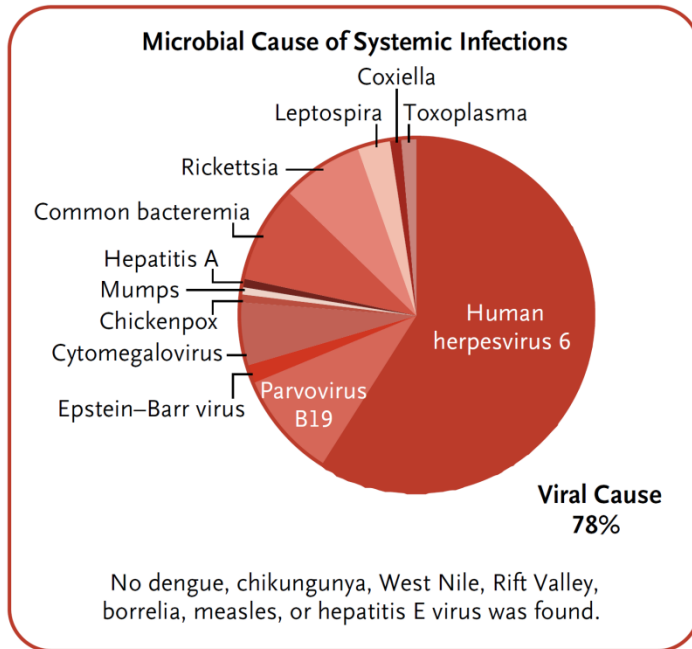


2nd step: Structured review of the literature



Search	PubMED	Embase
<p>Severe infections/ infections</p>	<p>OR "Shock, Septic"[Mesh] OR "Status Asthmaticus"[Mesh] OR "Meningitis"[Mesh:NoExp] OR "Meningitis, Bacterial"[Mesh] OR "Arthritis, Infectious"[Mesh] OR "Bone Diseases, Infectious"[Mesh] OR "Cellulitis"[Mesh] OR "Skin Diseases, Bacterial"[Mesh:NoExp] OR "Skin Diseases, Infectious"[Mesh:NoExp] OR "Ecthyma"[Mesh] OR "Erysipelas"[Mesh] OR "Staphylococcal Skin Infections"[Mesh] OR "Soft Tissue Infections"[Mesh] OR "Diarrhea, Infantile"[Mesh] OR "Dysentery"[Mesh] OR "Urinary Tract Infections"[Mesh] OR "Pyelonephritis"[Mesh:NoExp] OR "Typhoid Fever"[Mesh] OR "Fever of Unknown Origin"[Mesh] OR bacterial infection*[tiab] OR serious infection*[tiab] OR severe infection*[tiab] OR invasive infection*[tiab] OR (death[tiab] OR bronchiolitis[tiab] OR dehydration[tiab] OR urinary tract infection*[tiab] OR rickettsia*[tiab] OR bacteremia[tiab] OR ("Signs and Symptoms"[Mesh] OR "Abdominal Pain"[Mesh] OR "Jaundice"[Mesh] OR "Chest Sounds"[Mesh:NoExp] OR "Dyspnea"[Mesh:NoExp] OR "Vital Signs"[Mesh] OR "Tachycardia"[Mesh:NoExp] OR "Diagnostic Tests, Routine"[Mesh] OR "Physical Examination"[Mesh:NoExp] OR "Diagnosis"[Mesh:NoExp] OR "Clinical Decision-Making"[Mesh] OR "Medical History Taking"[Mesh:NoExp] OR "Symptom Assessment"[Mesh] OR "Odds Ratio"[Mesh] OR "Sensitivity and Specificity"[Mesh:NoExp] OR "Predictive Value of Tests"[Mesh] OR "ROC Curve"[Mesh] OR "Severity of Illness Index"[Mesh] OR "Decision Trees"[Mesh] OR "C-Reactive Protein"[Mesh] OR "Anemia"[Mesh:NoExp] OR clinical sign*[tiab] OR clinical syndrome*[tiab] OR "syndromic diagnosis"[tiab] OR clinical variable*[tiab] OR clinical predictor*[tiab] OR vital sign*[tiab] OR clinical feature*[tiab] OR "signs and symptoms"[tiab] OR red flag*[tiab] OR danger sign*[tiab] OR "abnormal mental status"[tiab] OR "altered mental status"[tiab] OR convulsion*[tiab] OR "stiff neck"[tiab] OR meningeal sign*[tiab] OR prostration[tiab] OR "chest wall retraction"[tiab] OR "chest indrawing"[tiab] OR stridor[tiab] OR tachypnea[tiab] OR "fast breathing"[tiab] OR tachypnoea[tiab] OR "respiratory rate"[tiab] OR tachycardia[tiab] OR "fast heart rate"[tiab] OR "capillary refill time"[tiab] OR vomiting[tiab] OR pallor[tiab] OR fever[tiab] OR algorithm*[tiab] OR decision tree*[tiab] OR prediction rule*[tiab] OR imci[tiab] OR "integrated management of childhood illness"[tiab] OR "severe anemia"[tiab] OR "severe anaemia"[tiab] OR procalcitonin[tiab] OR "C-</p>	<p>/'bacterial infection'/de OR Infection/de OR 'Enterobacteriaceae infection'/exp OR 'pyonephrosis'/exp OR 'rickettsiosis'/exp OR 'Staphylococcus infection'/exp OR 'Streptococcus infection'/exp OR 'community acquired infection'/exp OR 'sepsis'/de OR 'bacteremia'/de OR 'septic shock'/de OR 'septicemia'/de OR 'respiratory tract infection'/exp OR 'pneumonia'/de 'bronchopneumonia'/exp OR 'asthmatic state'/exp OR 'meningitis'/de OR 'bacterial meningitis'/exp OR 'Haemophilus meningitis'/exp OR 'pneumococcal meningitis'/exp OR 'bone infection'/de OR 'bacterial arthritis'/exp OR 'soft tissue infection'/exp OR 'cellulitis'/exp OR 'bacterial skin disease'/de 'erysipelas'/de OR 'impetigo'/exp OR 'skin abscess'/exp OR 'staphylococcal skin infection'/exp OR 'urinary tract infection'/exp OR 'bacterial NEXT/1 infection*') OR (serious infection NEXT/1 infection*) OR (invasive infection NEXT/1 malaria) OR (severe infection NEXT/1 sepsis OR meningitis OR pneumonia OR urinary tract infection NEXT/1 tract NEXT/1 infection*) OR (bacteremia OR rickettsia* OR osteomyelitis OR bacteraemia OR (otitis NEXT/1 media)):ab,ti) OR (pallor/exp OR 'seizure'/de OR 'convulsion'/de OR 'abdominal pain'/de OR 'vomiting'/de OR 'jaundice'/de OR 'abnormal respiratory sound'/exp OR 'dyspnea'/de OR 'tachypnea'/de OR 'vital sign'/exp OR 'heart rate'/de OR 'breathing rate'/de OR 'oxygen saturation'/exp OR 'tachycardia'/de OR 'diagnostic accuracy'/de OR 'diagnostic test accuracy study'/de OR 'classification algorithm'/exp OR 'practice guideline'/de OR 'predictive value'/exp OR 'diagnostic value'/de OR 'diagnostic accuracy'/de OR 'C reactive protein'/exp OR 'procalcitonin'/exp OR 'anemia'/de OR ((clinical NEXT/1 sign*) OR (clinical NEXT/1 syndrome*) OR (clinical NEXT/1 variable*) OR (clinical NEXT/1 predictor*) OR (vital NEXT/1 sign*) OR (clinical NEXT/1 feature*) OR "signs and symptoms" OR (red NEXT/1 flag*) OR (danger NEXT/1 sign*) OR "abnormal mental status" OR "altered mental status" OR convulsion* OR "stiff neck" OR (meningeal NEXT/1 sign*) OR prostration OR "chest wall retraction" OR "chest indrawing" OR stridor OR tachypn*a OR "fast breathing" OR "respiratory rate" OR tachycardia OR "fast heart rate" OR "capillary refill time" OR vomiting OR pallor OR fever OR algorithm* OR (decision NEXT/1 tree*) OR (prediction NEXT/1 rule*) OR imci OR "integrated management of childhood illness" OR "severe anemia" OR procalcitonin OR "C-reactive protein" OR "Urine dipstick" OR (Urine NEXT/1 leucocyte*) OR (Urine NEXT/1 nitrite*) OR</p>
<h1>12'124 articles</h1>		

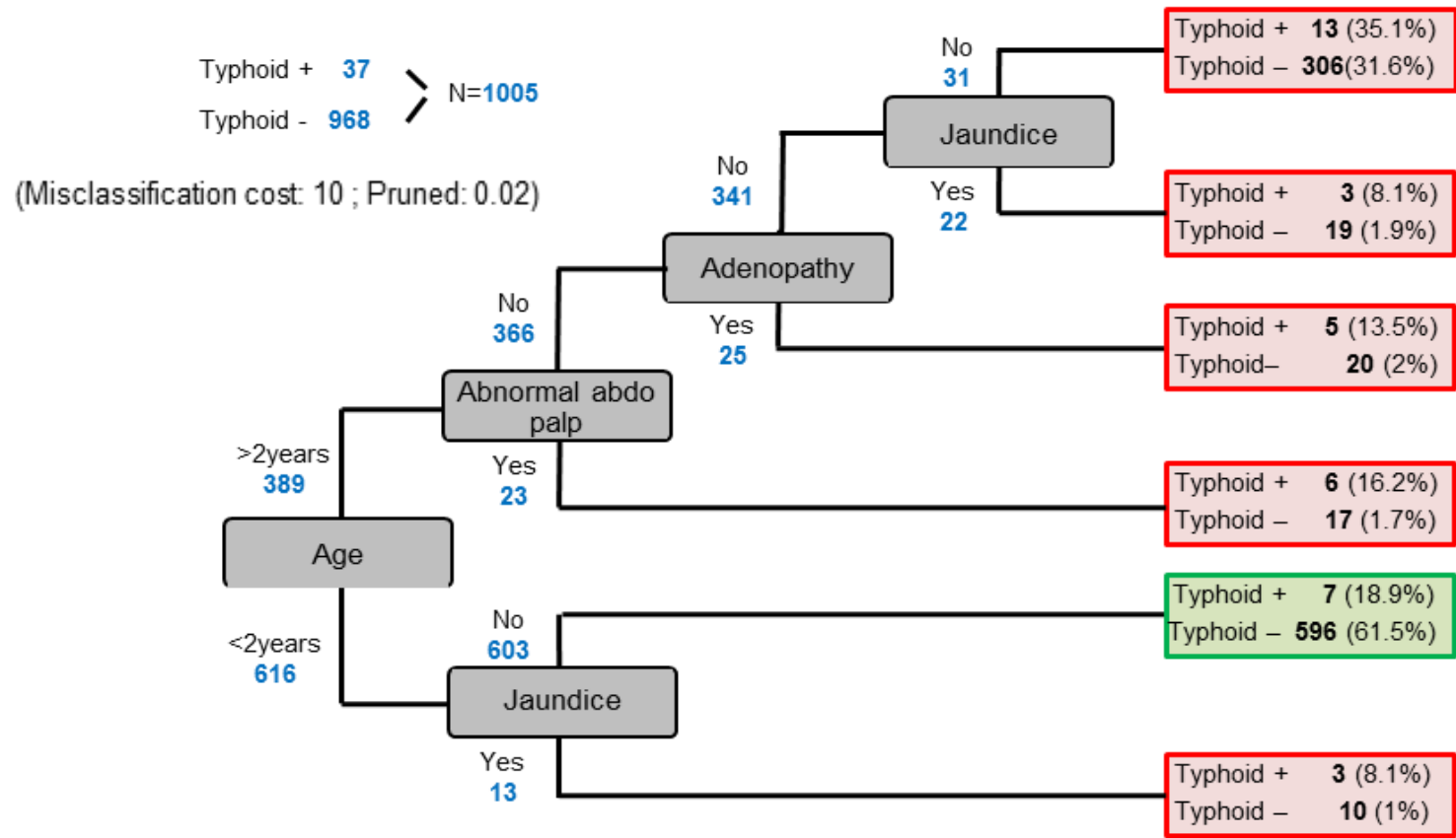
3rd step: studies to measure disease prevalence



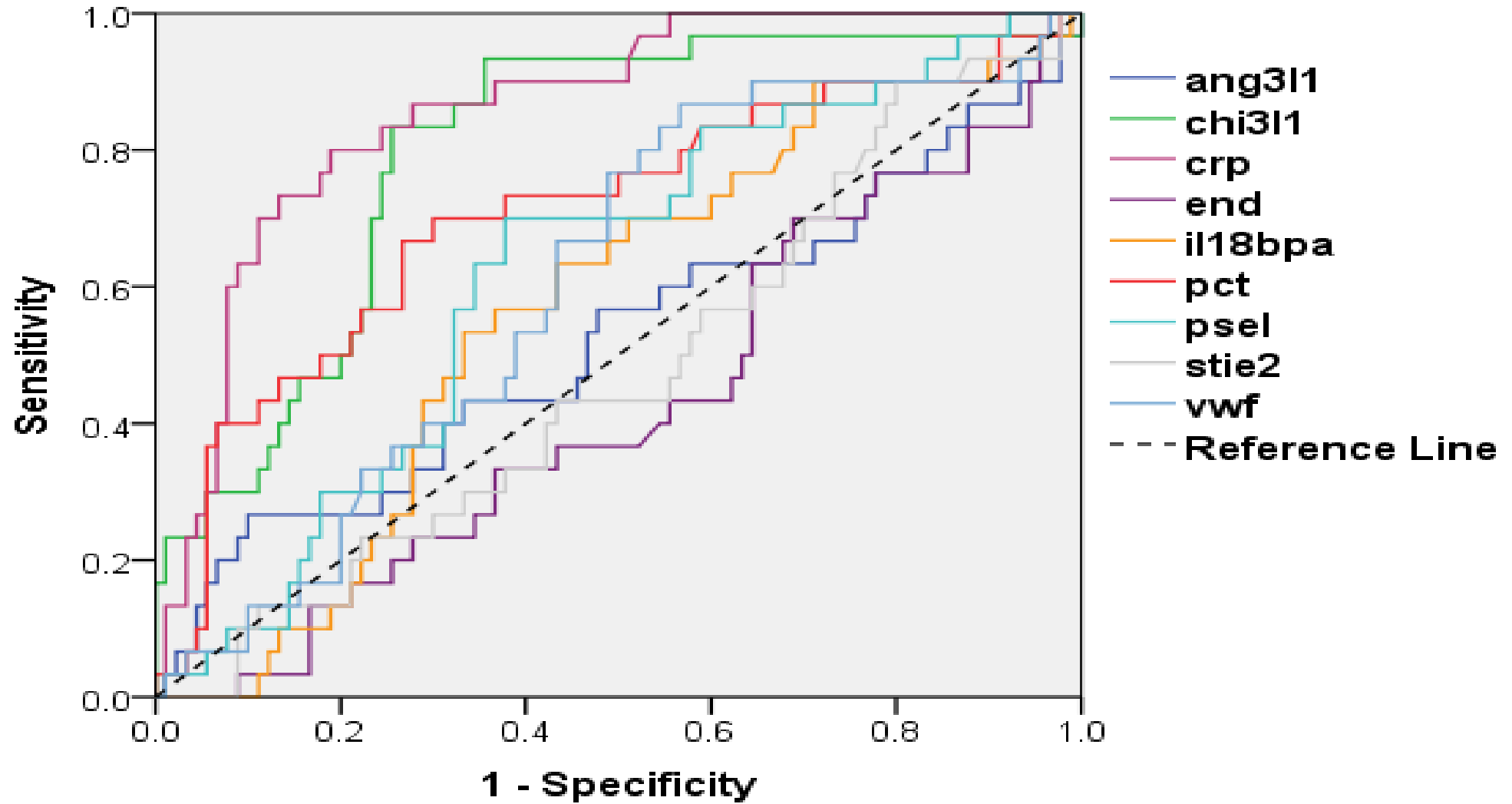
25'743 biological tests performed

D'Acremont et al., *NEJM* 2014

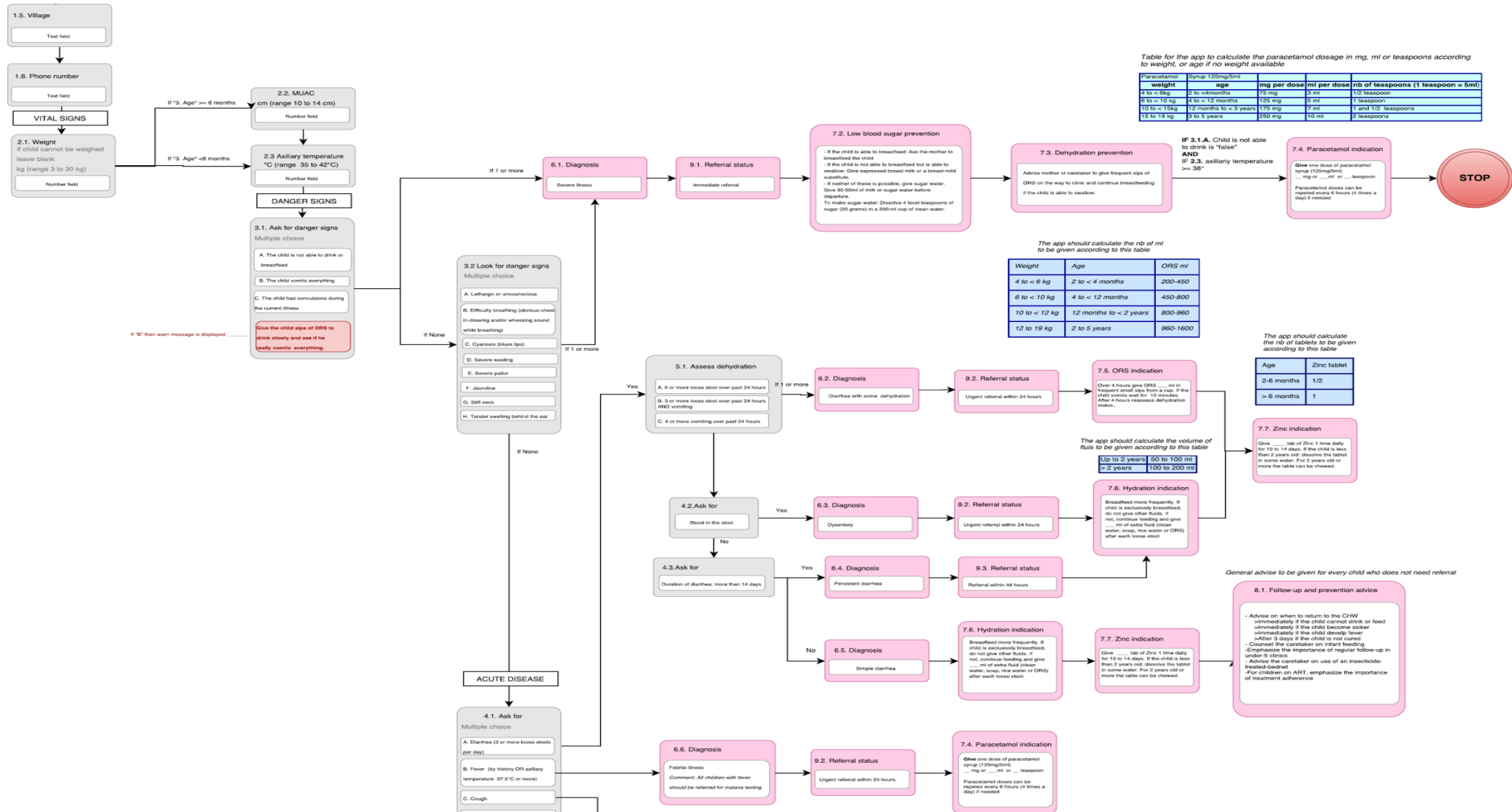
TYPHOID FEVER



Sensitivity	Specificity	LR+	LR-
0.46	0.93	6.57	0.58



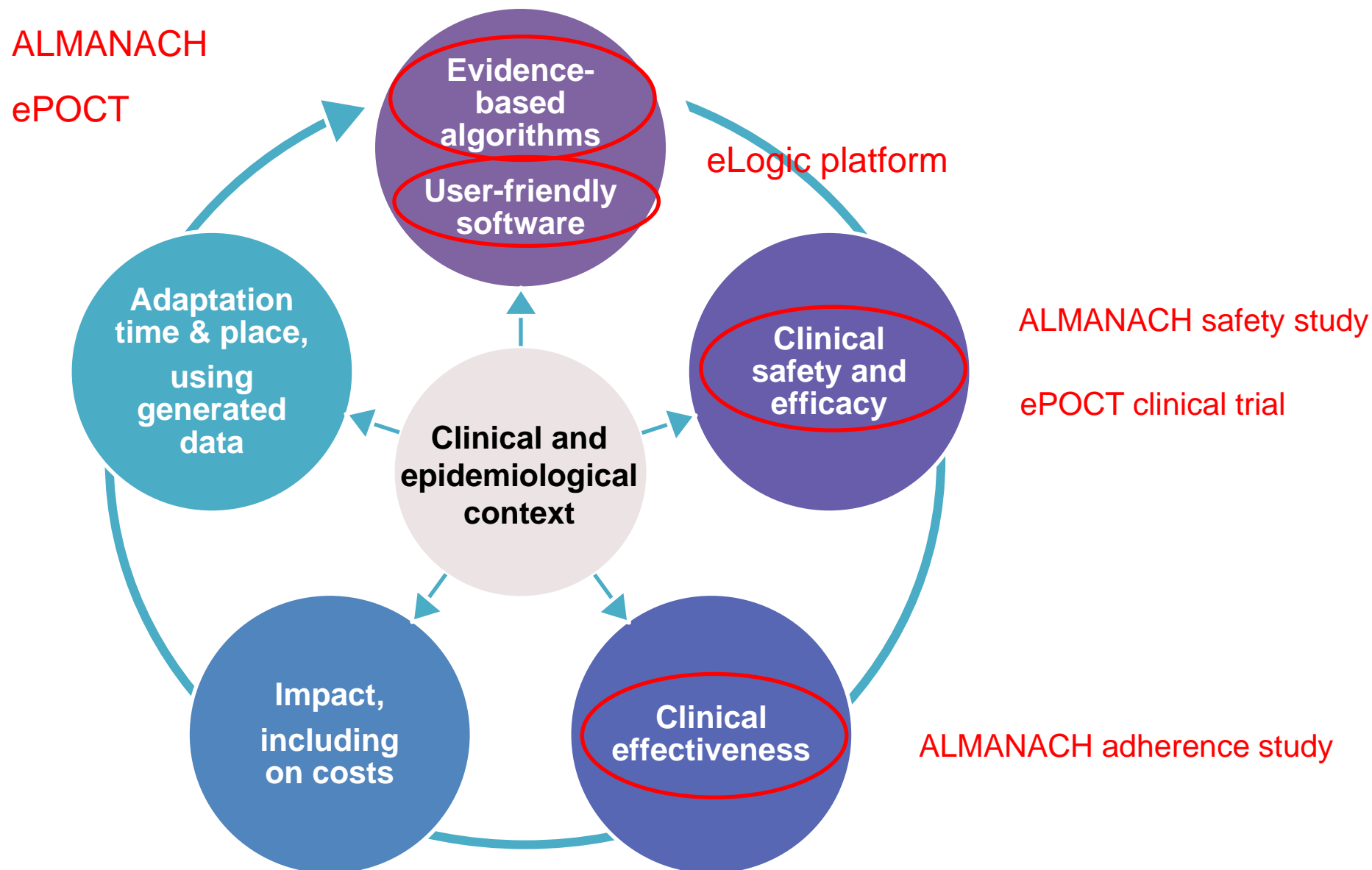
5th step: electronic clinical decision algorithm (CDSA)



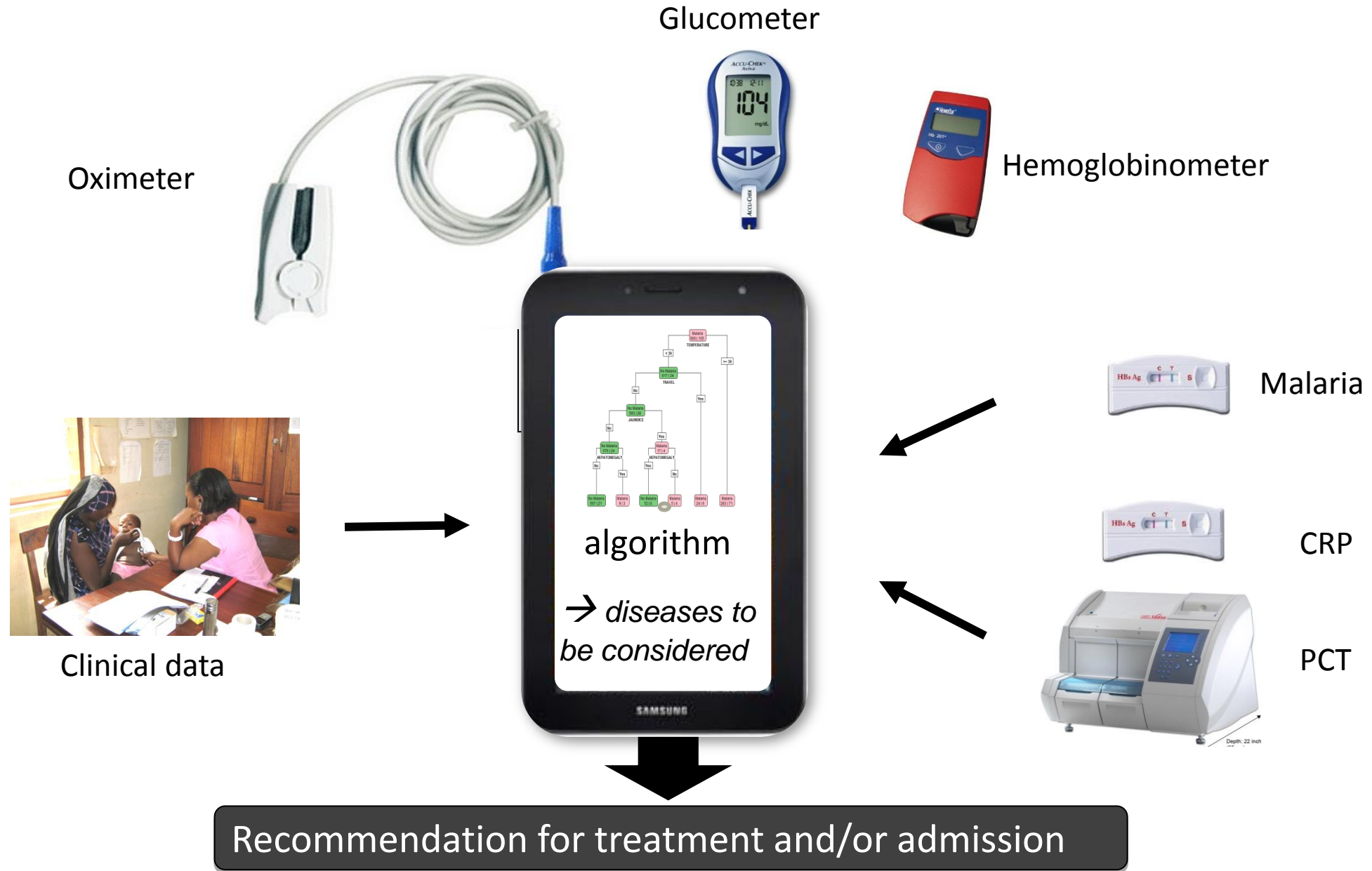
Name of CDSA	Author/ developer	POCTs used	Algorithm content	Clinical efficacy	Clinical effectiveness	Impact study	Qualitative assessment	Implemented
<i>iCCM based tools</i>								
SL eCCM	Imperial Col London	mRDT	CCM	-	Ongoing	-	√	Free on website
e-iCCM	WHO, World Vision, Malaria Consortium	?	?	-	Ongoing	?	?	Niger and Mozambique
eCCM	D-Tree, WEEMA	mRDT	CCM	-	√	√	√	Ethiopia and Malawi
<i>IMCI based tools</i>								
eIMCI	D-Tree, JHPIEGO, Harvard, Mariland	mRDT, HIV RDT	?	-	√	-	-	Zambia (large-scale planned)
Neonatal IMNCI	D-Tree, Boston Children Hospital	none	Tanzanian IMNCI	-	√	-	-	-
REC	Terre des hommes	mRDT	Burkina Faso IMCI	-	-	Ongoing	√	Burkina Faso (8 districts)
Bangladesh digital IMCI	MoH, ICDDR B	mRDT Urine test	Bangladesh IMCI	-	-	-	Ongoing	Bangladesh (3 sub-districts)



Name of CDSA	Author/ developer	POCTs used	Algorithm content	Clinical efficacy	Clinical effectiveness	Impact study	Qualitative assessment	Implemented
<i>ALMANACH based tools</i>								
e-ALMANACH	Swiss TPH	mRDT Urine test Typhoid	Published	√	√	-	√	Afghanistan Nigeria
MSFeCARE	MSF	mRDT Urine test Oximeter	Unpublished	-	Unpublished	-	Unpublished	Central African R Niger, Tanzania, Mali
<i>Novel content based tools</i>								
MEDSINC	Think MD	None, then mRDT	?	-	Unpublished	-	-	-
ePOCT	SwissTPH	mRDT, Hb Oximeter Glucomete CRP/PCT	Published	√	-	-	-	-



Second generation algorithm: ePOCT

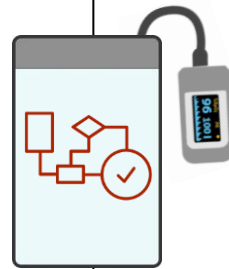




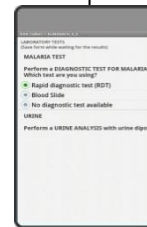


3739 children 2 months to 5 years (9 facilities, Dar es Salaam)

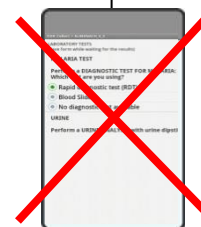
e-POCT



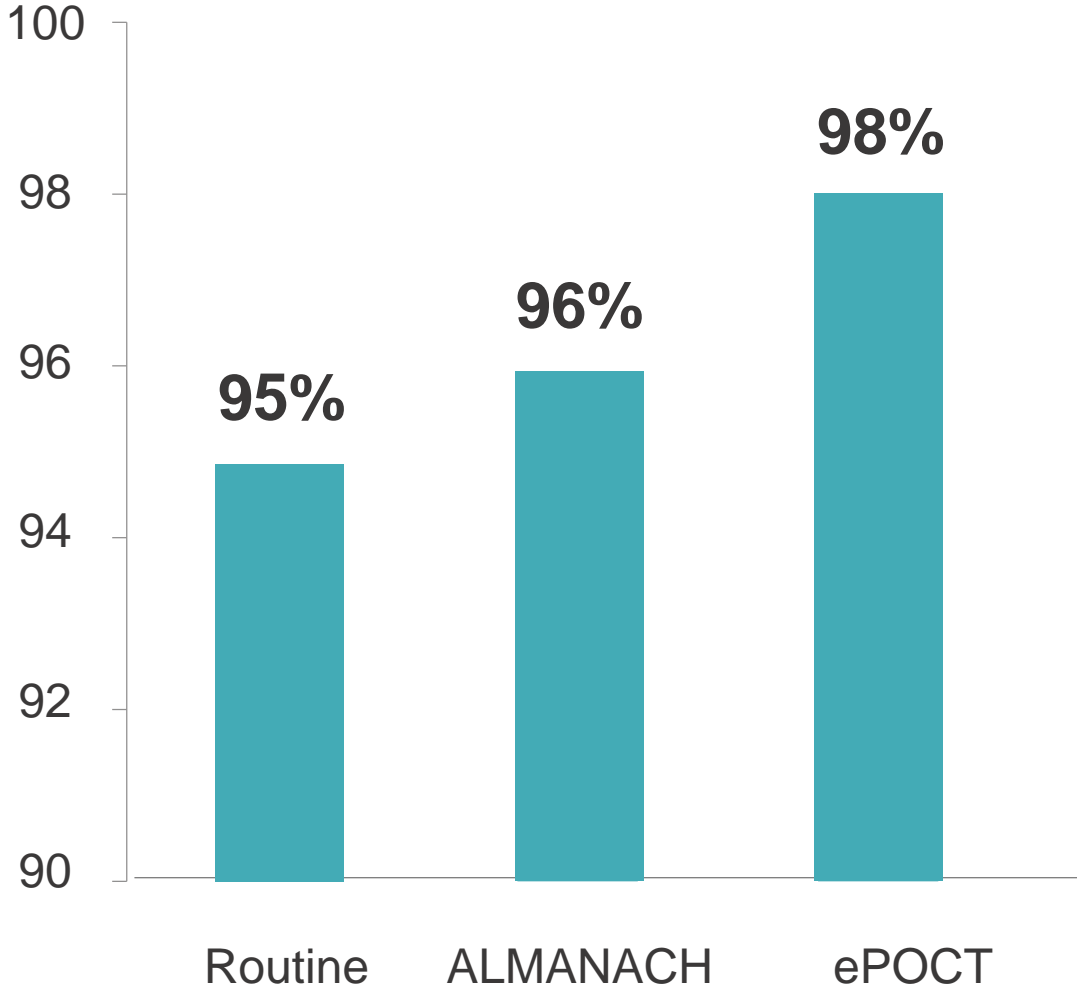
ALMANACH



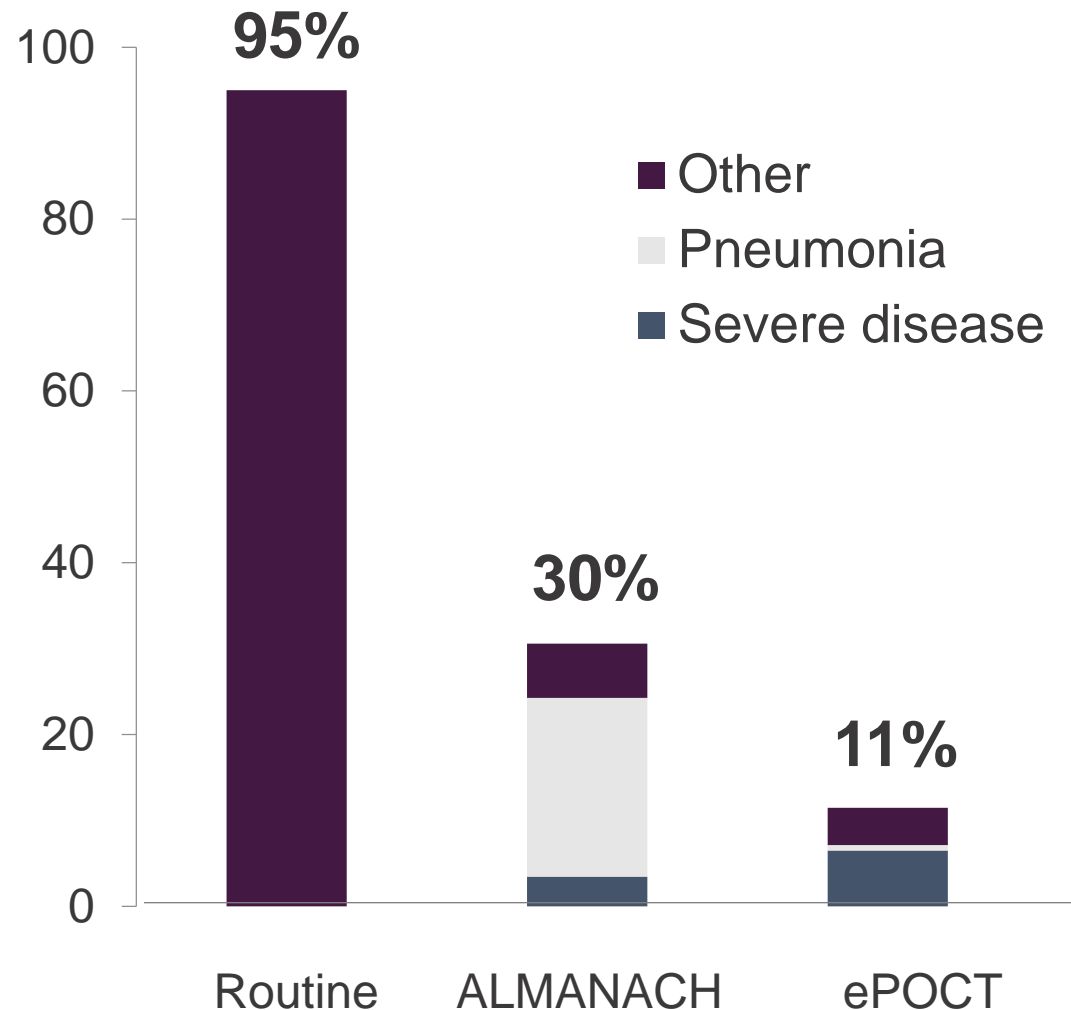
Routine



Cure rate at D3 and D7; 2nd hospitalisations and deaths by D30

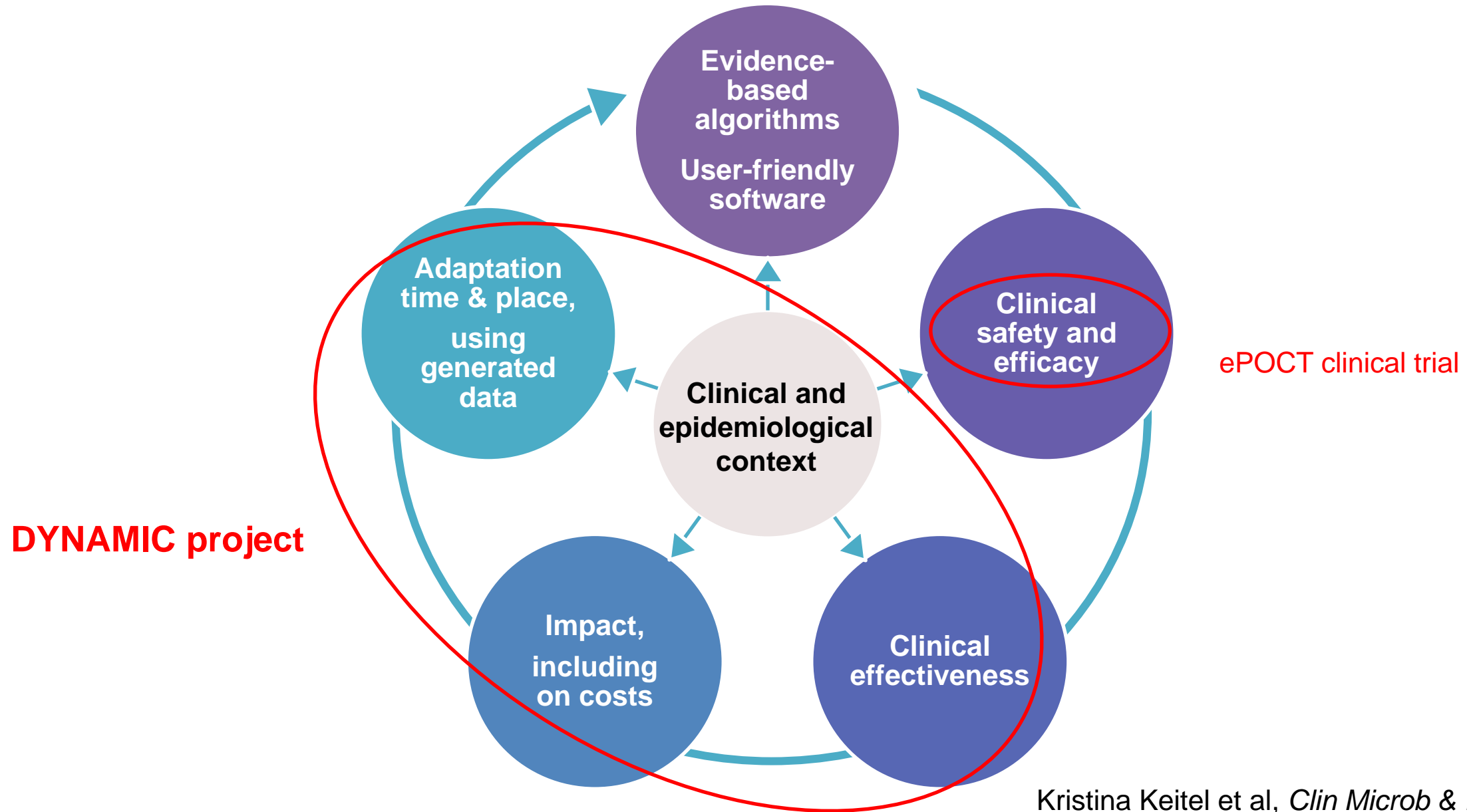


Potential impact of ePOCT in children in Tanzania:
1 million clinical failures averted per year



*Potential impact of ePOCT
in children in Tanzania:*

28 million unnecessary
antibiotics saved per year





ePOCT: - extended medical content
- new software
- full connection to biosensors and rapid tests

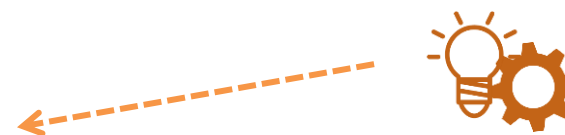
Validation:

- 70 health facilities
- 2 semi-urban districts in Tanzania



Beneficiaries:

500,000 sick children per year attending primary care facilities

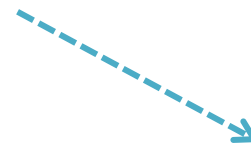


Dynamic algorithm:

Through machine-learning and optimisation

Health system:

Enhanced M&E, disease surveillance, epidemic detection

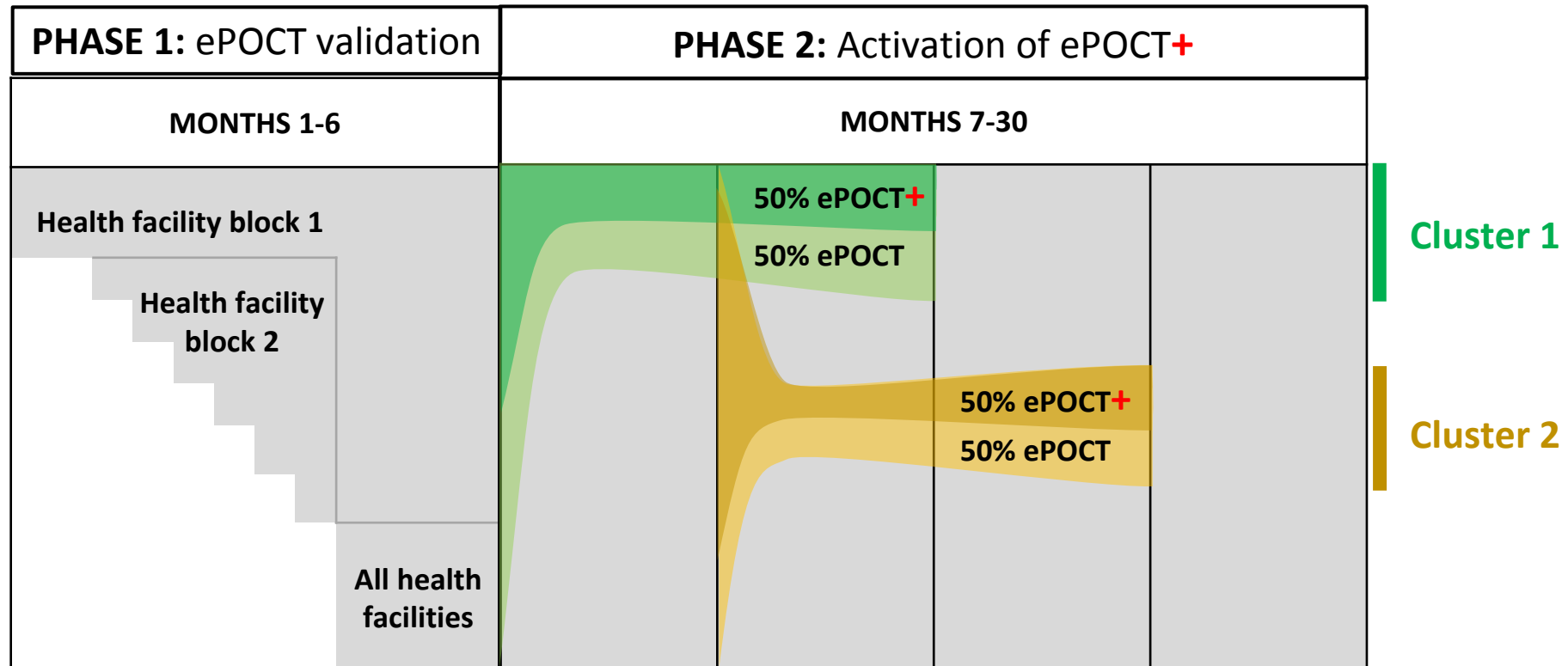



Data sciences:

High number and variability of data



Moving from a static to a dynamic algorithm

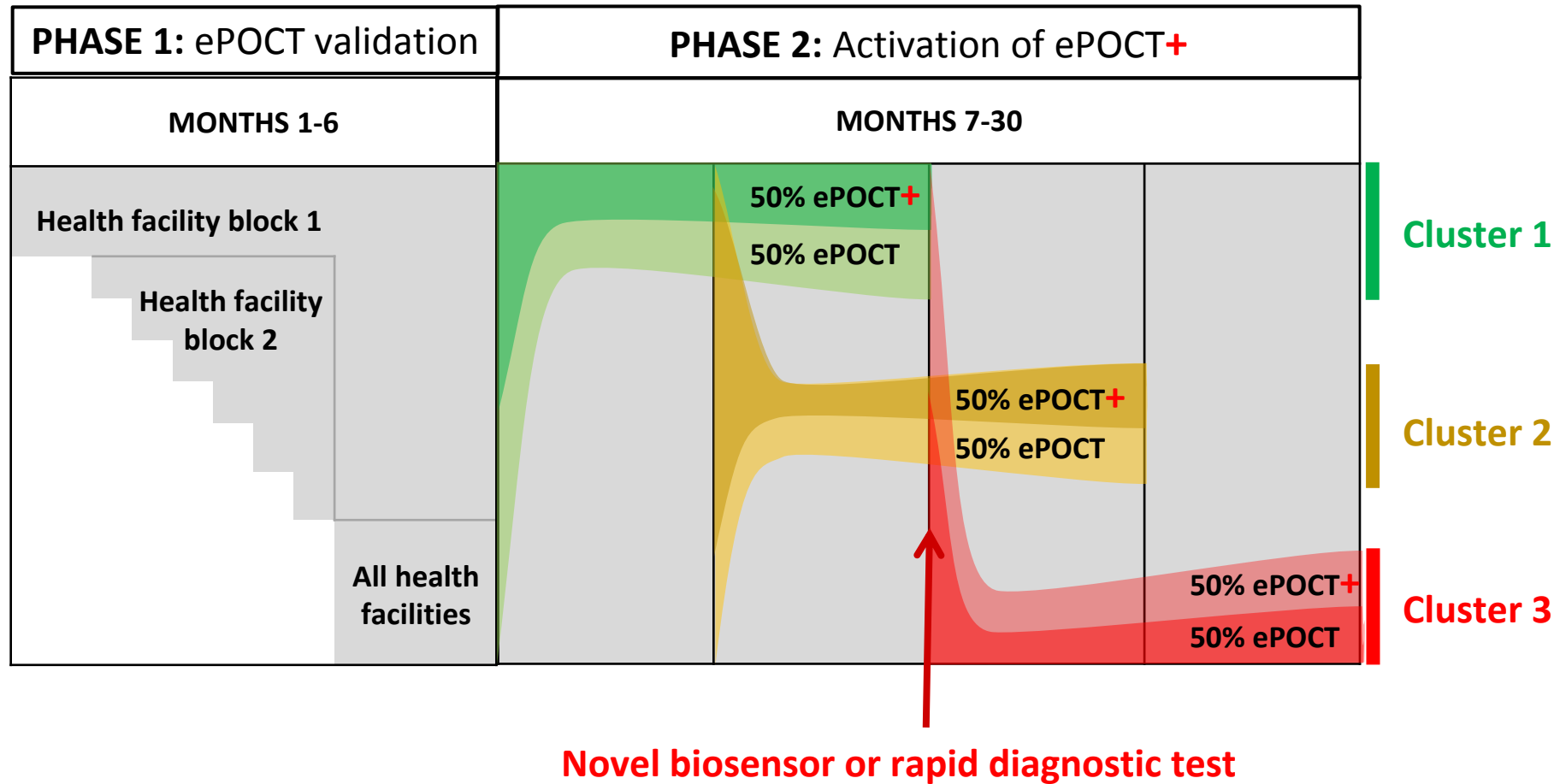


 Routine care

 ePOCT static algorithm

 ePOCT+ dynamic algorithm with ML adaption

DYNAMIC: an ideal platform to test emerging devices





« If you record in the REC, you learn at the same time.
If one day there is no tablet, you will still be able to
correctly manage the child. »

Accoucheuse, Centre de Santé de Boulma



It increases knowledge

« Now the clinicians ask us more questions
on the child and touch him more. »

Président comité de gestion, village de Yako



It improves communication

It gives self-confidence

« Yes, it teaches us, as you cannot retain
everything in your head. But with the REC, it
reminds you at any time. At any time, you have
it in front of you and it allows you to master. »

Infirmier, Centre de Santé de Samba



It brings transparency

« On était dans les ténèbres.
Maintenant, on est dans la lumière. »

Chef du village de Yako





It changes the power balance

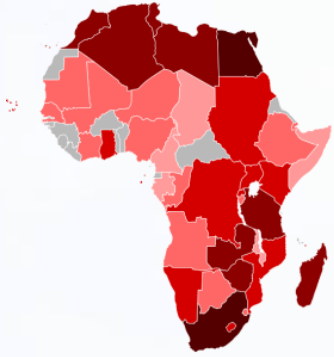
Each technical innovation is doubled sided, not due to the good or bad way of using it, but due to the change in the distribution of power. It removes power from some to give it to others, changing the reality for all.

*René Berger & Solange Ghernaouti-Hélie,
'Technocivilisation, pour une philosophie du numérique', 2010*

It brings back pride and autonomy



Collaborating institutions



Tanzanian
Ministry of
health and
Welfare

Dar es Salaam
City Medical
Office of Health



Funding

