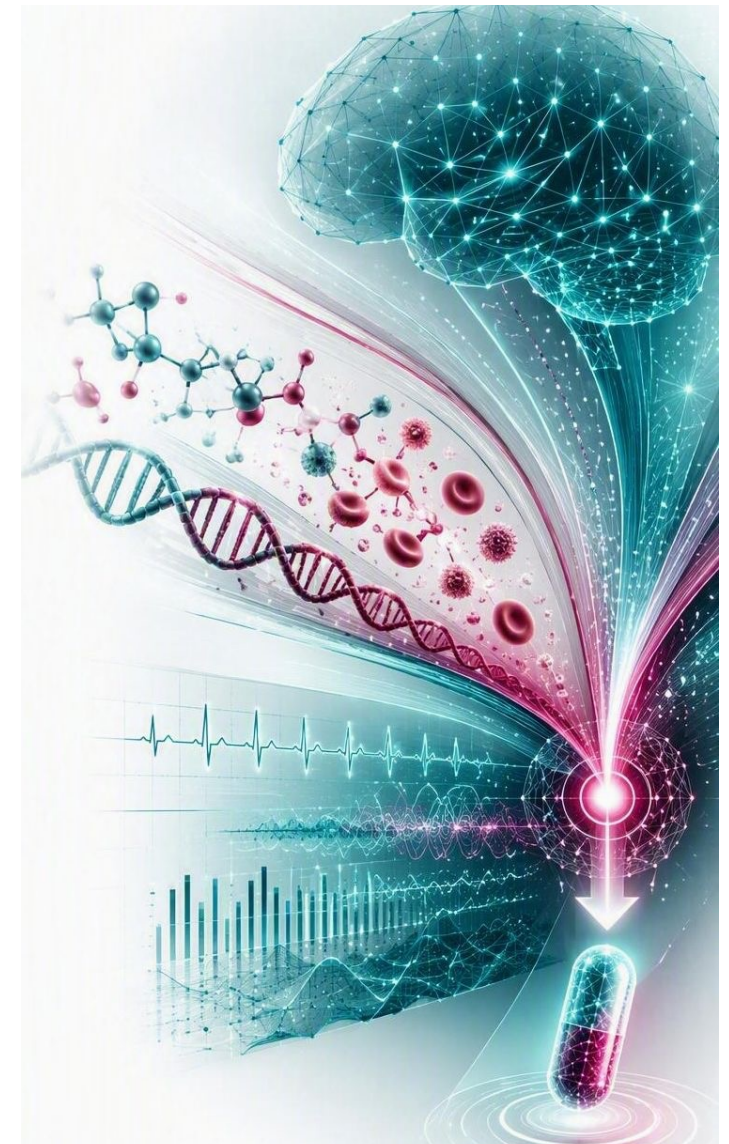


When Data Meets Intelligence:

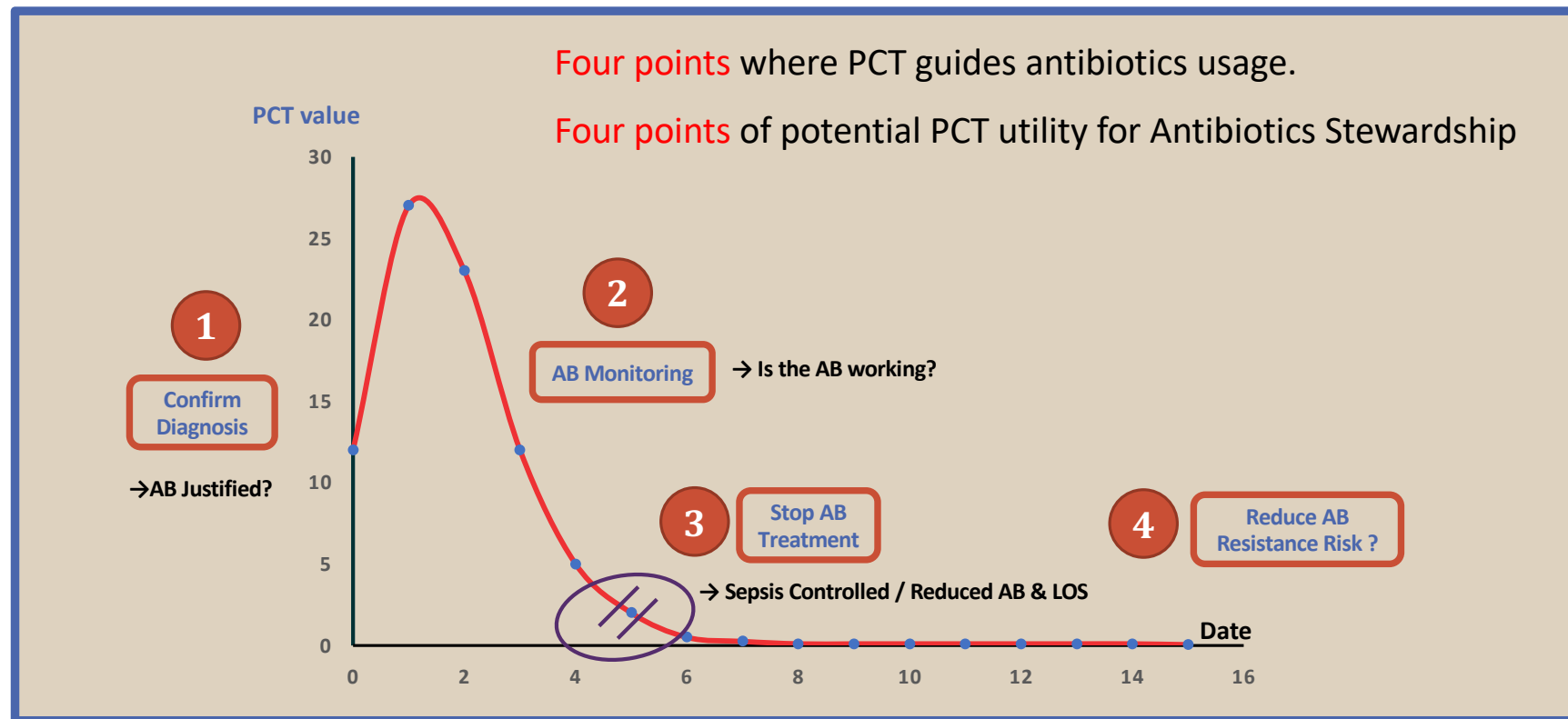
Singapore General Hospital's Deployment of
AI Predictive Models & Core Biomarkers to
combat AMR

Assoc Prof Andrea Kwa Lay Hoon (柯丽云)

Deputy Director (Research & Innovation), Pharmacy,
Singapore General Hospital
Associate Professor, Programme in Emerging Infectious Diseases,
Duke-NUS Medical School



PCT kinetics – 4 Points for Antibiotics Usage Guidance.

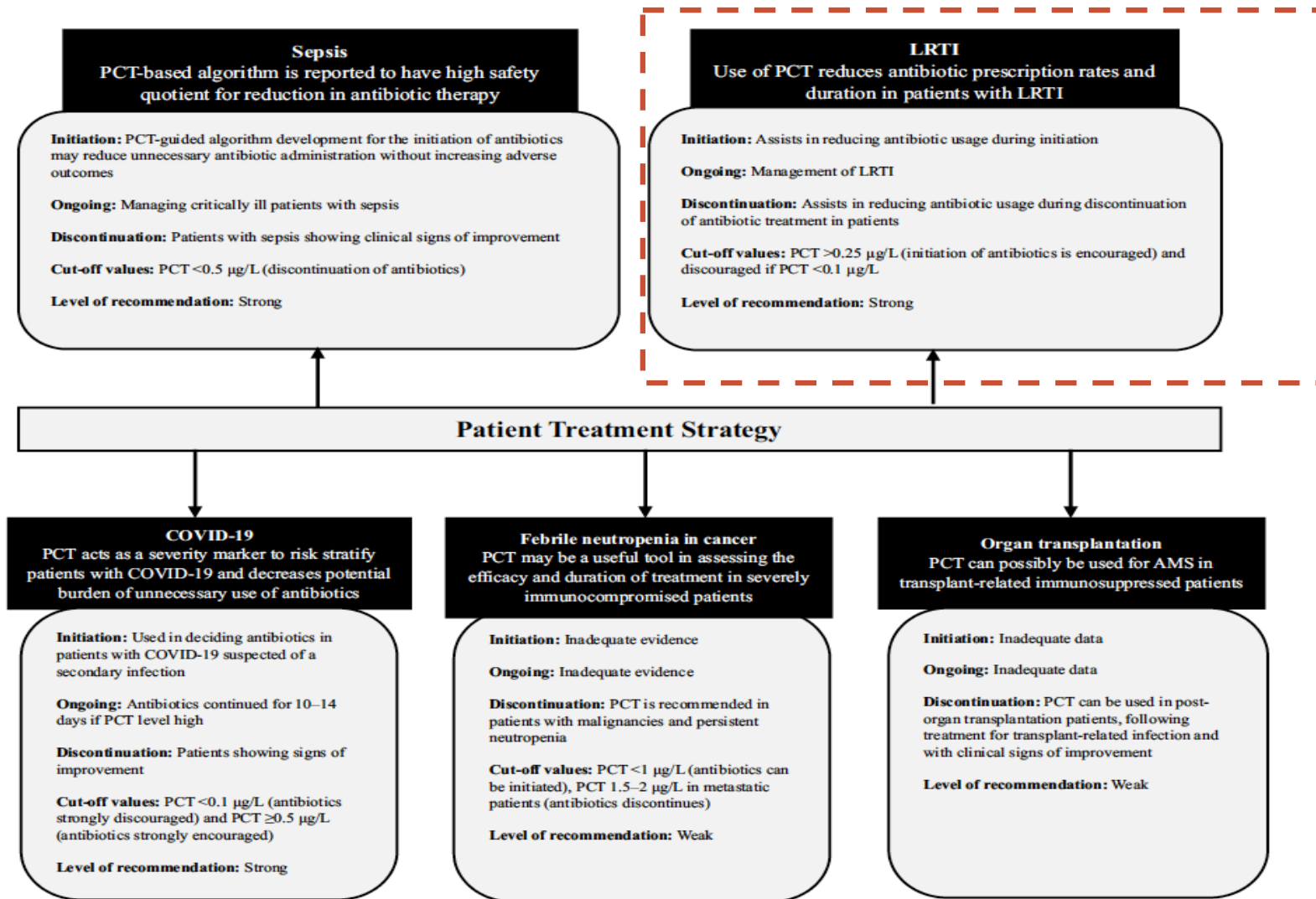


REVIEW

 OPEN ACCESS  Check for updates

Clinical utility of procalcitonin in implementation of procalcitonin-guided antibiotic stewardship in the South-East Asia and India: evidence and consensus-based recommendations

Andrea Lay-Hoon Kwa^a, Brigitte Rina Aninda Sidharta^b, Do Ngoc Son^c, Kapil Zirpe^d, Petrick Periyasamy^e, Rongpong Plongla^f, Subramanian Swaminathan^g, Tonny Loho^h, Vu Van Giapⁱ and Anucha Apisarnthanarak^j



Singapore General Hospital (SGH)

- >1800 bed, acute, tertiary-care hospital



Research

International Journal of Antimicrobial Agents 53 (2019) 606–611



Contents lists available at ScienceDirect

International Journal of Antimicrobial Agents

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



Discontinuation of antibiotic therapy within 24 hours of treatment initiation for patients with no clinical evidence of bacterial infection: a 5-year safety and outcome study from Singapore General Hospital Antimicrobial Stewardship Program



Loo Wei Lee^a, Piotr Chlebicki^b,

Working diagnosis:

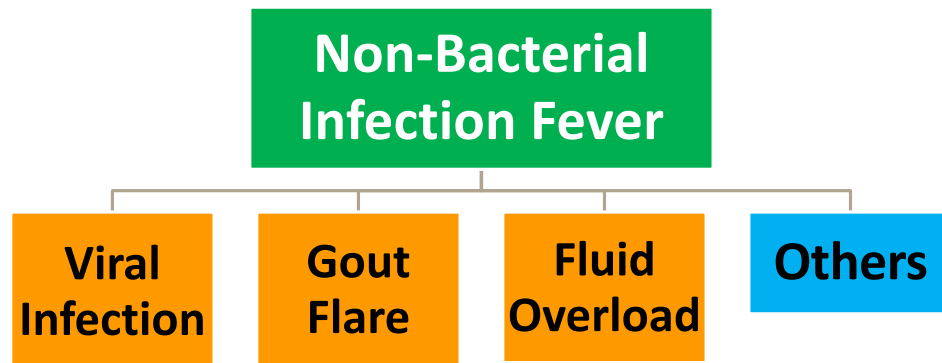
Unspecified sepsis? (mainly LRTI)

Arising from 1 temperature spike &/or a drop in BP

- Important in patients with bacterial co-infection

- Our study a

Discontinuation of empiric antibiotics in.....



PCT is used to rule out bacterial infection

- 70.3% (558/794) of ASP interventions
- Antibiotics started due to febrile episodes
- Initial investigations/ clinical evaluation by ASP team found other more convincing reasons for the febrile episodes:
 - Malignant fever, central fever
 - Drug fever, transfusion-related reactions
 - Fever secondary to pulmonary embolism, inflammatory bowel diseases

Reasons for discontinuation of antibiotics	Accepted group (N = 579)	Rejected group (N = 215)	P value	Proportion (%)
Likely viral infection	122 (21.1%)	34 (15.8%)	0.10	19.6
Clinical symptoms suggestive of fluid overload, not pneumonia	49 (8.5%)	19 (8.8%)	0.87	8.6
Fever likely secondary to gout flare, not a bacterial cause	10 (1.7%)	2 (0.9%)	0.41	1.5
Isolated febrile episodes	398 (68.7%)	160 (74.4%)	0.12	32.6
Drug-related fever	69 (11.9%)	27 (12.6%)	0.90	12.1
Malignant/ Central fever	142 (24.5%)	61 (28.4%)	0.27	25.6

SingHealth Academic Healthcare Cluster

PATIENTS. AT THE HE^{ART} OF ALL WE DO.®

Partner in
Academic Medicine



Results & Conclusion

- 794 interventions recommended [overall acceptance rate of 72.9% (579/794)].
- No significant difference in underlying demographics, & Charlson Co-morbidity score between the 2 groups.
- Interventions-acceptance group had **significantly shorter**
 - duration of therapy by **2.61 days** (2.72 ± 3.04 days vs 5.33 ± 2.54 days; $p < 0.01$)
 - LOS by **7.41 days** (7.98 ± 13.14 vs 15.39 ± 22.62 ; $p < 0.01$), with **estimated cost savings of S\$10817 per patient**.
- No significant differences in 14-day mortality and readmission rates between the 2 groups.
- It is safe to discontinue antibiotics within 24hrs of prescribing in patients with no evidence of bacterial infections.

Antimicrobial Stewardship Programme

Stopping antibiotics early may help patients: SGH

Early discharge, costs saved when drug intake ends in a day if bacterial infection found unlikely

Salma Khalik
Senior Health Correspondent

Each year, more than 100 patients

at Singapore General Hospital (SGH) are able to go home 7½ days earlier, saving about \$11,000 in treatment costs – all because their use of a strong antibiotic was stopped after just one day.

Antibiotics

About half of the 80,000 patients admitted to SGH yearly are given antibiotics, but not all have a bacterial infection.

It takes about three days for test results to tell if there is an infection. So

ance of bacteria in the digestive system, often resulting in patients suffering from diarrhoea. They may also get rashes, liver and renal problems, and a drop in platelet count.

SGH has been doing these reviews of patients in the first 24 hours after admission since 2010. It is the only

This saves about \$1.3 million a year. More importantly, patients

the drug, and their use of developing antibiotic resistance is reduced.

Because they are taken off the antibiotic early, patients are less likely to suffer from the side effects, and are able to get well faster and be discharged earlier.

Most hospitals review the use of antibiotics after three days, when the results of the tests for bacteria are available. SGH opted for earlier reviews, as the longer a patient is on an antibiotic, the higher the risk of resistance, said Associate Professor Andrea Kwa, assistant director of research at SGH's Department of Pharmacy.

"The once-easily treatable illness, such as urinary tract infection, be-

gested a patient be taken off antibiotics, the full test results could find any bacterial infection.

In fact, about 40 per cent of patients could have gone down route, but their doctors chose stop their antibiotic treatment.

In terms of patients returning, those who have not completed the antibiotic course, their ho-

stices have not adopted the practice given the good results. Dr Jasmine Chung, director of SGH's Antimicrobial Stewardship Programme, said different hospitals approach the issue differently.

She added that SGH is able to do the 24-hour review because the technology, support from infectious disease specialist pharmacists and buy-in from doctors.

It has five pharmacists specialising in infectious diseases, including Prof Kwa. Other hospitals may have one or two, or even none.

Even today in SGH, doctors still give about 30 per cent of patients antibiotics in spite of the team's recom-

研究显示 确诊没患细菌感染 可提早停药抗生素

刘智豪 报道
zhilong@sph.com.sg
特林斯泰摄影

研究显示，如果确诊没有细菌感染，患者可在24小时内提早停止服用抗生素，无需完成整个疗程，因为大量使用抗生素会增加细菌的耐药性。

当患者出现发烧或呼吸困难等症狀而入院时，医生一般会先给患者开抗生素。医生会先给患者开抗生素，再根据患者的血液培养结果决定是否进行细菌培养测试。等到测试结果在48至72小时内出来，确诊患者是否患上细菌感染，再决定是否要调整抗生素剂量或停止使用。

生治疗方案。

但新加坡中央医院的研究发现，医生可在开药的24小时内，通过抽血或生物指标测试确诊是否细菌感染，并安全地停止患者的抗生素疗程，以减少不必要的抗生素使用。中央医院是本地目前唯一采用这种做法的医院。

由传染病专家和临床药师组成的中央医院抗菌药物管理计划小组 (Antimicrobial Stewardship Programme) 针对2010年1月至2014年12月的1万2000例病例进行分析，发现当中有约300名患者其实无细菌感染，却服用了24小时。



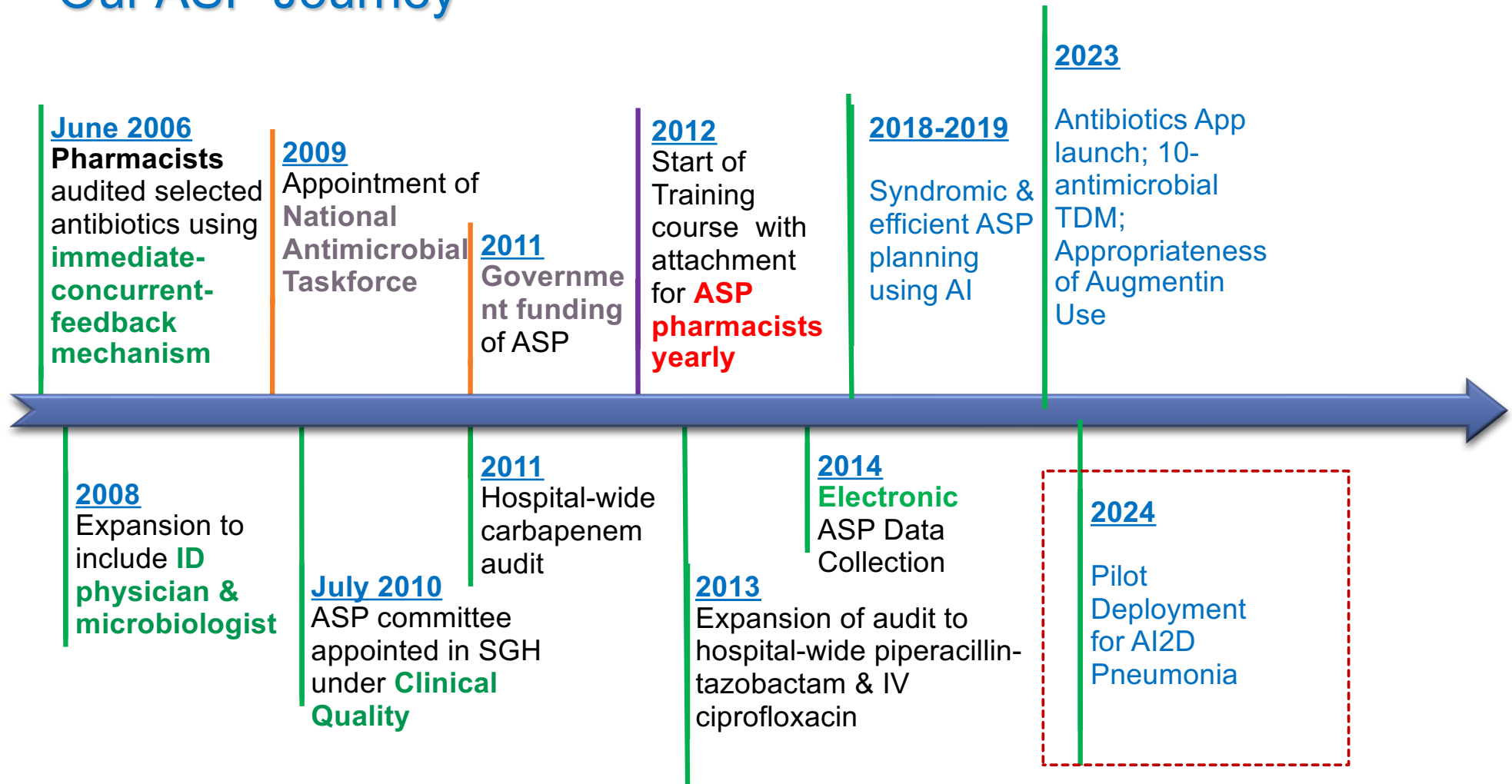
新加坡中央医院会将患者的血液或尿液样本进行细菌培养测试，以确诊患者是否患上细菌感染，再决定是否需提早停止抗生素疗程。

那些接受小组建议而提早停止抗生素的患者，住院时间缩短了7.5天，抗生素治疗天数也减少三天，比起那些没接受建议的患者，省下近1万1000元的医药费。

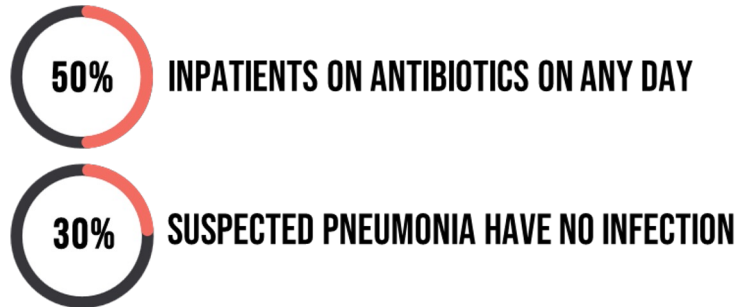
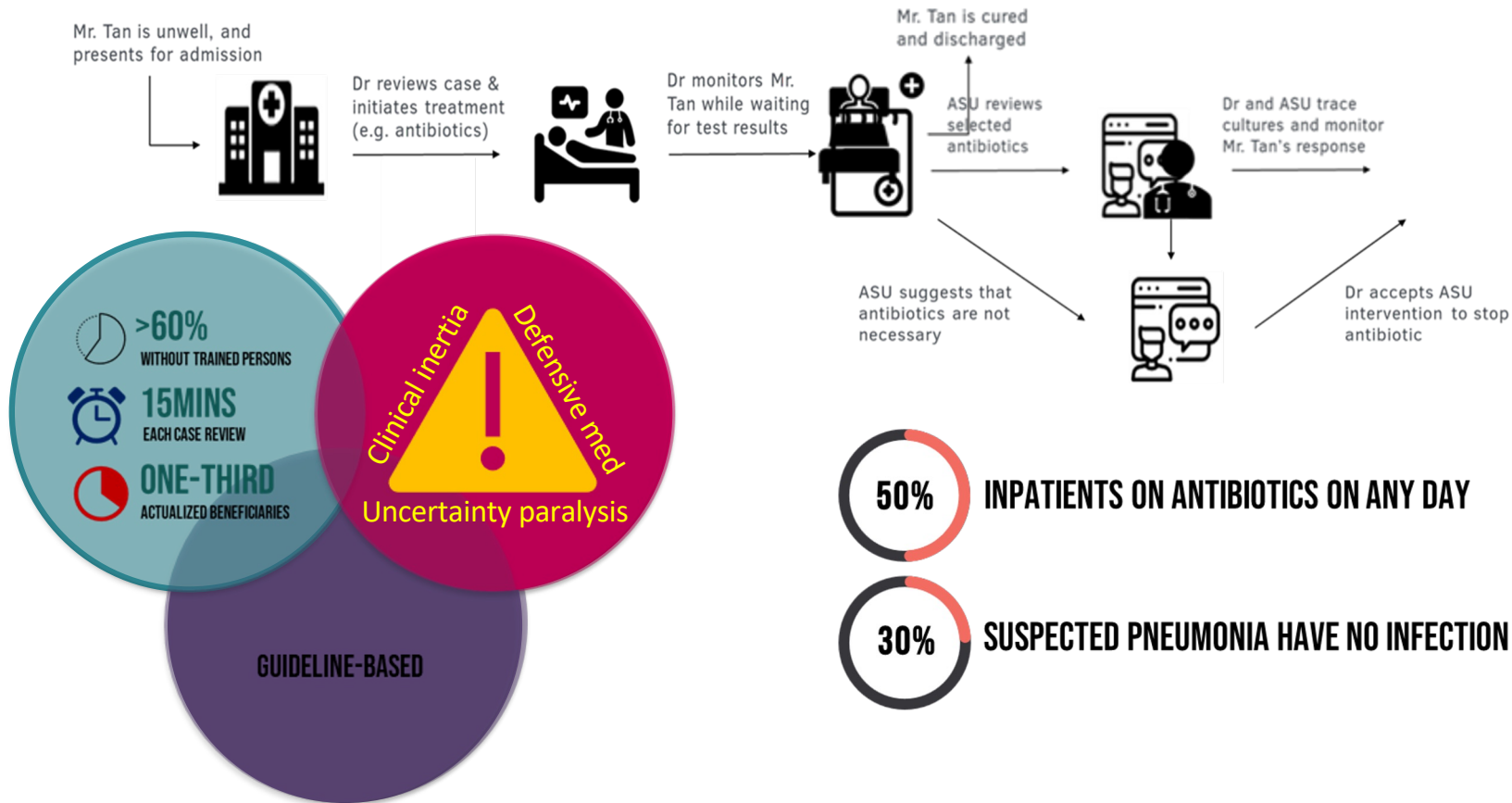
新加坡中央医院药剂部

临床研究助理史柯珊表示，医院使用广谱抗生素 (broad spectrum antibiotics)，得打点滴注入患者身体，如果患者能提早停止抗生素疗程，就能提早出院。

Our ASP Journey



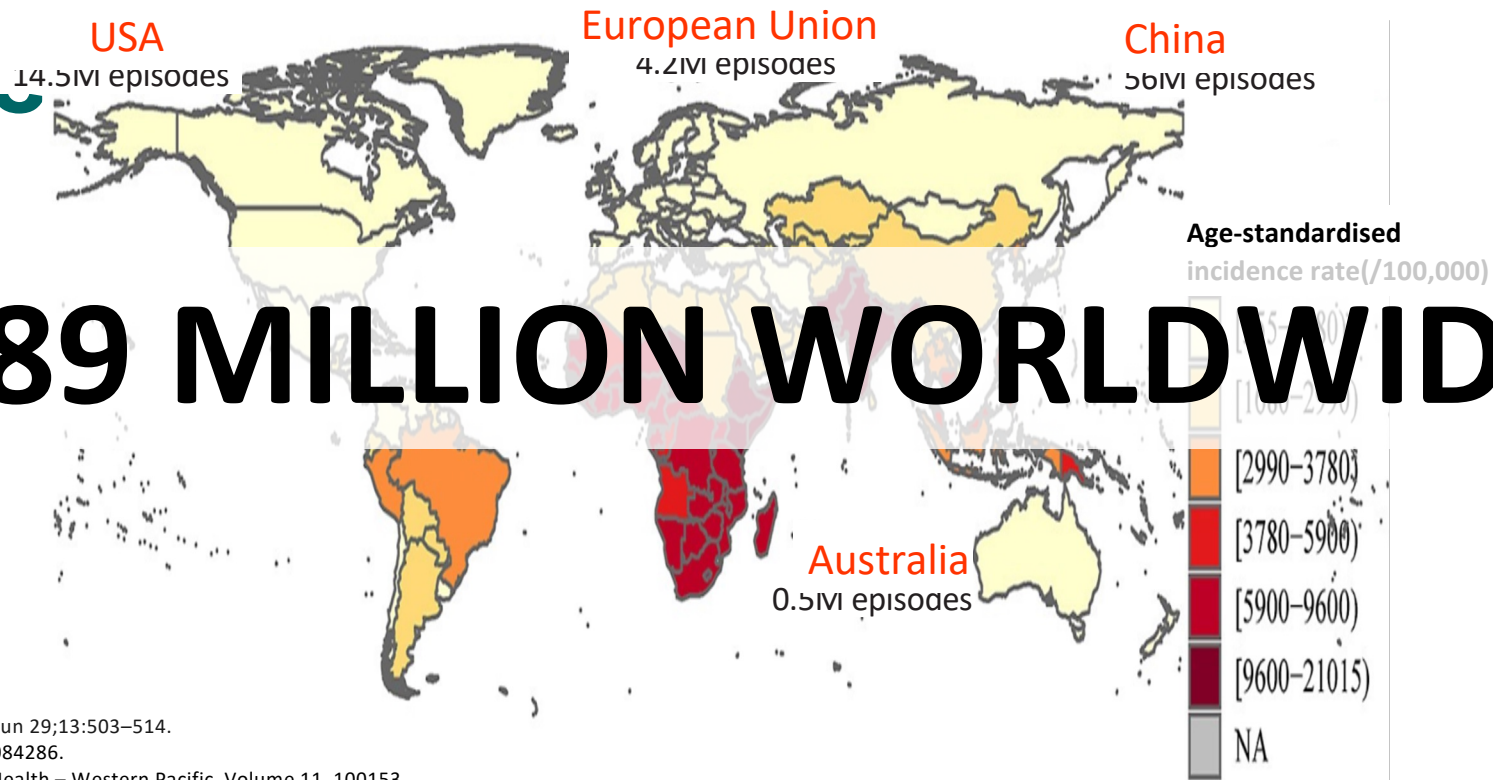
The Problem



In-house data

Lower Respiratory Tract

Info



Clin Epidemiol. 2021 Jun 29;13:503–514.

BMJ Open 2024;14:e084286.

The Lancet Regional Health – Western Pacific, Volume 11, 100153

Heliyon, 2024, Volume 10, Issue 16, e35841.

Front Public Health 2023;10:1028525.

The Problem is BIG

Global incidence of LRTI/year	489 M
Proportion of unnecessary antibiotic use	x 30%
No. of people that receive unnecessary antibiotics	146.7 M
Standard treatment duration/course	x 5 days
No. of unnecessary antibiotic-days	733.5 M days (that can potentially be avoided)

The Solution

WE NEED A...

PRECISE & INDIVIDUALISED

Guide to Antibiotic Initiation for Lower Respiratory Tract Infections

at the point of decision-making.

Indication. **Choice.** **Dose.** **Route.**

Duration.

A system of models are built - AI2D

Hypothesis



An AI clinical model that uses clinical features and CXR reports can correctly identify presence/absence of clinical pneumonia $\geq 80\%$ of time



Results Achieved

Developed a Classification Model with **83% accuracy** of classifying whether patient has pneumonia

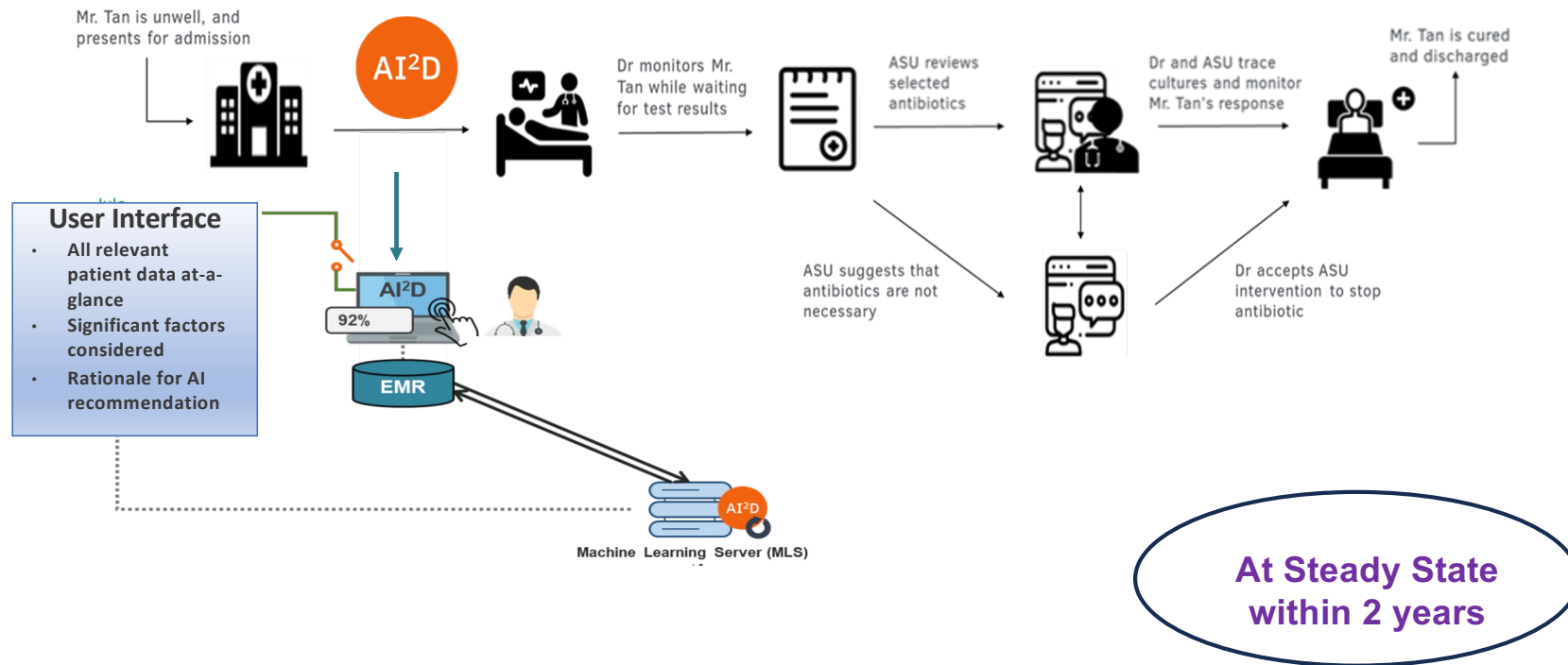


Addition of AI image analysis model can more correctly identify presence/absence of clinical pneumonia by 5% compared to AI clinical model alone

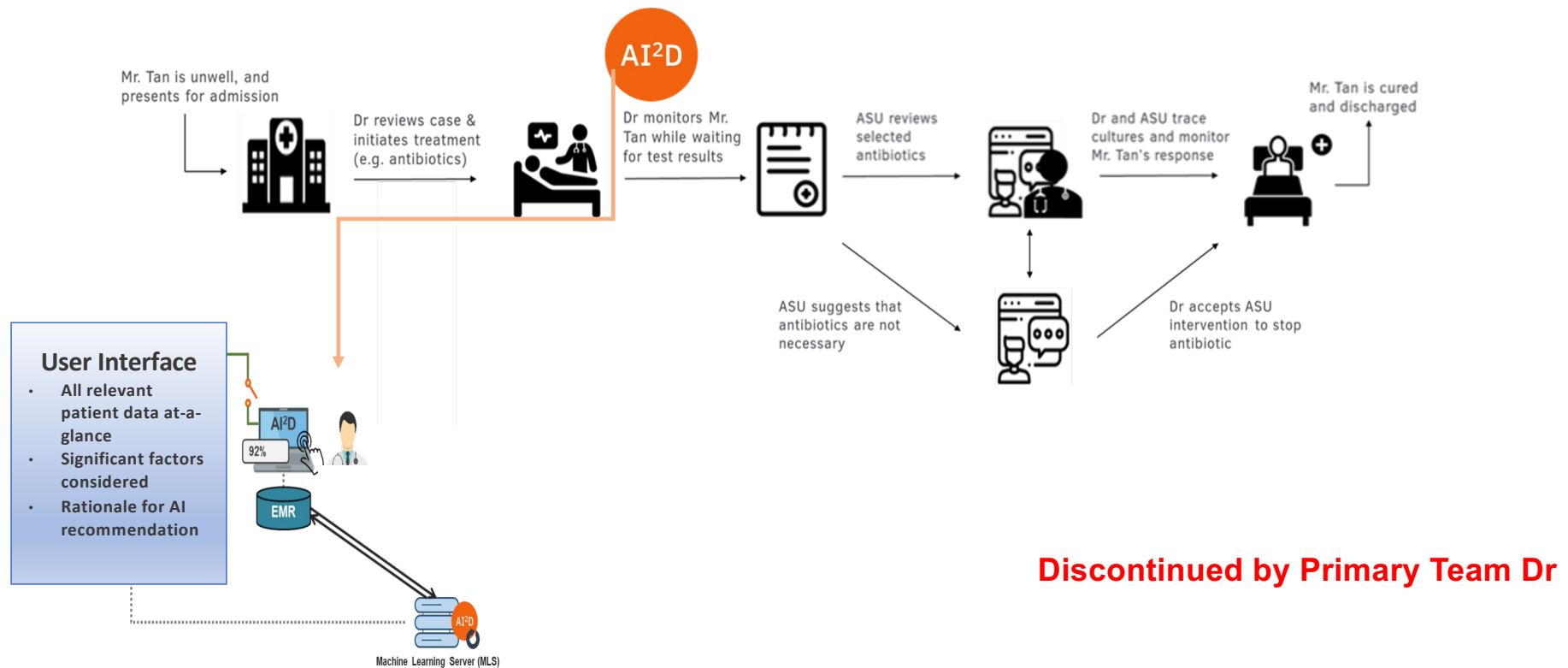


Developed a Deep Learning model with **87% accuracy**, when used alone

Guide to Antibiotic Initiation for Lower Respiratory Tract Infections



Guide to Antibiotic Discontinuation at Day 2 for Lower Respiratory Tract Infections



CLINICAL AI • ANTIMICROBIAL STEWARDSHIP

AI2D supports earlier antibiotic discontinuation in suspected LRTI

Prospective implementation study at Singapore General Hospital

Sarah Tang • Daphne Yii • Rachel Lim • Maciej Piotr Chlebicki • Shimin Jasmine Chung • Andrea Kwa

Singapore General Hospital • SingHealth Duke-NUS Medicine ACP

Clinical conference presentation in ESCMID 2026

**12–15
MIN**

CLINICAL PROBLEM

LRTI is a high-value target for reducing unnecessary antibiotic exposure

The stewardship gap

Suspected lower respiratory tract infection is a major driver of antibiotic overuse—raising resistance pressure and healthcare cost.

AI2D premise

Use routinely available patient information to identify when bacterial LRTI is unlikely, then prompt a clinician review.

STUDY QUESTIONS

Can decision support reduce exposure—and remain safe?

1

Effectiveness

Early discontinuation and treatment duration

2

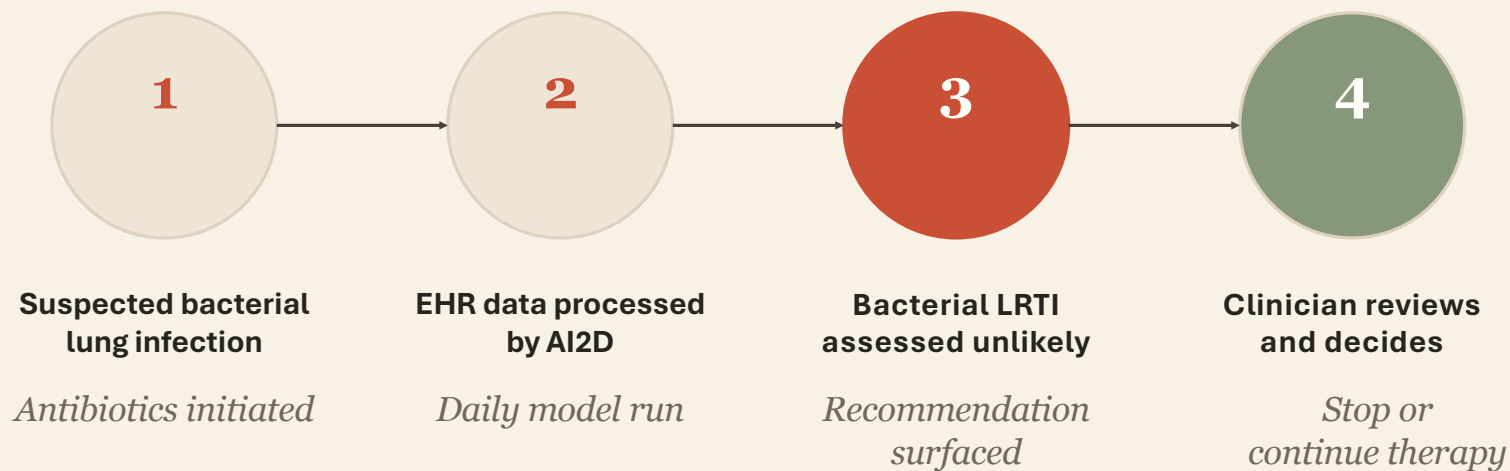
Safety

Length of stay, mortality and readmission

INTERVENTION

AI2D inserts a decision signal into the day-2 stewardship workflow

A clinician-facing recommendation—not an automated stop order.



DESIGN PRINCIPLE

Human judgment stays in the loop.

Physicians could continue treatment when they disagreed with AI2D.

METHODS

A prospective implementation study tested effectiveness and safety

SETTING

Acute medical wards, Singapore General Hospital · January–September 2025

POPULATION

Adults newly started on antibiotics for possible LRTI; key exclusions included another antibiotic indication, confirmed bacterial LRTI, or palliative prognosis <48 hours

ALLOCATION

Physicians randomized 2:1 to receive AI2D recommendations (INT) or continue standard care (SOC)

OUTCOMES

Primary: early discontinuation ≤ 3 days · Secondary: duration, length of stay, 30-day mortality and readmission

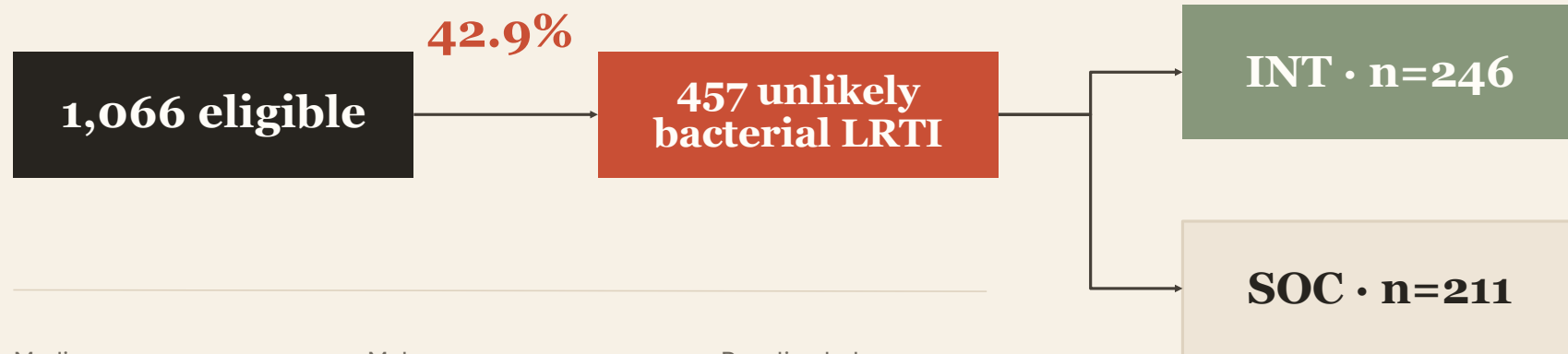
ANALYSIS

Target $n=336$; χ^2 /Fisher exact and Mann–Whitney U tests.

**Prospective ·
pragmatic ·
clinician-mediated**

COHORT

AI2D ruled bacterial LRTI unlikely in 42.9% of eligible patients



Median age

77

years (IQR 68–86)

Male

50.3%

230 patients

Baseline balance

Similar

except chronic pulmonary disease

IMPLEMENTATION

Clinicians acted on nearly two-thirds of AI2D recommendations

65.4%

161 of 246 recommendations accepted

Adoption was substantial but not automatic—consistent with decision support that preserves clinician discretion.



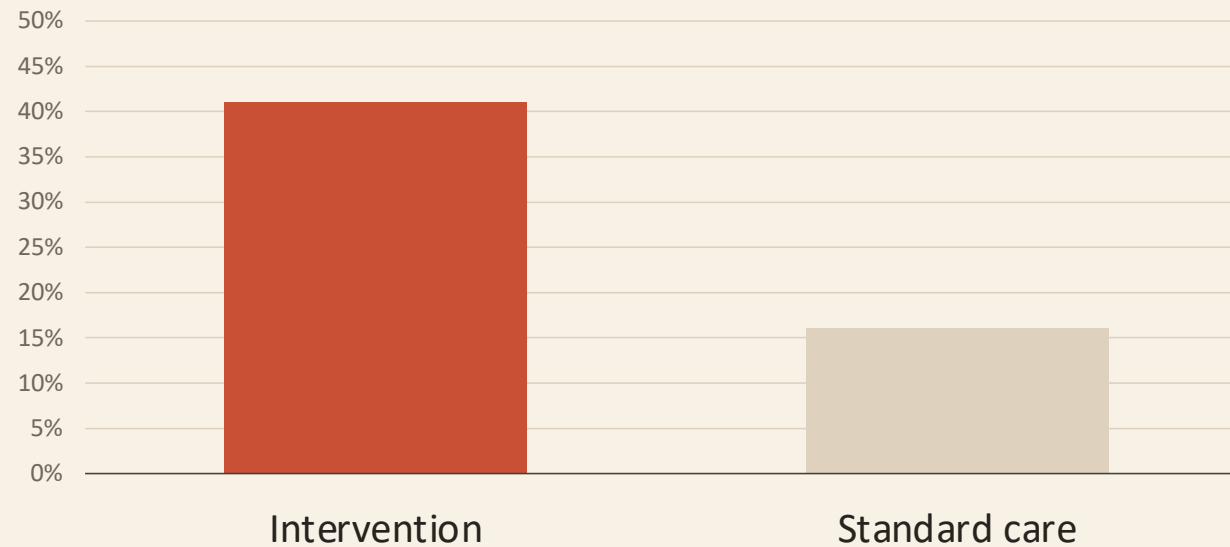
INTERPRETATION

Real-world impact depends on both model signal and clinician uptake.

PRIMARY OUTCOME

Early antibiotic discontinuation more than doubled with AI2D

Discontinued within 3 days.



+25.0

percentage points

absolute difference

p < 0.001

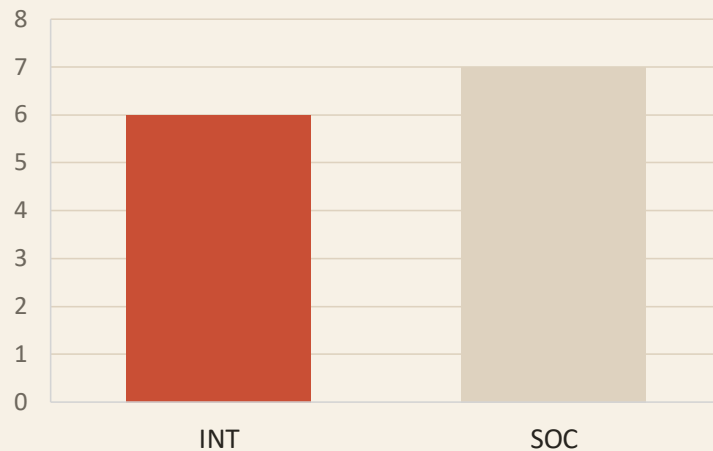
Primary endpoint

CLINICAL OUTCOMES

AI2D shortened exposure and reduced 30-day readmissions

Antibiotic duration

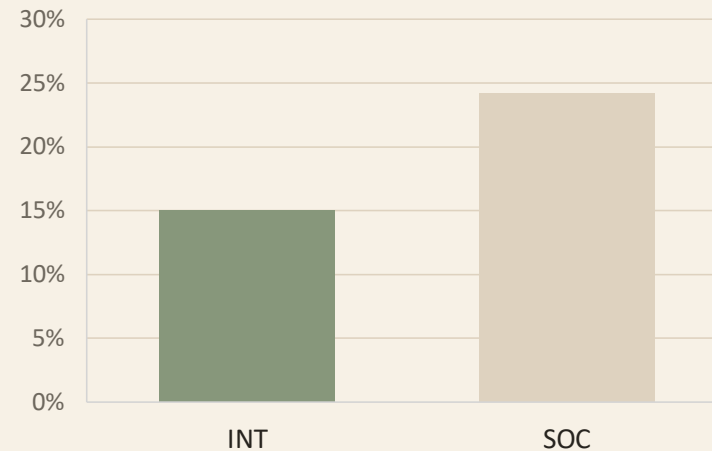
Median days



$p < 0.001$

30-day readmission

All-cause, %



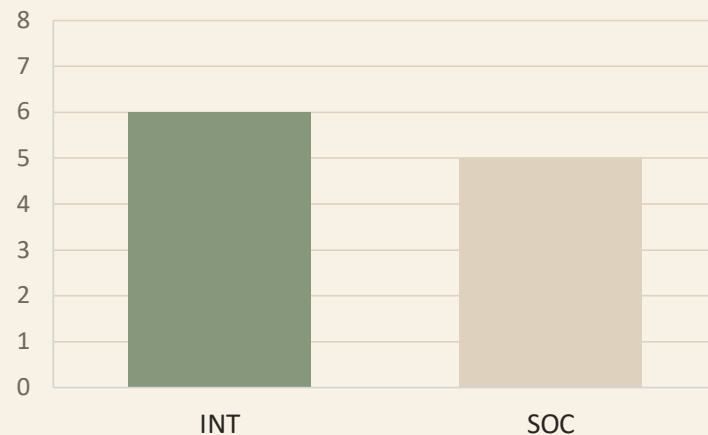
$p = 0.01$

SAFETY

Efficiency gains were not accompanied by a detected safety penalty

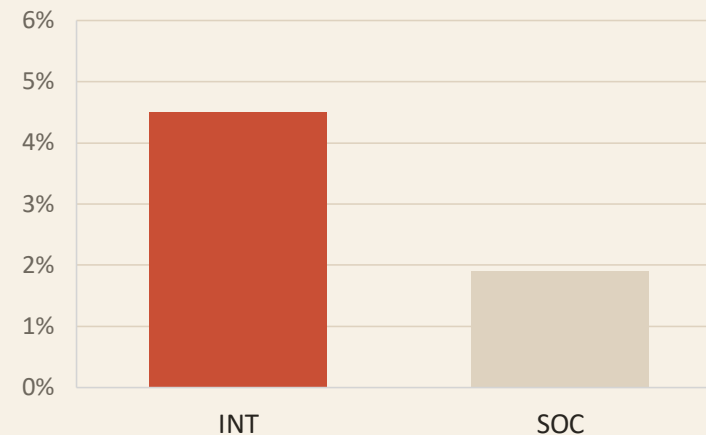
No statistically significant difference in length of stay or 30-day mortality.

Length of stay



$p = 0.43 \cdot \text{NS}$

30-day mortality



$p = 0.12 \cdot \text{NS}$

Interpret as “no detected difference,” not proof of equivalence.

TAKE-HOME MESSAGE

Decision support can strengthen stewardship when clinicians retain judgment

AI2D increased early discontinuation, reduced antibiotic exposure, and lowered 30-day readmissions without a detected difference in mortality or hospital stay.

01 What changed

Earlier stopping
Shorter treatment
Fewer readmissions

02 Why it matters

A daily model signal can focus stewardship review where antibiotics may be unnecessary.

03 What comes next

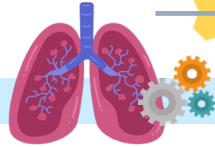
Validate generalisability, monitor safety, and study how recommendation design affects uptake.

Key limitation: single-centre implementation evidence; clinician acceptance and local workflow shape effect size.

Restricted, Sensitive (Normal)

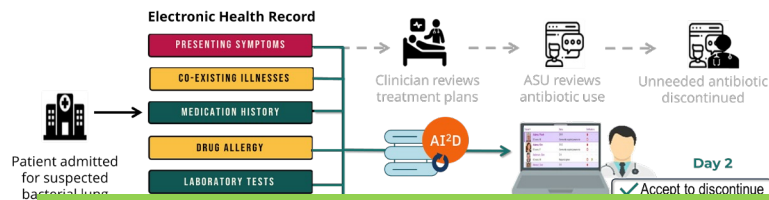


AI²D — Augmented Intelligence in Infectious Diseases



What AI²D Does

- Analyses individual patient EHR data to determine **when antibiotics are not needed**
- Promotes **early identification and discontinuation** of unnecessary antibiotics
- Supports clinical judgement** while lowering cognitive load



Estimated cost savings

- direct per patient >SGD\$3544
- for hospital >SGD\$7000

ASU:

Operational Impact



Workforce Productivity



Fewer Prescriptions to Review



Healthcare Costs Saved

Clinical Impact



Less Antibiotic Use



More Patients Safely Stopped Antibiotics by Day 2



Earlier Hospital Discharge

AI²D enables faster, safer, and more precise antibiotic decisions—at scale—by **embedding augmented intelligence** directly **into real-world clinical workflows**.



THE END