Diagnostic stewardship

Does optimization of the blood culture pathway have a role to play?

Dr Michael Weinbren

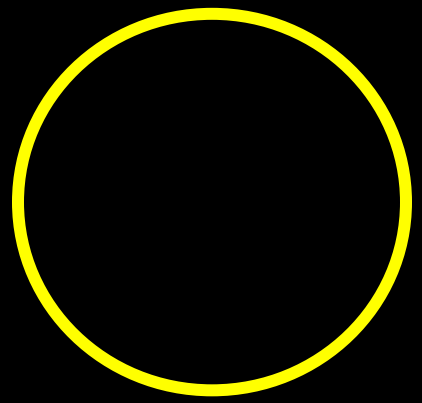
BSMT MAY 2018

M Weinbren
Kings Mill hospital

R. E. Holliman. The therapeutic impact of blood culture results. Journal of Hospital Infection (1986) 7, 185-188

- Summary: The influence on therapy of blood culture results was monitored over a 3-month period.
- Approximately half the patients yielding significant cultures commenced initial or altered antibiotic treatment on the basis of laboratory results.
- Therapy based on a defined antibiotic policy was found to be satisfactory in most instances.
- Whilst an antibiotic policy allows effective treatment of many patients, there remains a need for an early microbiological diagnosis.

GENTAMICIN



MEROPENEM

PIPERACILLIN/
TAZOBACTAM

AMIKACIN

CIPROFLOXACIN

CEFTAZIDIME

But is that all there is to blood culture microbiology?

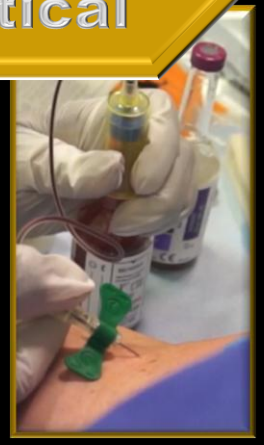
Blood cultures are the gold standard for diagnosis of blood stream infections

Rapid results associated with improved outcome, shorter length of stay

Is there a role for improved antimicrobial stewardship?

Pre analytical

1



Right patient / volume of blood to analyser with minimum delay

Analytical

2

SHORTEST TIME TO KEY RESULT

Post analytical

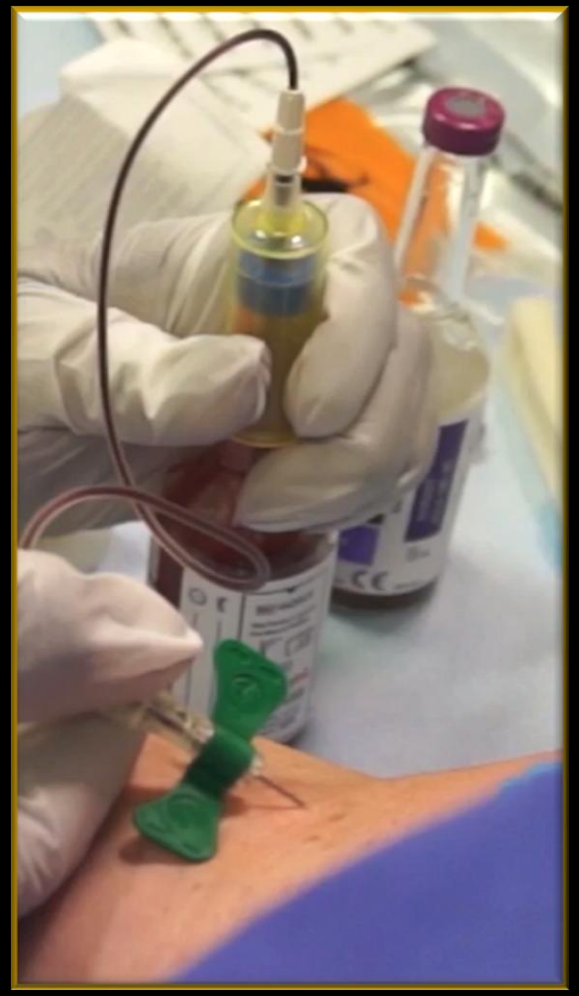
3

USE KEY RESULT TO MANAGE PATIENT WITH MINIMUM DELAY

FINISH

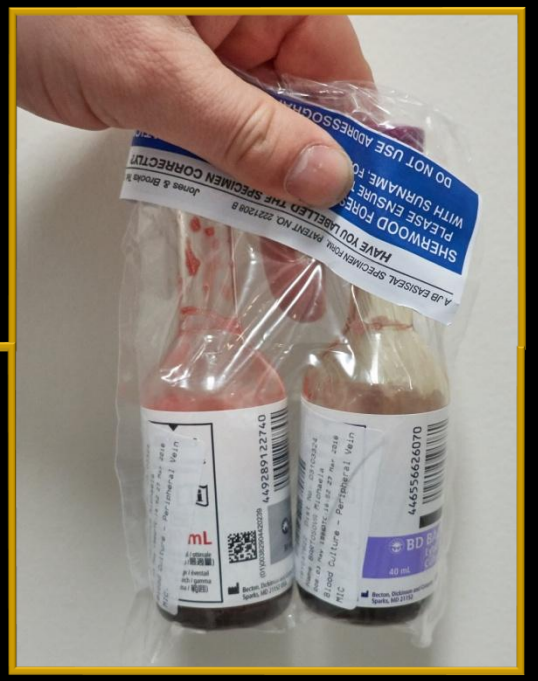
Pre analytical

Blood culture collection

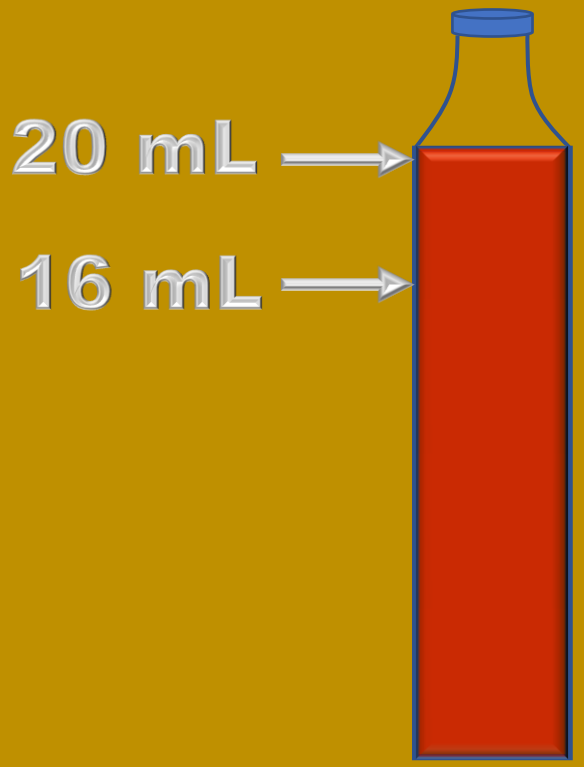


Right patient

Right volume

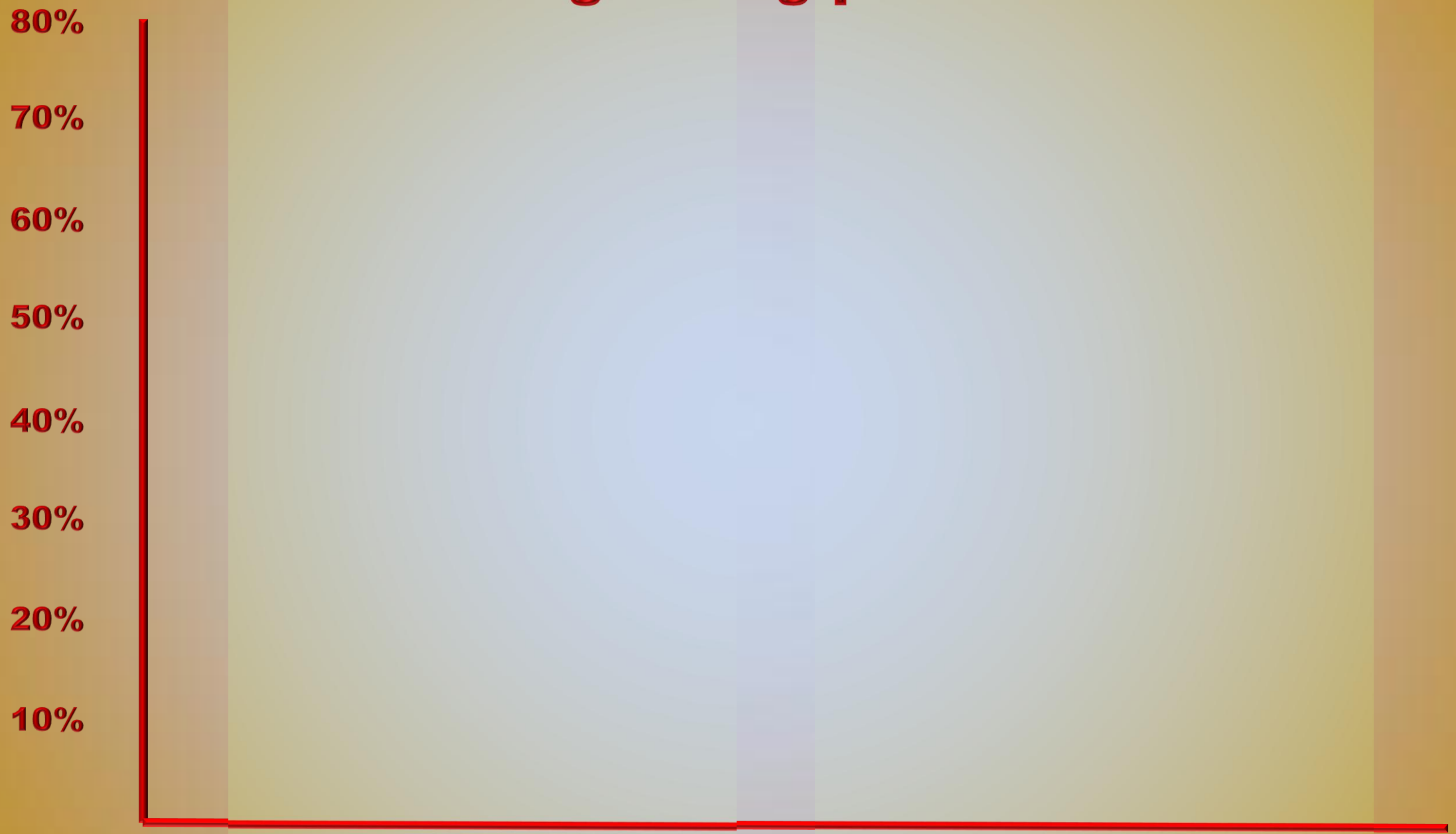


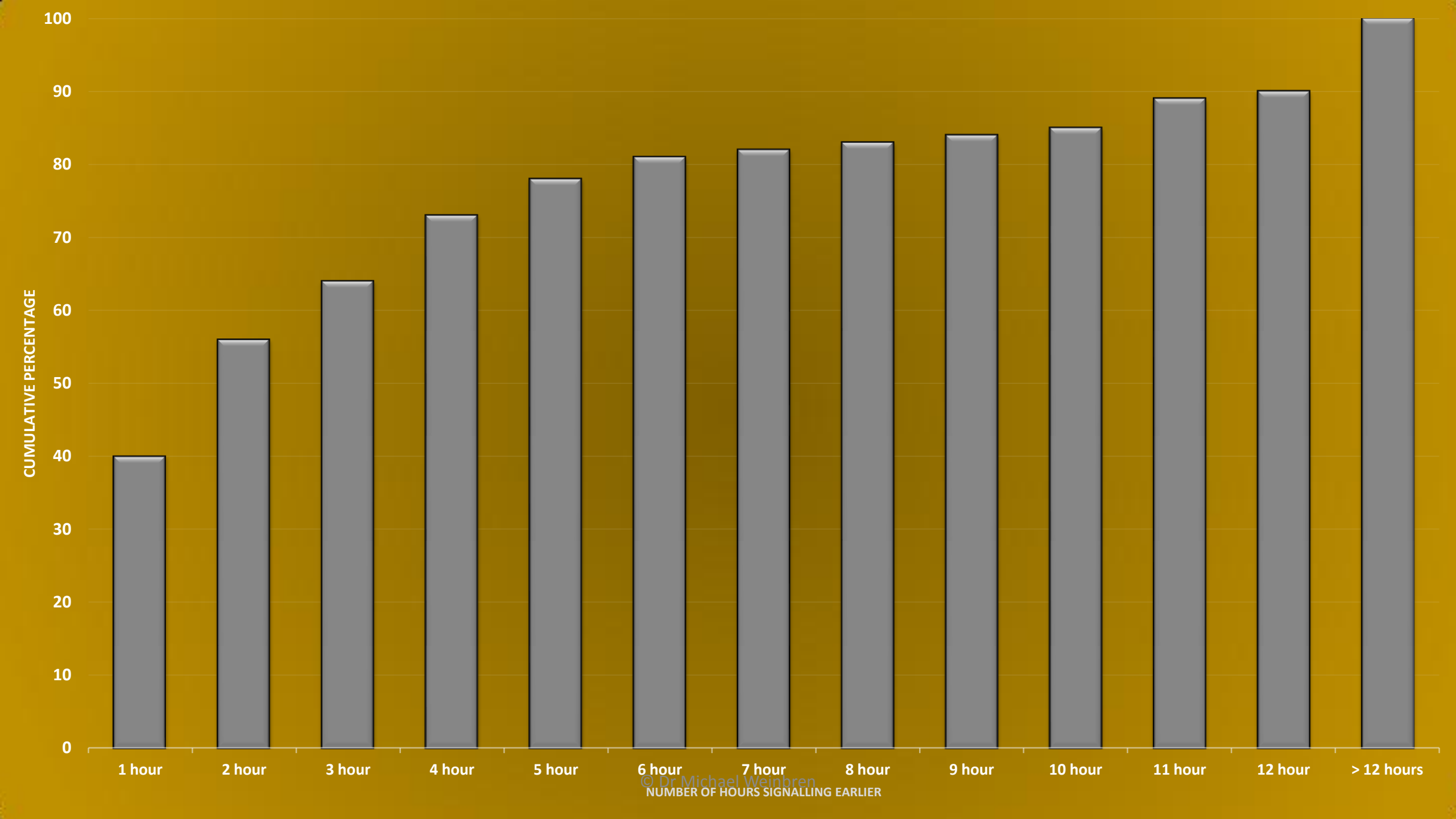
Volume of blood received in one set of blood cultures



25% adequately filled

Bottle signalling positive first





Pre analytical

Blood culture collection

Right patient

Right volume

Right time

Two Sets in adults

2 sets- 20% extra E.coli
Vivienne Weston

SEPSIS- 40ml blood- 50% extra significant positive blood cultures
Shabnam Iyer

≤4 hours

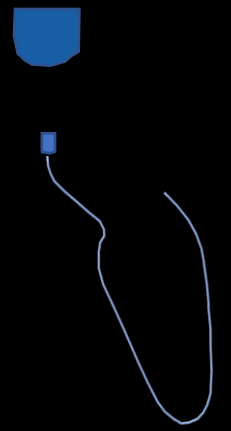
Analytical

Blood culture processing

TIME TO KEY INFORMATION

- 36 HOUR NEGATIVE BLOOD CULTURE
- GRAM STAIN
- ORGANISM ID
- ANTIBIOTIC SENSITIVITIES

Post analytical

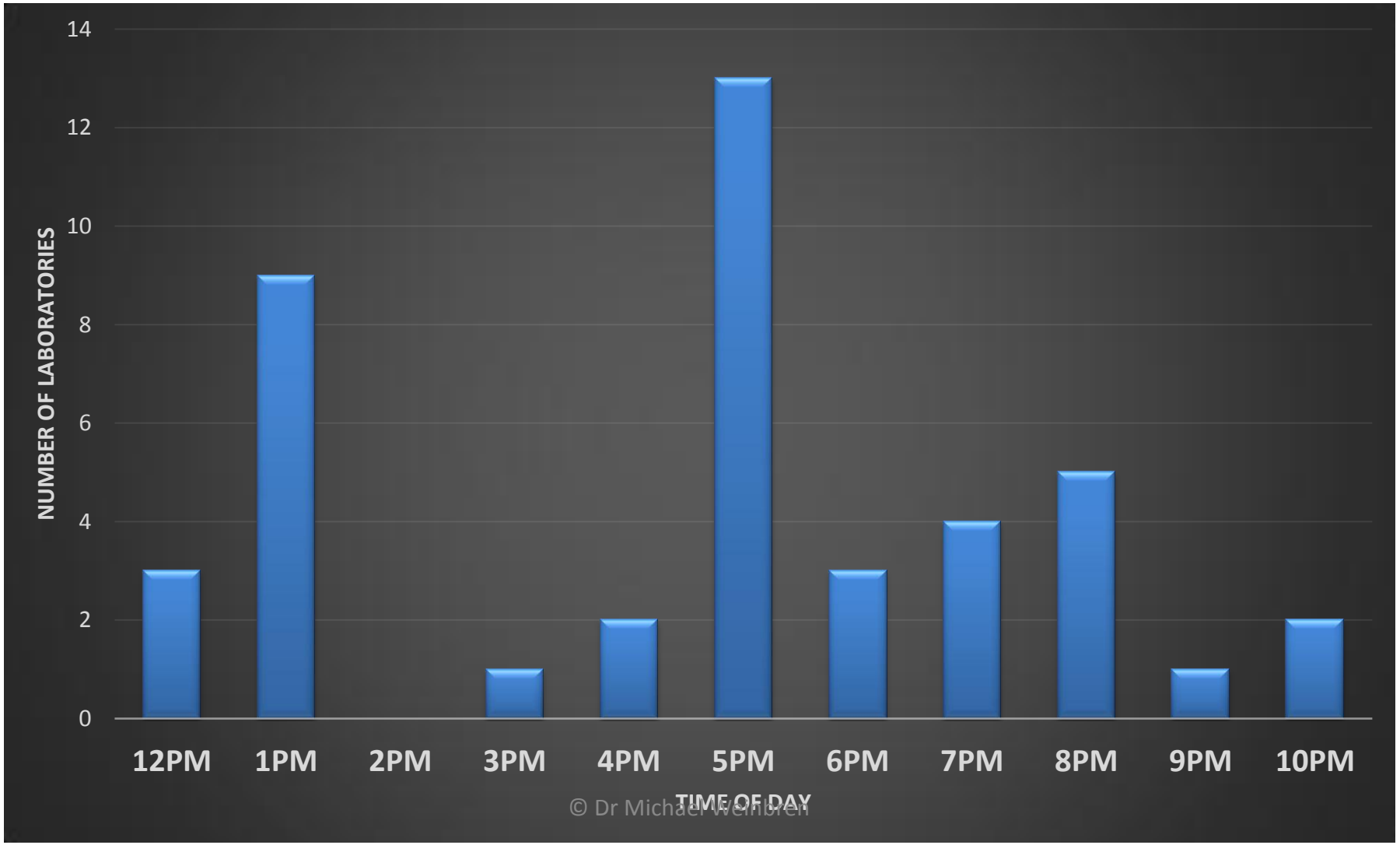


NATIONAL TELEPHONE SURVEY IN 2012 – 43 LABOARTORIES

- **NO** LABORATORY LOADS BLOOD CULTURE MACHINE DURING NIGHT
- **21 LABORATORIES** PRE-INCUBATE BLOOD CULTURES OVERNIGHT
- **22 LABORATORIES** LEAVE BLOOD CULTURES AT ROOM TEMPERATURE OVERNIGHT
- 24 HOUR SHIFT SYSTEM IN BLOOD SCIENCES IN SAME LABORATORY **31 LABORATORIES**

WEEKEND

TIME LAST POSITIVE BLOOD CULTURE PROCESSED



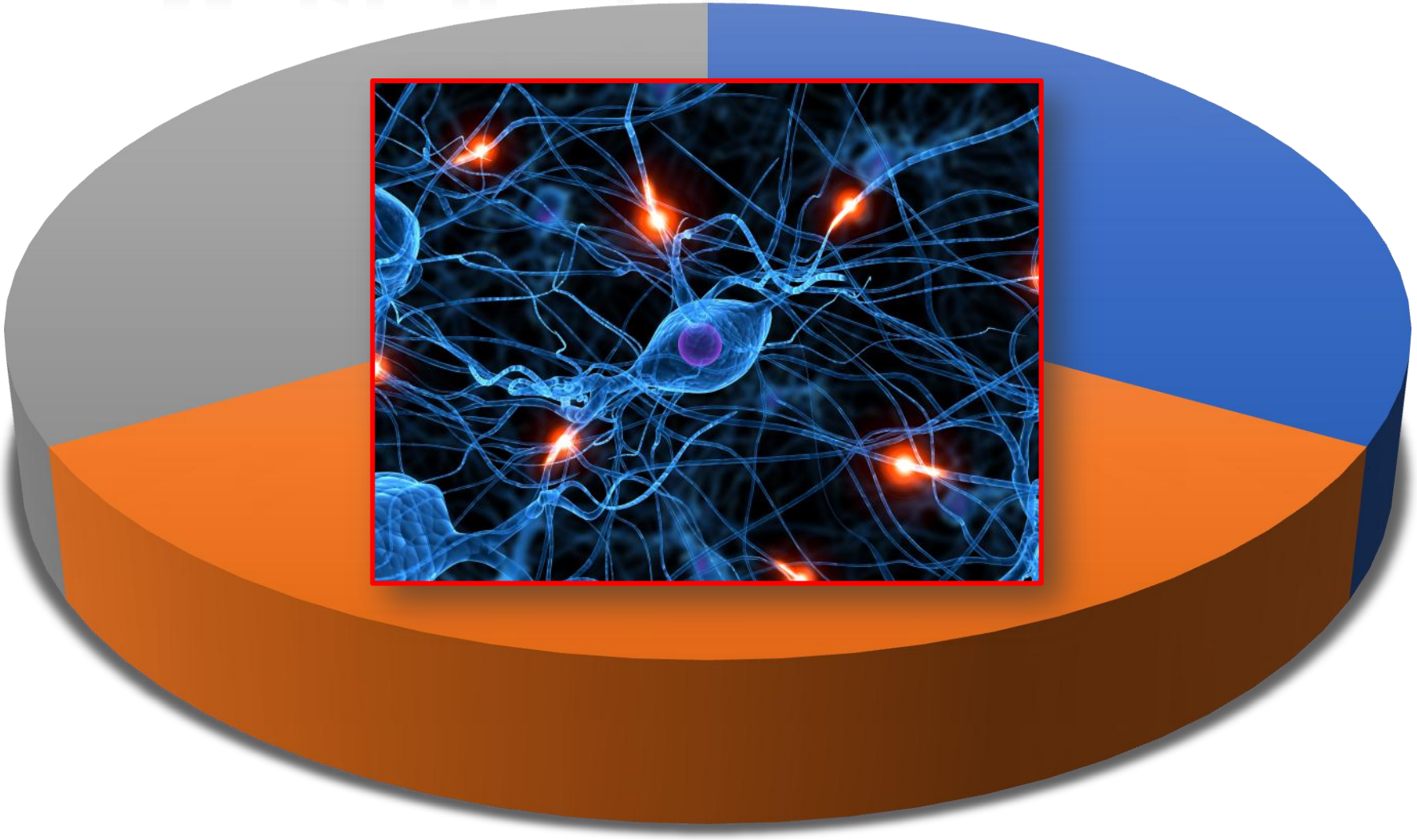
AUDIT OF BLOOD CULTURE TURNAROUND TIME

- REGULARLY- 2
- OCCASIONALLY – 11
- DO NOT KNOW- 1
- **NEVER- 29**

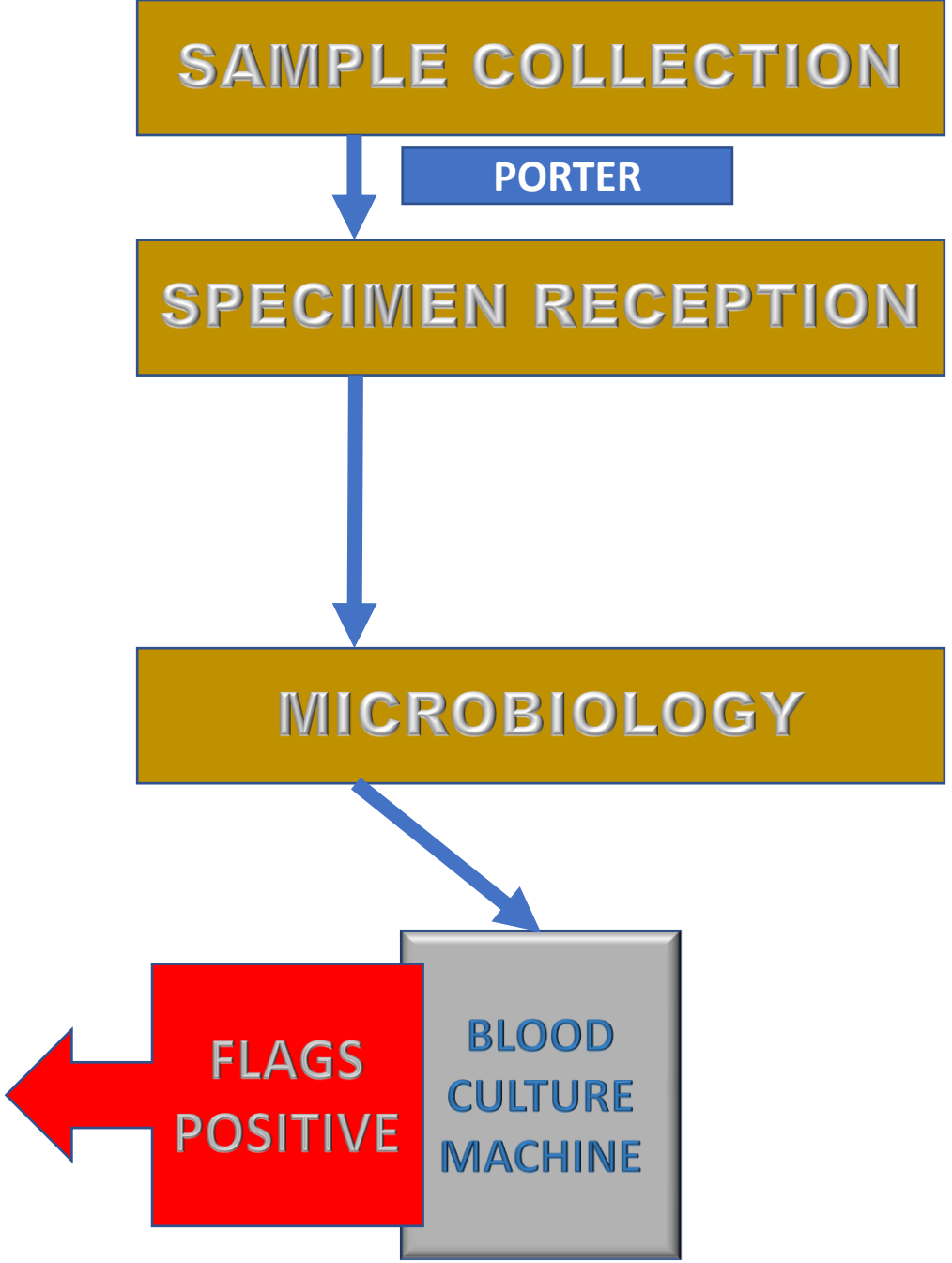
1. Audit of blood culture pathway is key

2. Set time standards for critical control points

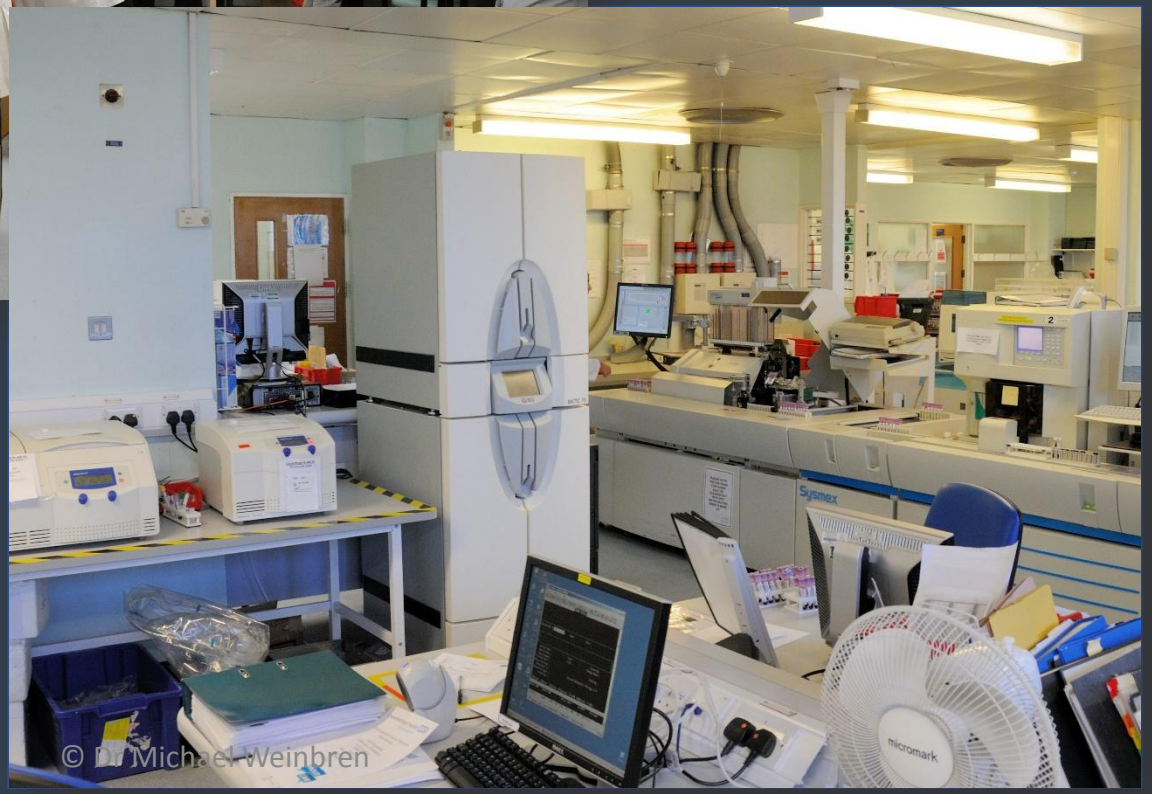
Multi-disciplinary group



BLOOD SCIENCE MICROBIOLOGY CLINICAL



CHESTERFIELD PATHOLOGY BUILDING



SAMPLE COLLECTION

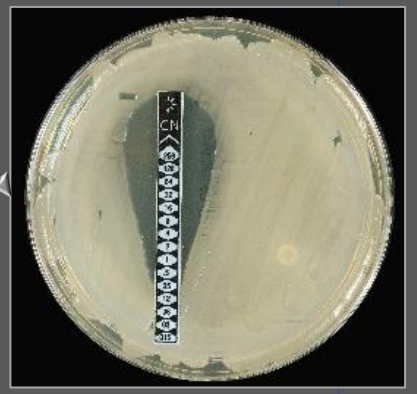
SPECIMEN RECEPTION

FLAGS POSITIVE

FLAGS POSITIVE

MICROBIOLOGY

Sensitivity plates



Rapid sensitivities

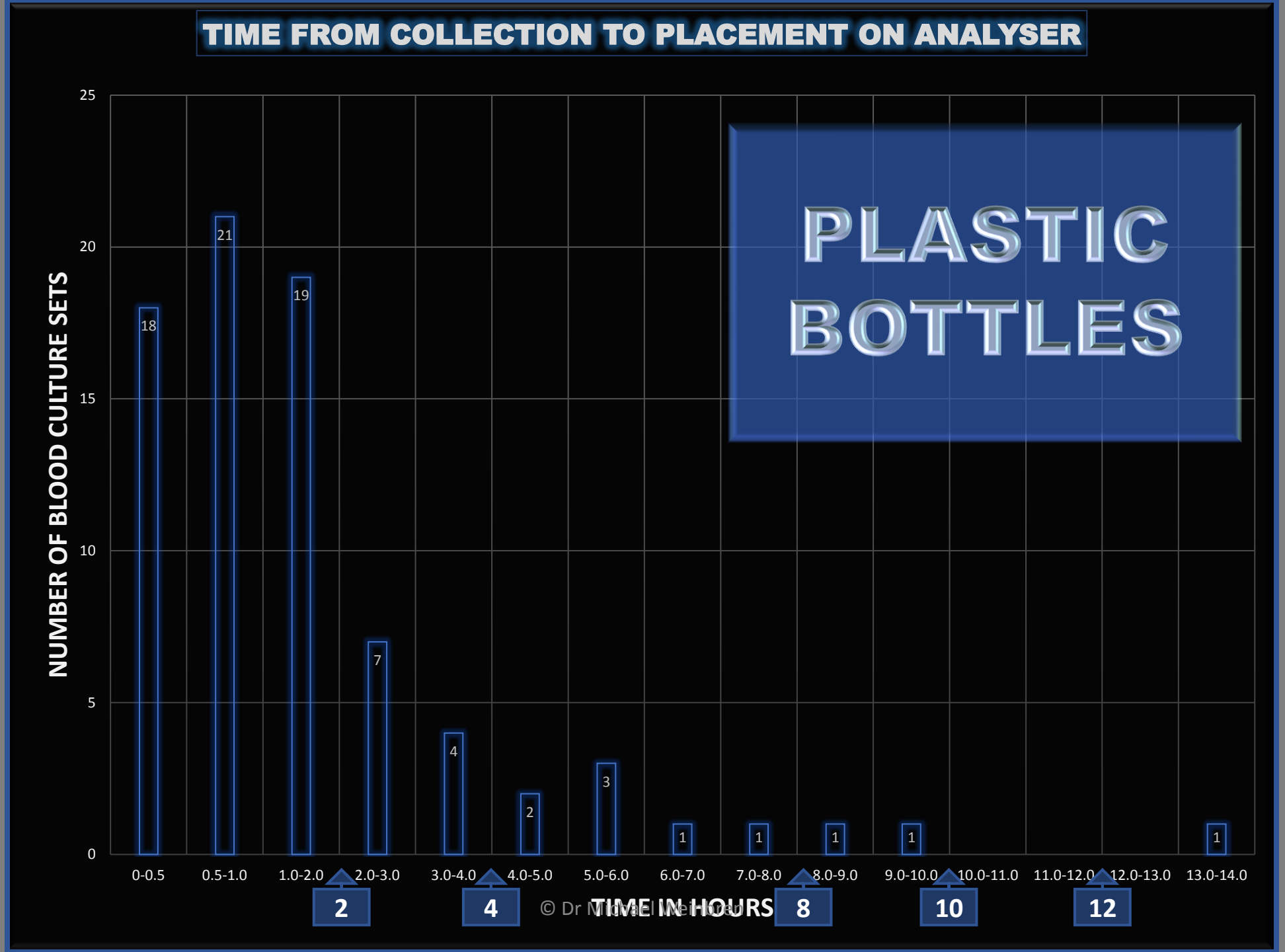
Table 1 The average time to positivity

pre-move	**17 hours and 49 minutes**
post move	**18 hours and five minutes**

Table 3 The average time to positivity for E. coli

pre-move	**15 hours 34 minutes**
post move	**12 hours 56 minutes**

E. coli common pathogen in blood cultures
Rarely a contaminant
Allows coarse comparison between laboratories


TIME FROM COLLECTION TO PLACEMENT ON ANALYSER
PLASTIC BOTTLES
NUMBER OF BLOOD CULTURE SETS
25
20
15
10
5
0
18
21
19
7
4
2
3
1
1
1
1
1
0-0.5
0.5-1.0
1.0-2.0
2.0-3.0
3.0-4.0
4.0-5.0
5.0-6.0
6.0-7.0
7.0-8.0
8.0-9.0
9.0-10.0
10.0-11.0
11.0-12.0
12.0-13.0
13.0-14.0
2
4
8
10
12
TIME IN HOURS
© Dr Michael Mellerio

	1 HOUR	2 HOURS	3 HOURS	4 HOURS	>4 HOURS	NUMBER OF SETS
GLASS	46%	69%	77%	82%	18%	84
PLASTIC						
PLASTIC 2						
JAN 1						
JAN 2						
SEPT						

The 'clinical' perspective

- Urgent requirement for blood culture transportation not common knowledge
- Not taught at medical school or afterwards
- Conduct survey of hospital staff across grades and staff groups

MICROBIOLOGY QUESTIONNAIRE

- The purpose of this questionnaire is not to test your own knowledge
- It is to find out if pathology has provided you with adequate information.
- Therefore please answer honestly , write what you think– there are no rights or wrongs in this setting.
- Only by learning what you know can we discover if there are any issues that can be improved upon.

Question 1. The microbiology laboratory opening times are;

(a) Routine service 24 hours / day

(b) 08.30 to 20.00 hours Monday to Friday, 09.00 to 17.00 Saturday / Sunday with an on call service outside of theses times

(C) None of the above

Question 2. How quickly are initial results routinely available for the following specimens;

	CSF	BLOOD CULTURE	URINE
1-2 HOURS			
24 HOURS			
48 HOURS			
72 HOURS			
OTHER PLEASE STATE			

Question 3. During routine hours how quickly should the following specimens be sent to the Laboratory;

	CSF	BLOOD CULTURE	URINE
IMMEDIATELY			
WITHIN 1 HOUR			
UP TO 2 HOURS			
NO URGENCY AS LONG AS ARRIVES SAME DAY			
OTHER PLEASE STATE			

91% of staff thought a CSF sample should be sent immediately to the lab

68% would send a blood culture immediately

Out of hours only 52% of staff would send a blood culture immediately

28% of staff thought it took ≥ 48 hours for a blood culture to flag positive

UNIVERSITY HOSPITAL PATHOLOGY REPORT
Patient- J. Brown NHS No. 456785943
Specimen- blood culture Collected 14/04/2016

Result-

NEGATIVE AFTER 48 HOURS INCUBATION

Authorised BSF 17/04/16

'there was a box in ED for blood cultures which was emptied once or twice / day'

BLOOD CULTURES

Use the Pod -save a life

This bottle may contain a killer.

Help us stop them before they succeed.

Pod it– save time, save lives

The quicker a blood culture reaches the laboratory the sooner

the correct antibiotic can be found for the patient.

For the sick patient minutes count.

By podding the blood culture at the earliest opportunity you could save a life.

Use the Pod -save a life

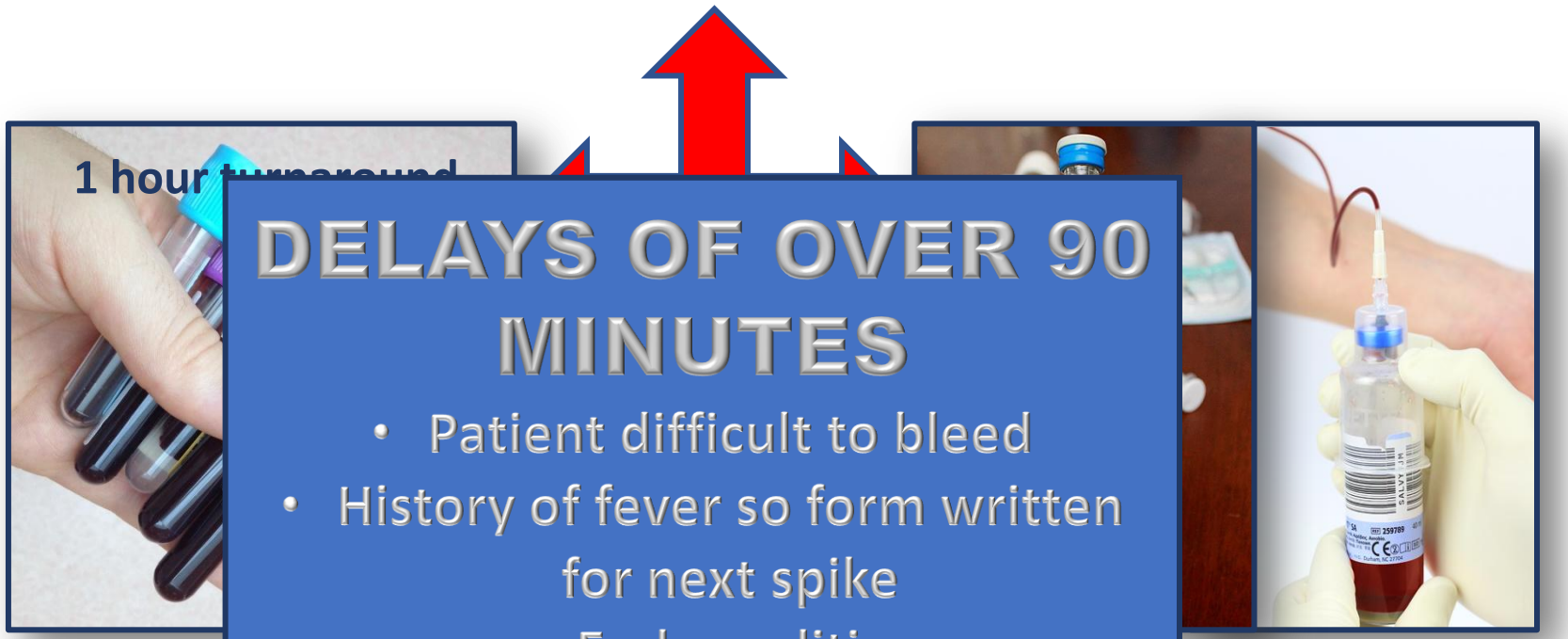
Blood cultures sitting around on a ward could mean a patient lying down forever.

Help us protect patients.

The sooner a blood culture reaches the laboratory the quicker the invading organism can be identified, so the correct antibiotic can be found to stop it in it's tracks.

Blood cultures– Pod them and you could save a life

	1 HOUR	2 HOURS	3 HOURS	4 HOURS	>4 HOURS	NUMBER OF SETS
GLASS	46%	69%	77%	82%	18%	84
PLASTIC	71%	83%	91%	95%	5%	65
PLASTIC 2	79%	88%	94%	95%	5%	82
JAN 1						
JAN 2						
SEPT						



DELAYS OF OVER 90 MINUTES

- Patient difficult to bleed
- History of fever so form written for next spike
- Endocarditis

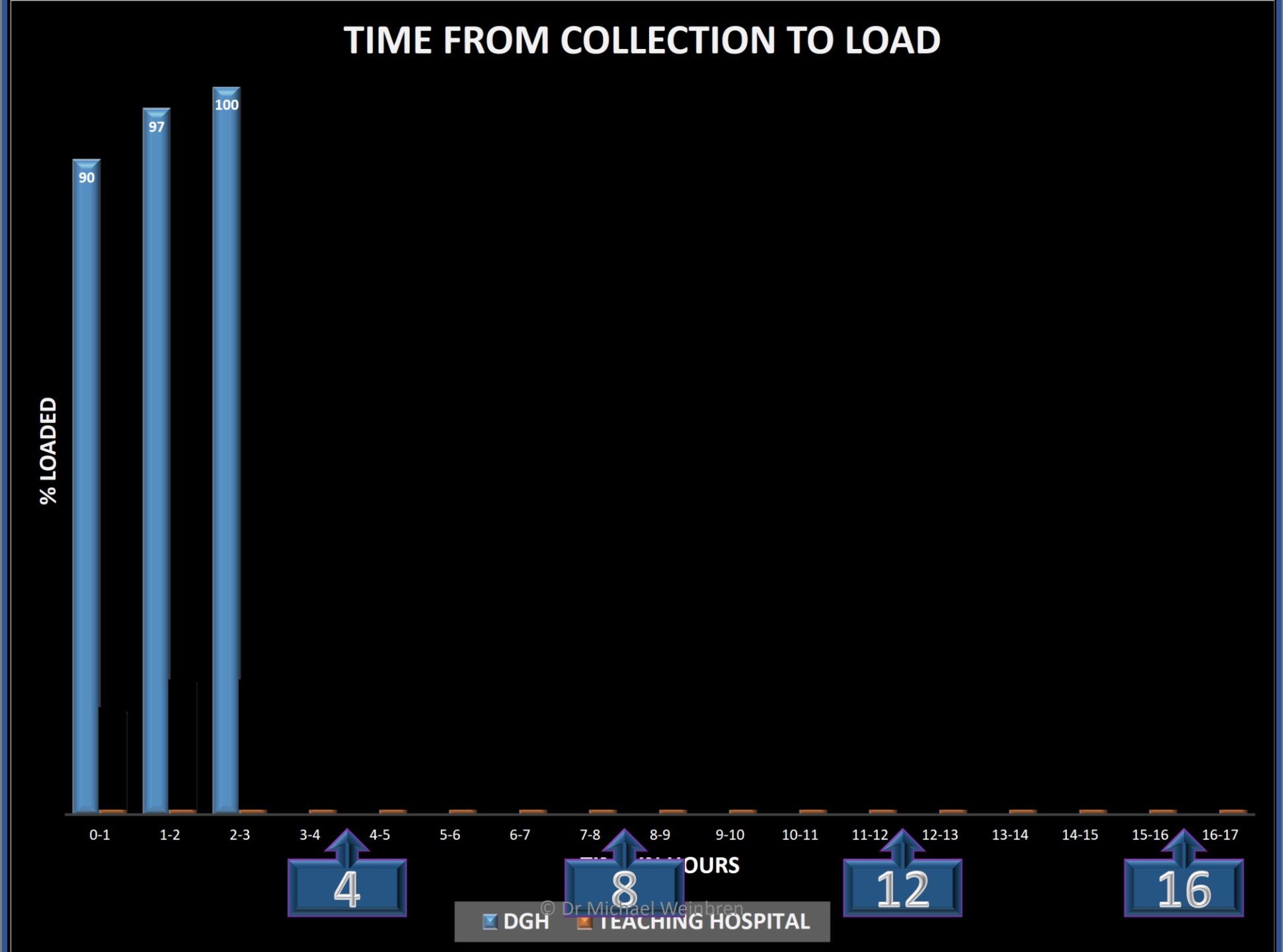
Impact of optimising the pathway

NEONATAL 36 HOUR NEGATIVE BLOOD CULTURE REPORTS

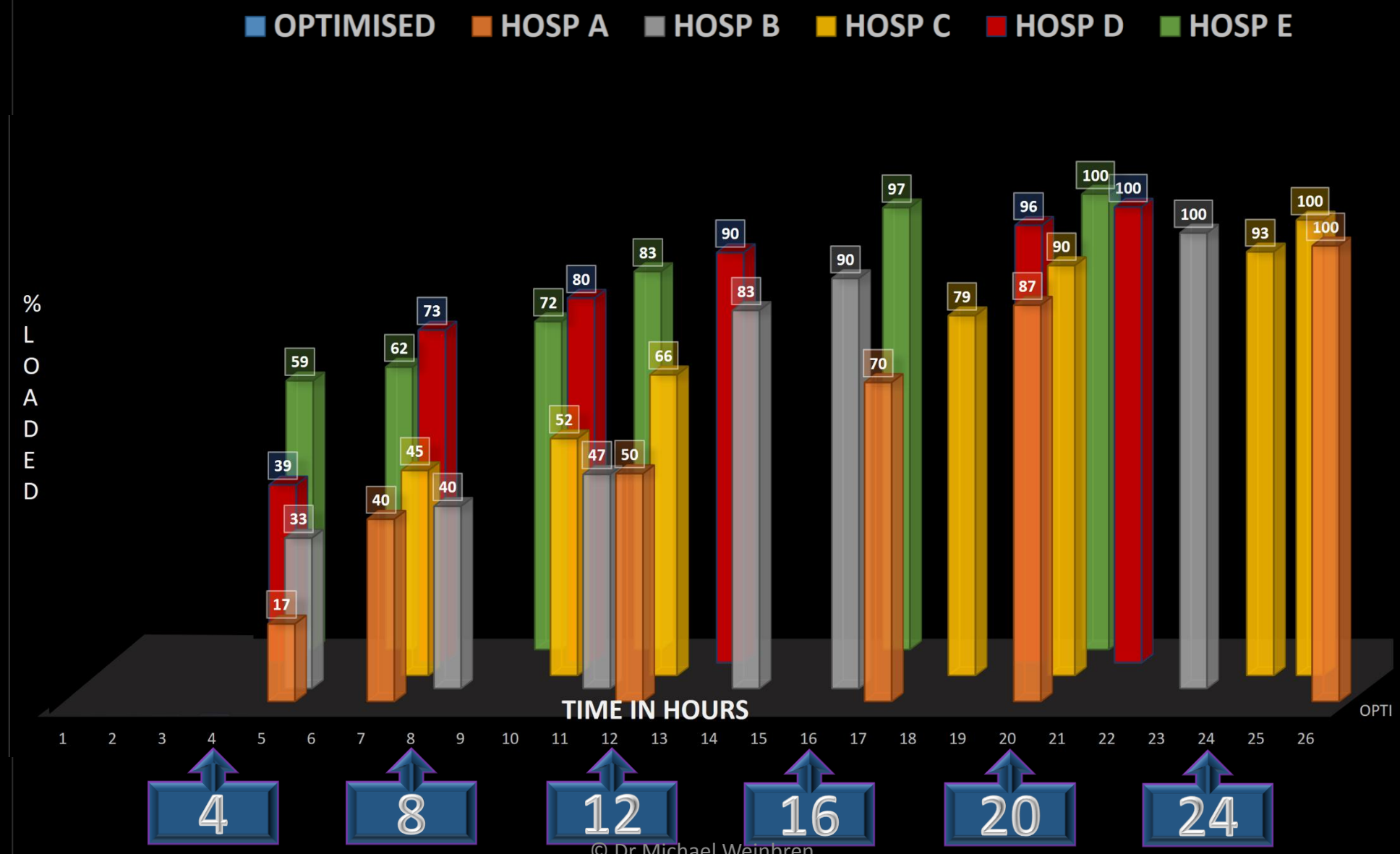
TIME FROM COLLECTION TO NEGATIVE REPORT	CUMULATIVE % OF NEGATIVE BLOOD CULTURE REPORTS ISSUED
36- 36.5 HOURS	43%
36-37 HOURS	81%
36-38 HOURS	100%

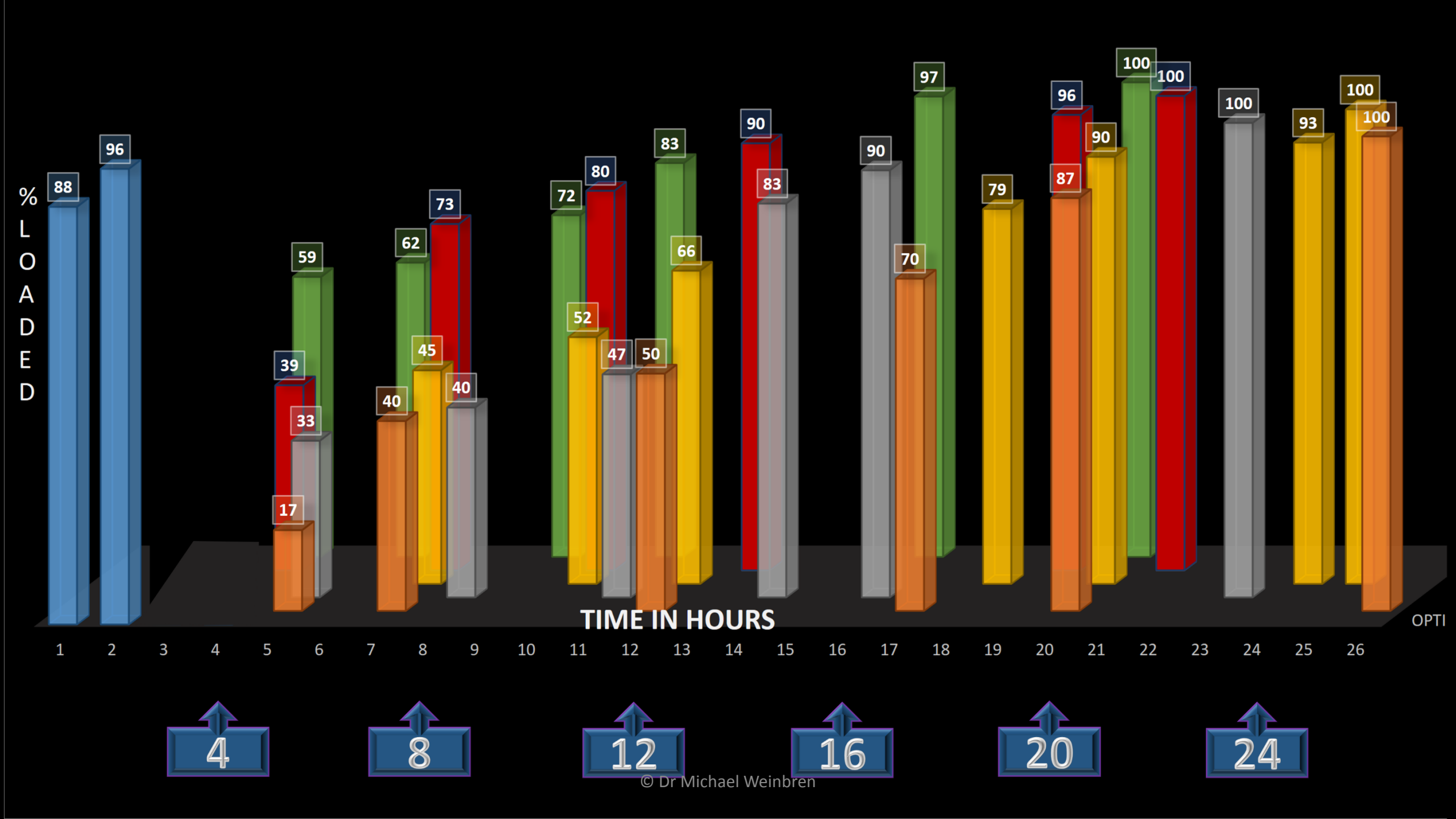
NEONATAL 36 HOUR NEGATIVE BLOOD CULTURE REPORTS

TIME FROM COLLECTION TO NEGATIVE REPORT	CUMULATIVE % OF NEGATIVE BLOOD CULTURE REPORTS ISSUED
36- 36.5 HOURS	43%
36-37 HOURS	81%
36-38 HOURS	100%

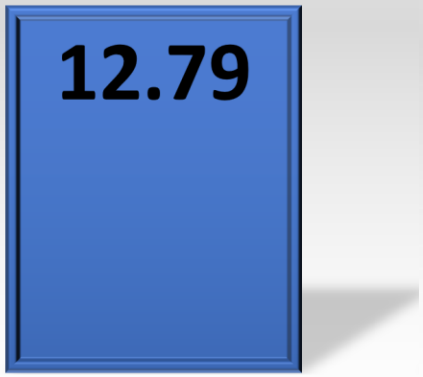


DELAY BETWEEN COLLECTION AND PLACEMENT ON BLOOD CULTURE ANALYSER



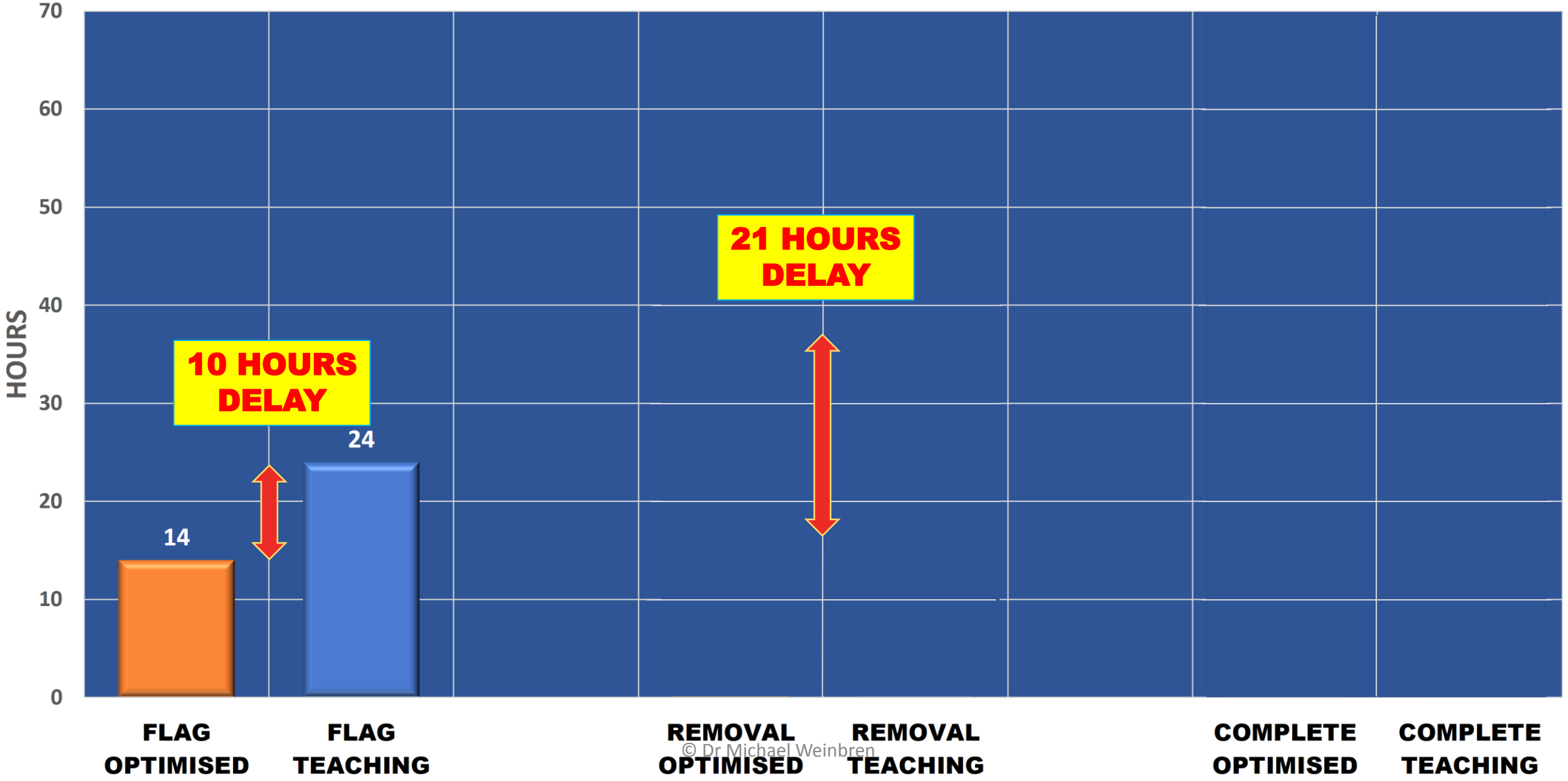


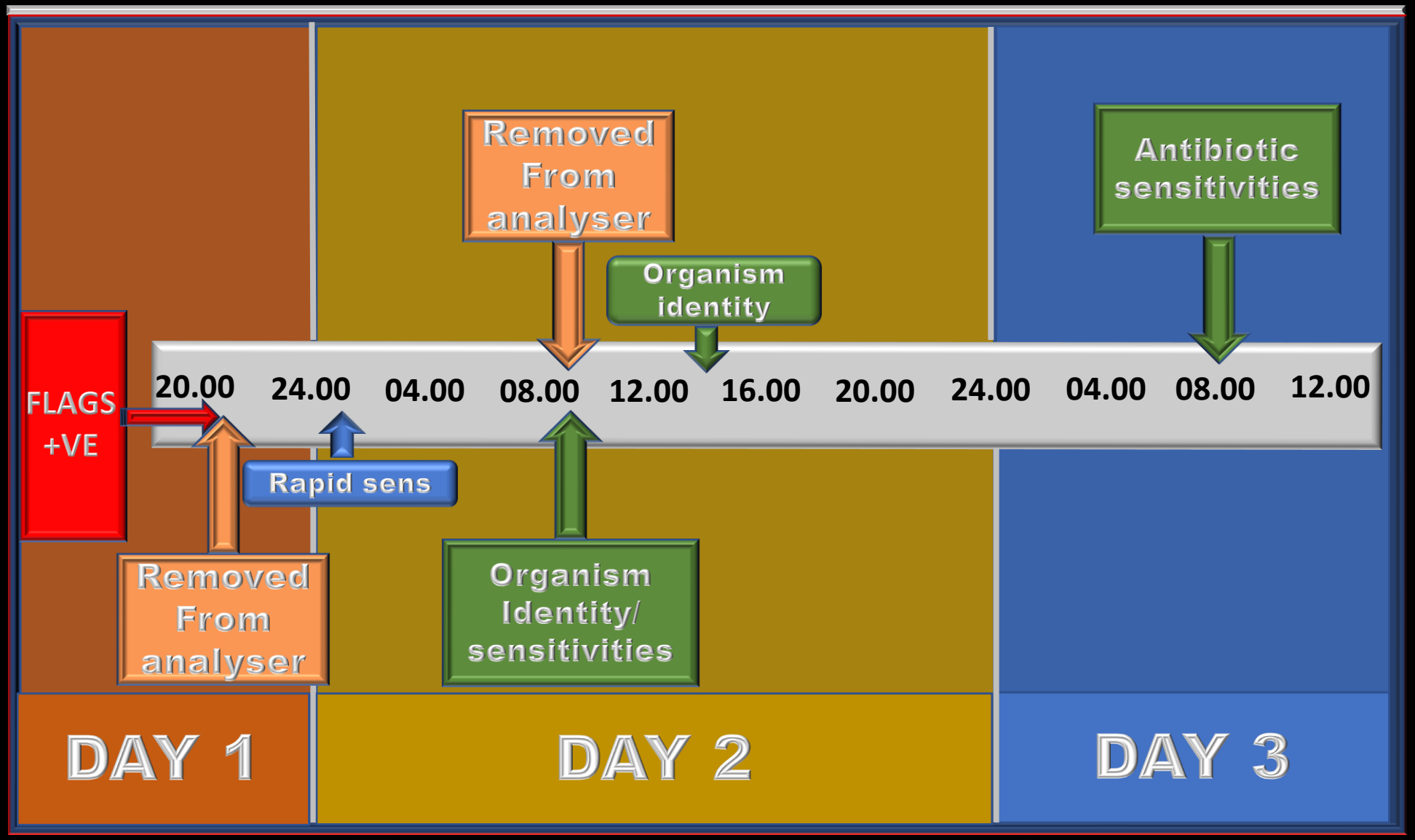
Average time in hours from collection to flagging positive and removal for *E. coli* positive blood culture



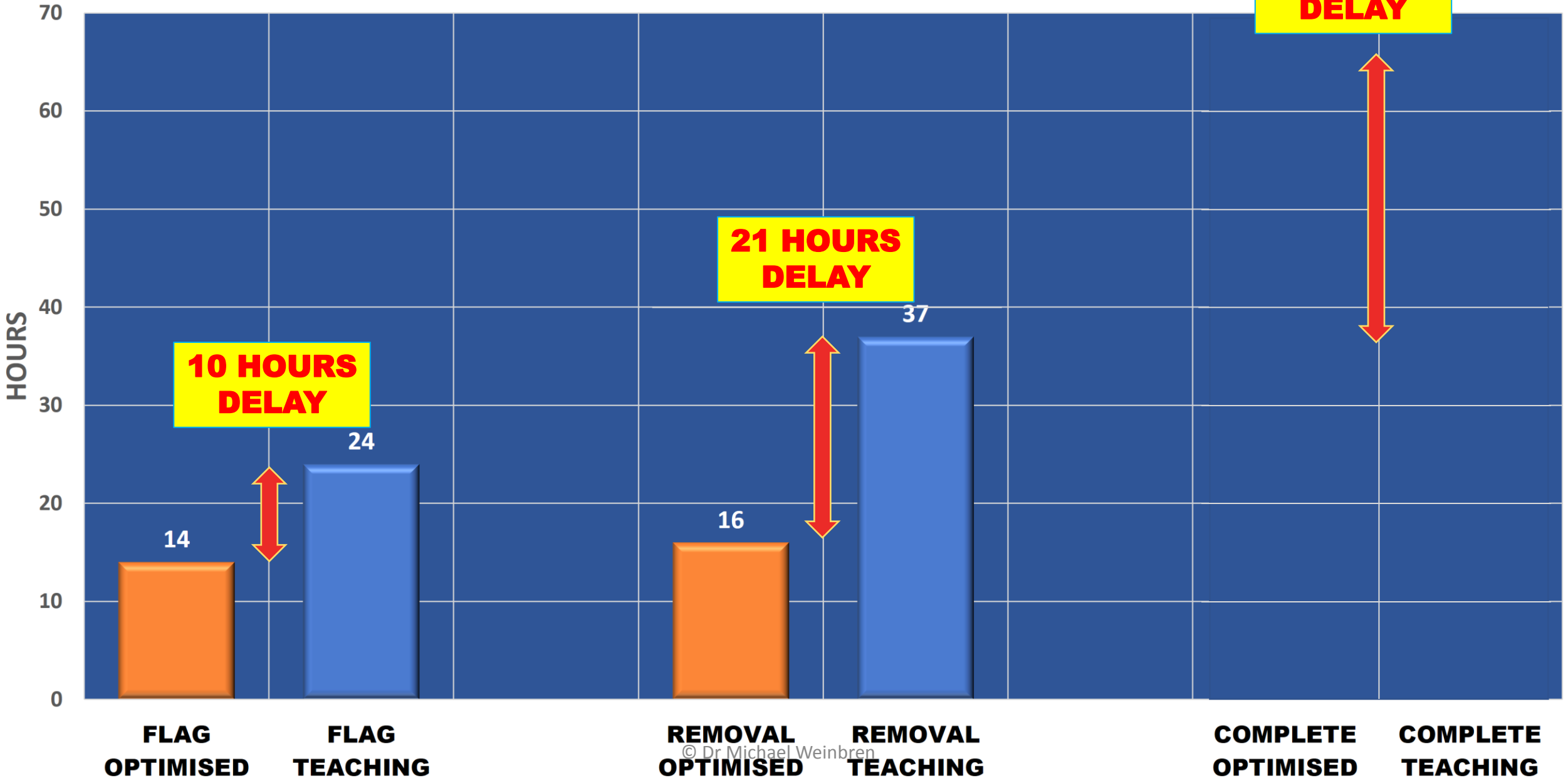
OPTIMISED

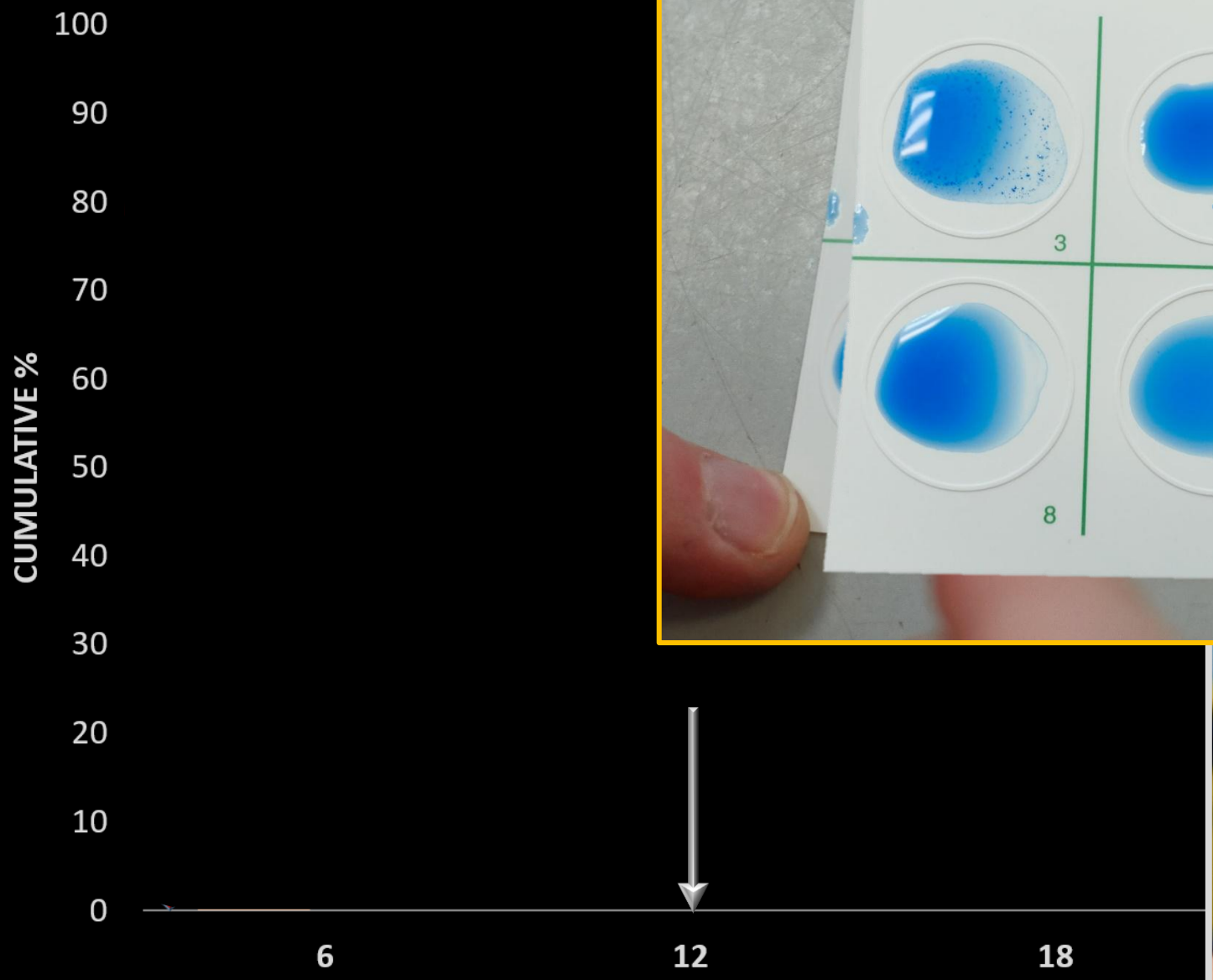
Time in hours to complete >85% of E. coli positive blood cultures at various stages in processing

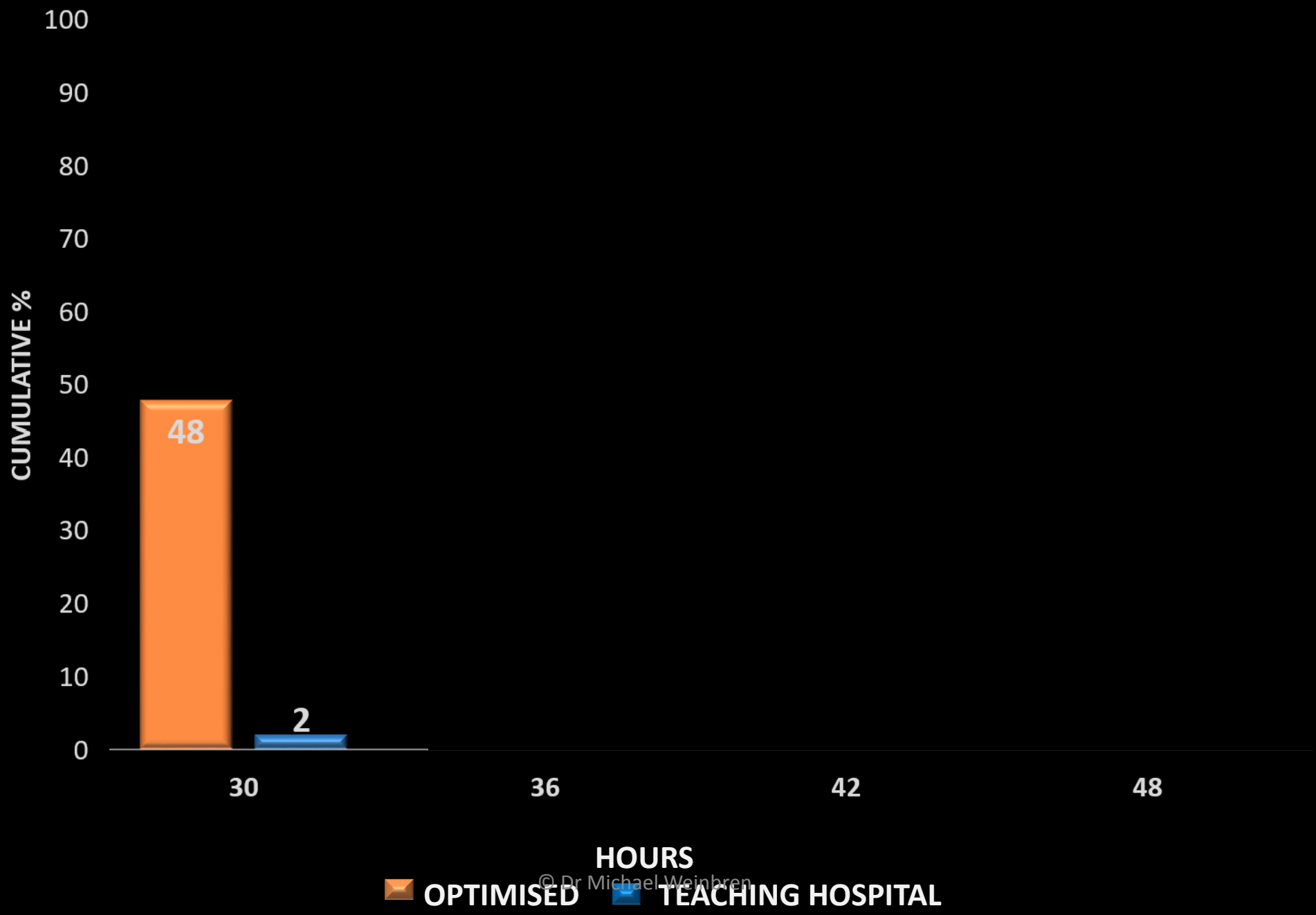




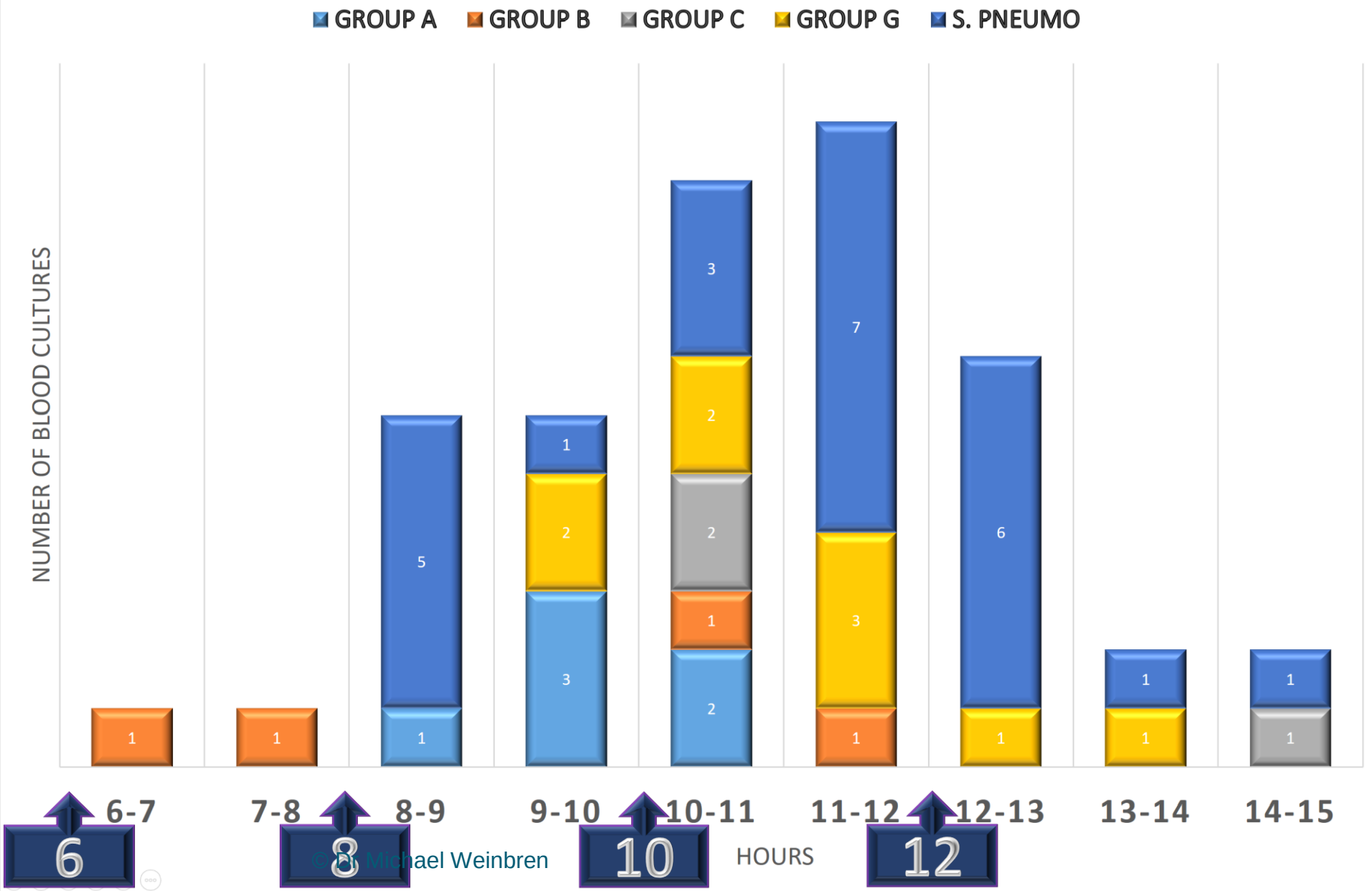
Time in hours to complete >85% of E. coli positive blood cultures at various stages in processing



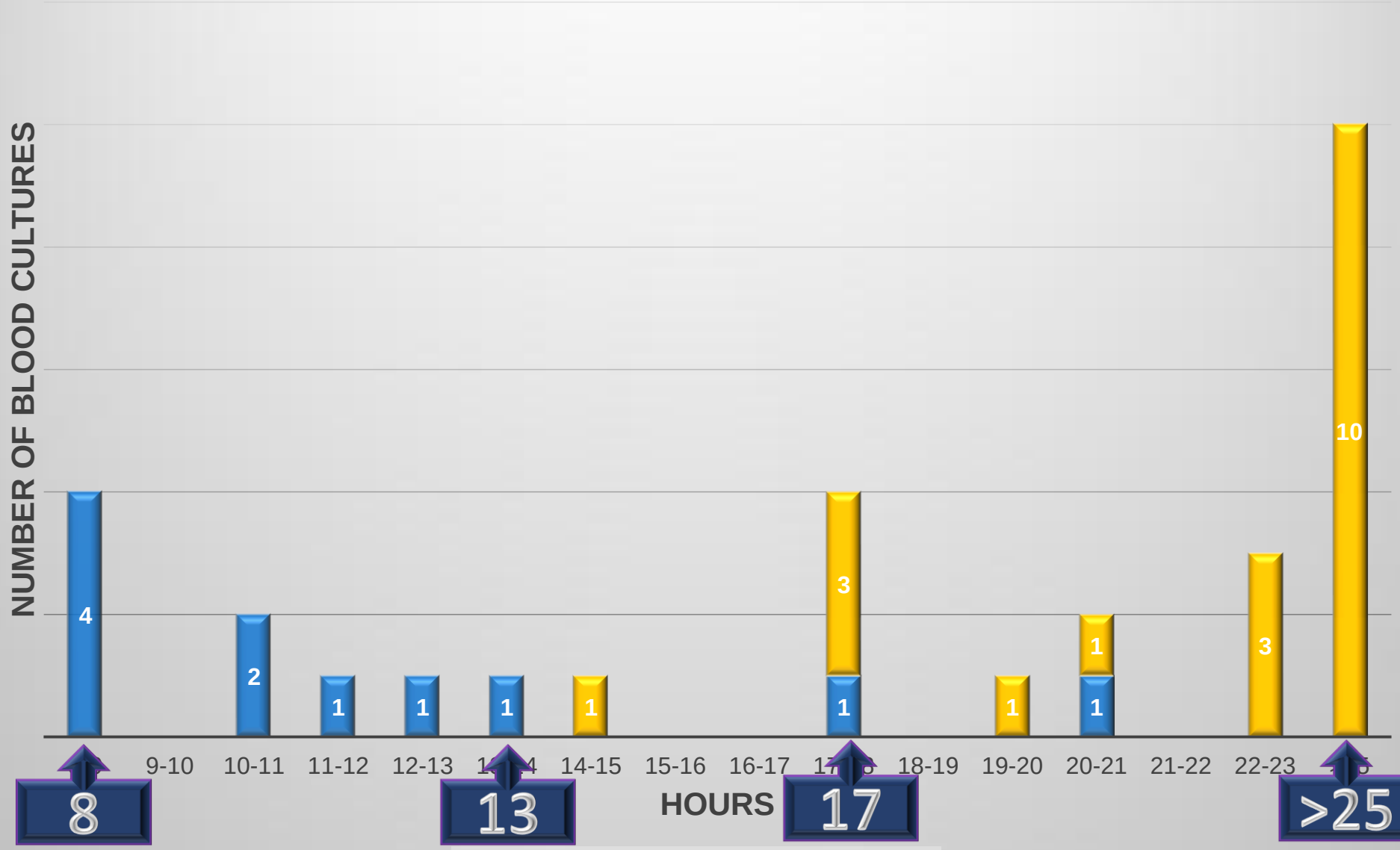




TIME FROM COLLECTION TO FLAGGING POSITIVE STREPTOCOCCI



TIME FROM COLLECTION TO FLAGGING POSITIVE STAPHYLOCOCCI



Clinical cases

- Mr RB
- ? Chest infection
- Oral clarithromycin
- 8hours 36 minutes- group G strep
- Teicoplanin and clindamycin (Clari res)
- Stormy next 48 hours
- Home day 6 -cellulitis

Benefits

- Real time 36 hour negative neonatal blood cultures
- Improved management of patients- earlier correction of deficiencies in empirical antibiotic therapy
- Earlier de-escalation of antibiotics
- Real time results gives clue to relevance of organism
- Minimises risks of organisms auto-lysing
- Improvements mostly achieved through better use of existing resources
- Essential pathway is optimised to maximise benefits of new rapid diagnostic methodology

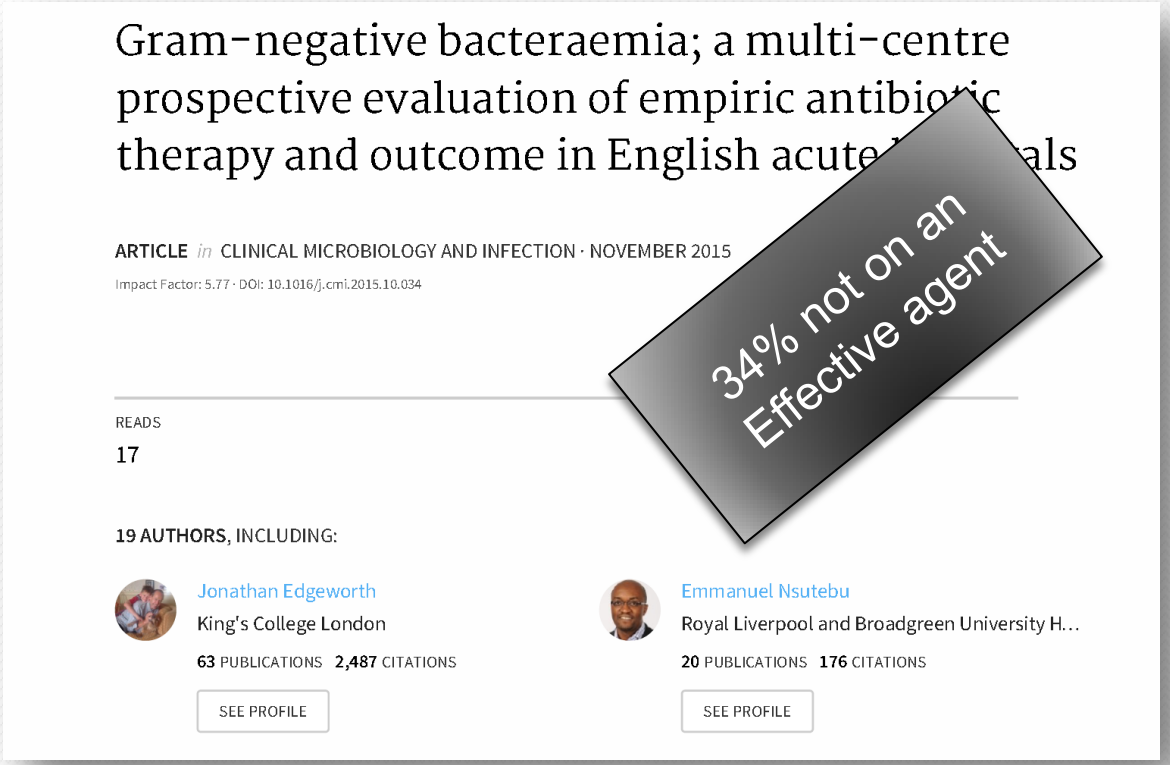
EMPIRICAL TREATMENT OF GRAM NEGATIVE SEPSIS

ANTIBIOTIC	AVG % SENS	MIN % SENS	MAX %SENS
CO-AMOX	57.0	49.8	65.2
GENT	92.0	85.0	94.5
PIP-TAZO	87.2	81.7	94.2
CIP	86.4	81.4	93.0
MERO	99.4	98.8	100.0

Data courtesy of Naomi Thompson

Analysis (106 positive blood cultures)

- 33% patients (36) not on an effective antibiotic
- 6 patients not on antibiotics



Gram-negative bacteraemia; a multi-centre prospective evaluation of empiric antibiotic therapy and outcome in English acute [illegible]als

ARTICLE *in* CLINICAL MICROBIOLOGY AND INFECTION · NOVEMBER 2015

Impact Factor: 5.77 · DOI: 10.1016/j.cmi.2015.10.034

34% not on an Effective agent

READS

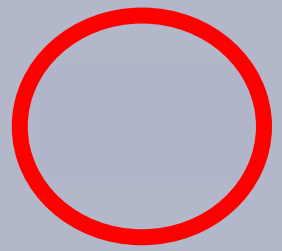
17

19 AUTHORS, INCLUDING:

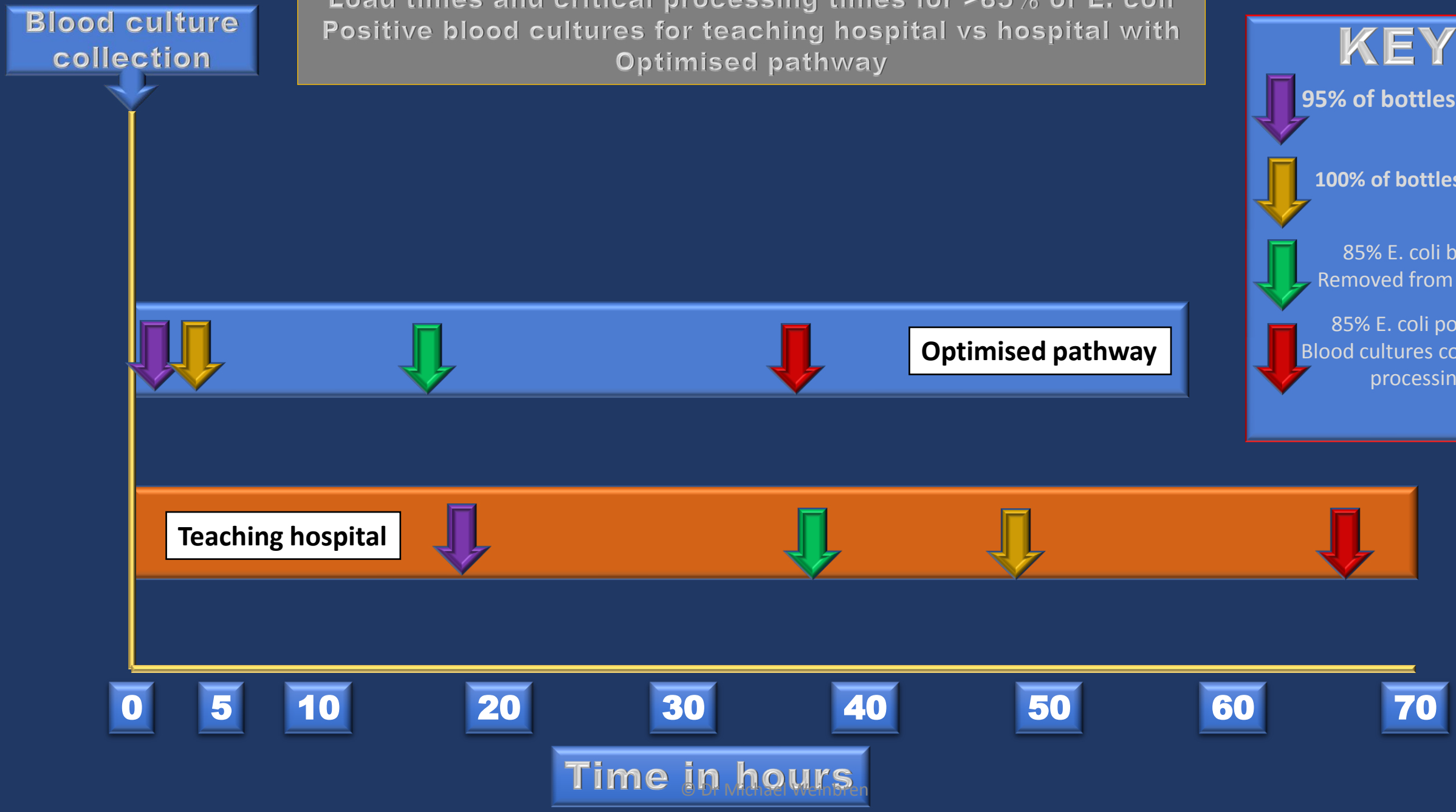
Jonathan Edgeworth
King's College London
63 PUBLICATIONS 2,487 CITATIONS
SEE PROFILE

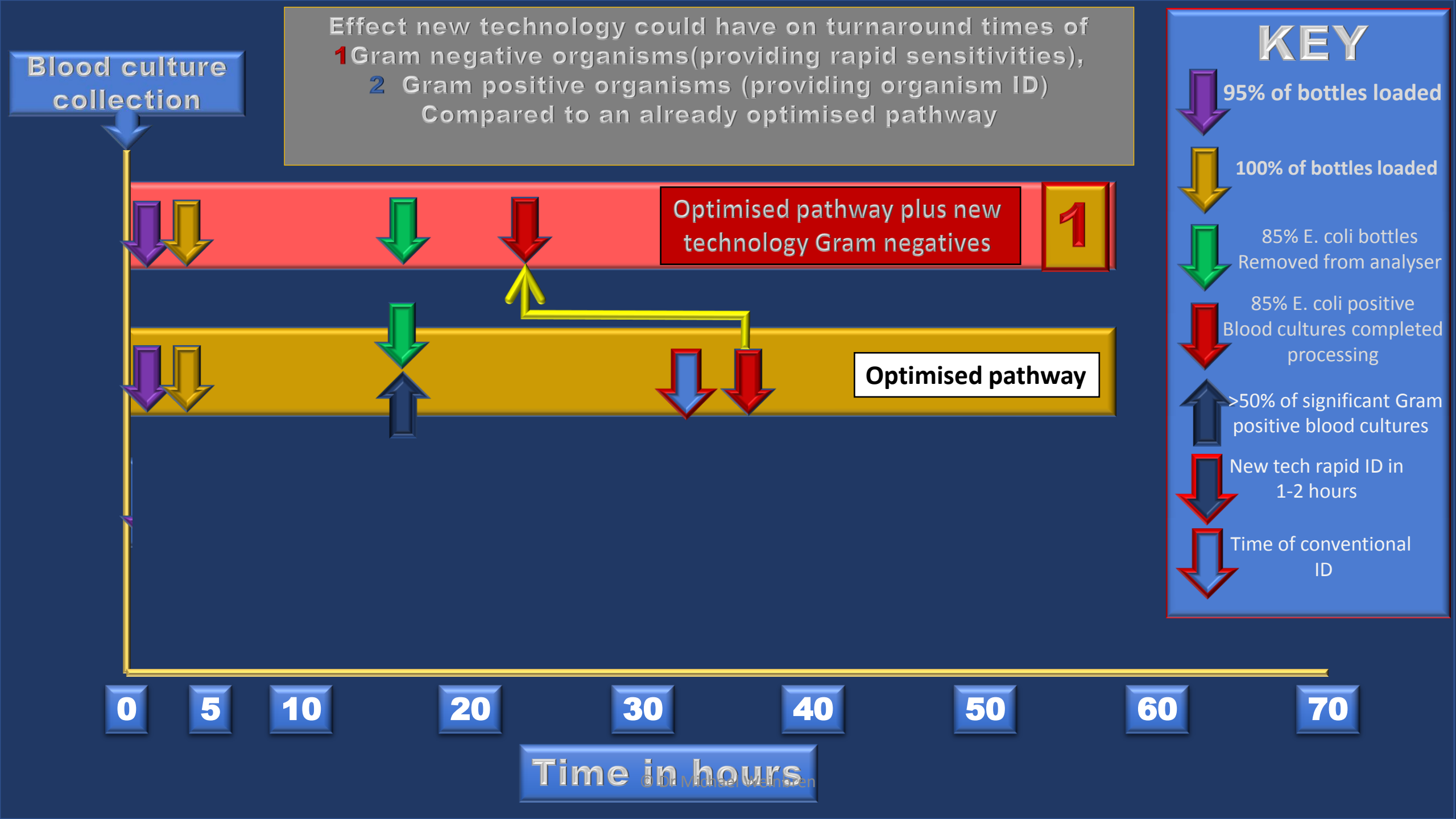
Emmanuel Nsutebu
Royal Liverpool and Broadgreen University H...
20 PUBLICATIONS 176 CITATIONS
SEE PROFILE

CORRECTION OF INITIAL ANTIBIOTIC THERAPY

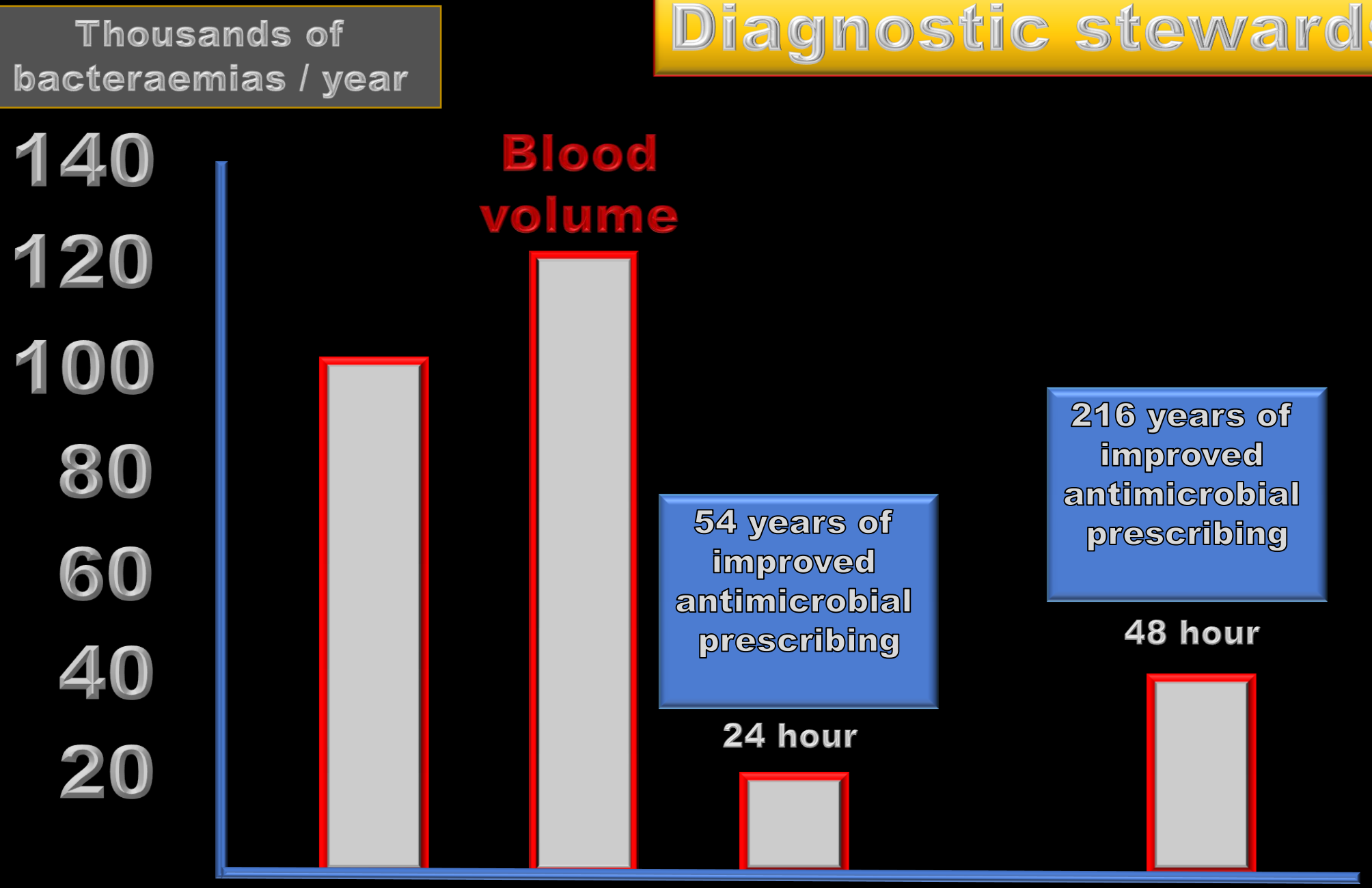
	GRAM STAIN	ORGANISM IDENTITY	ANTIBIOTIC SENSITIVITIES (RESISTANCE)
NOT ON ONE EFFECTIVE ANTIBIOTIC			

Load times and critical processing times for >85% of E. coli Positive blood cultures for teaching hospital vs hospital with Optimised pathway





Diagnostic stewardship



4.05

Case 2-
MRS DM DOB 28/12/1930

Admitted with sepsis ? Biliary/ urinary source

Started on co-amox but changed to tazocin as systemically unwell

Blood culture collected 8/11/2015 at 13.32

On blood culture machine at 14.49

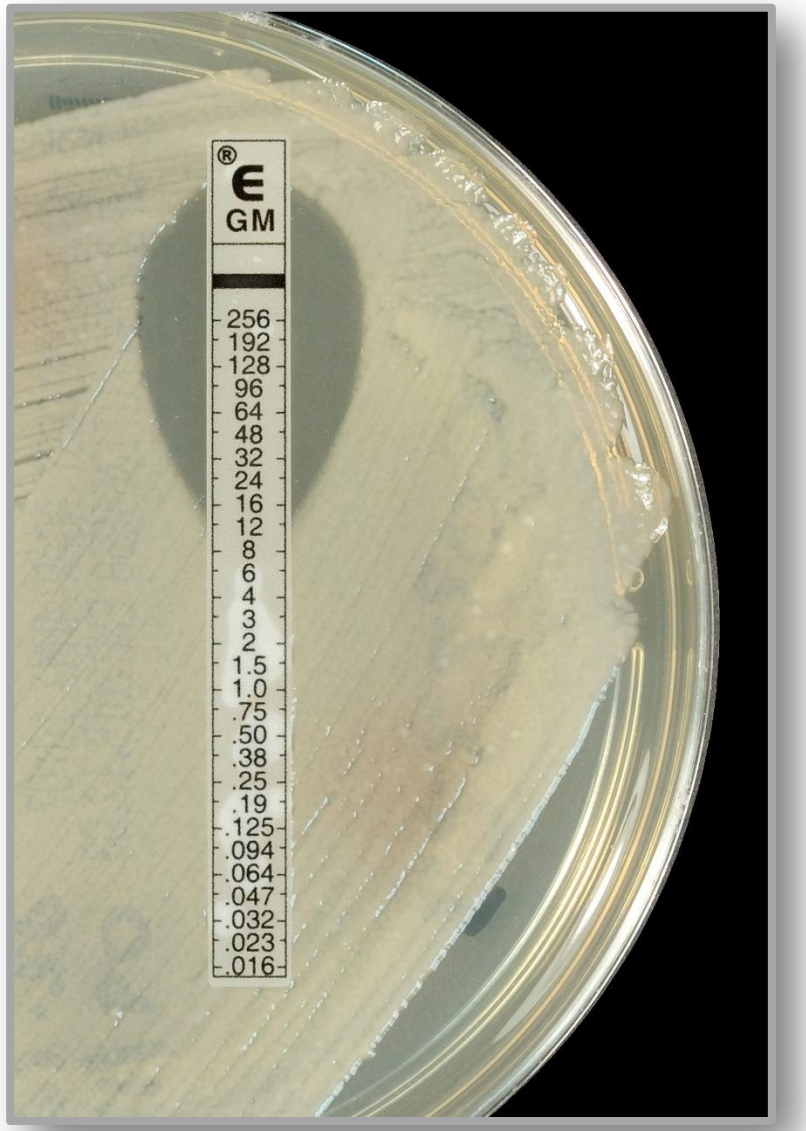
Flagged positive 09/11/15 03.04

Subcultured 03.20

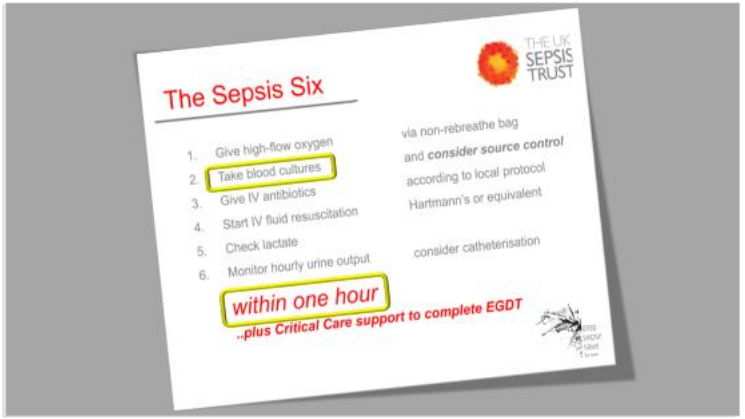
09.00

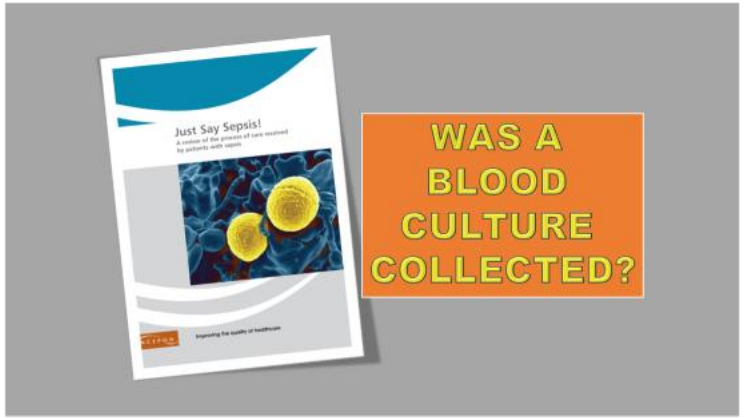
09.45 changed to meropenem

15.00 E. coli gent and tazocin resistant



What do these have in common?





The Sepsis Six

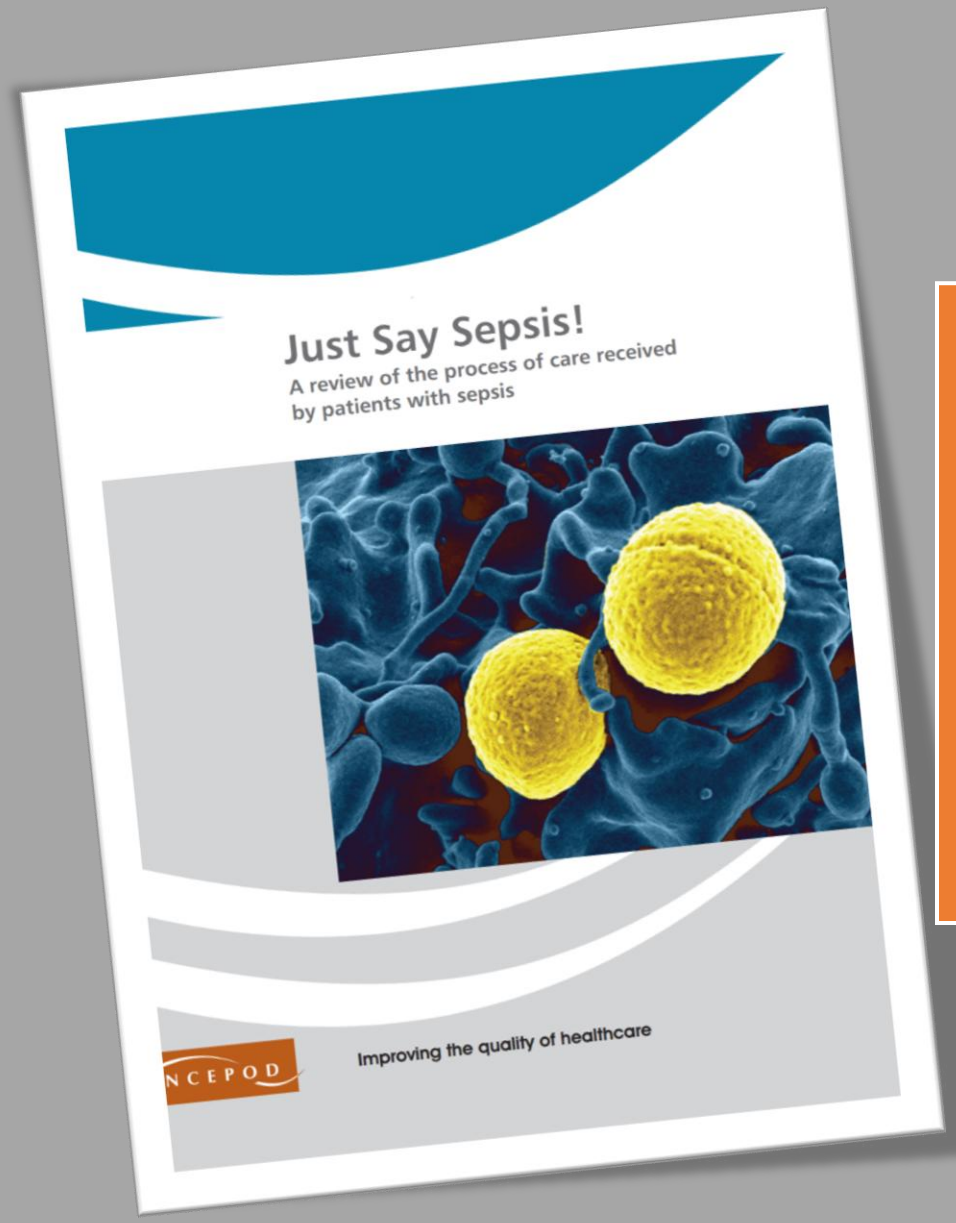
THE UK SEPSIS TRUST

1. Give high-flow oxygen — via non-rebreathe bag
2. Take blood cultures — and ***consider source control***
3. Give IV antibiotics — according to local protocol
4. Start IV fluid resuscitation — Hartmann's or equivalent
5. Check lactate
6. Monitor hourly urine output — consider catheterisation

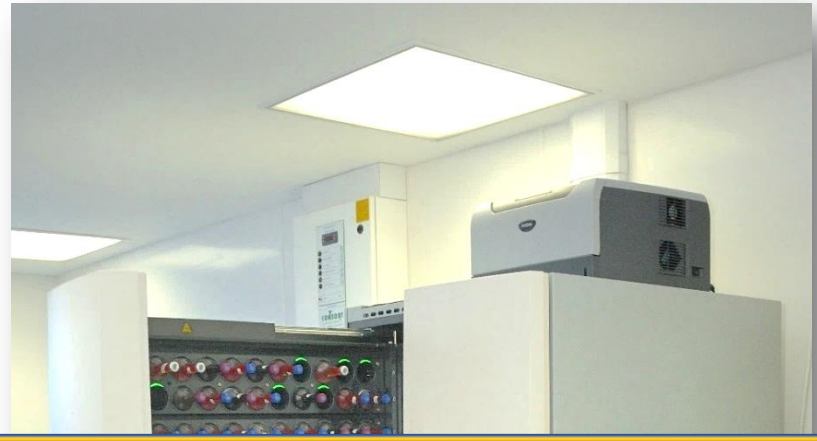
within one hour

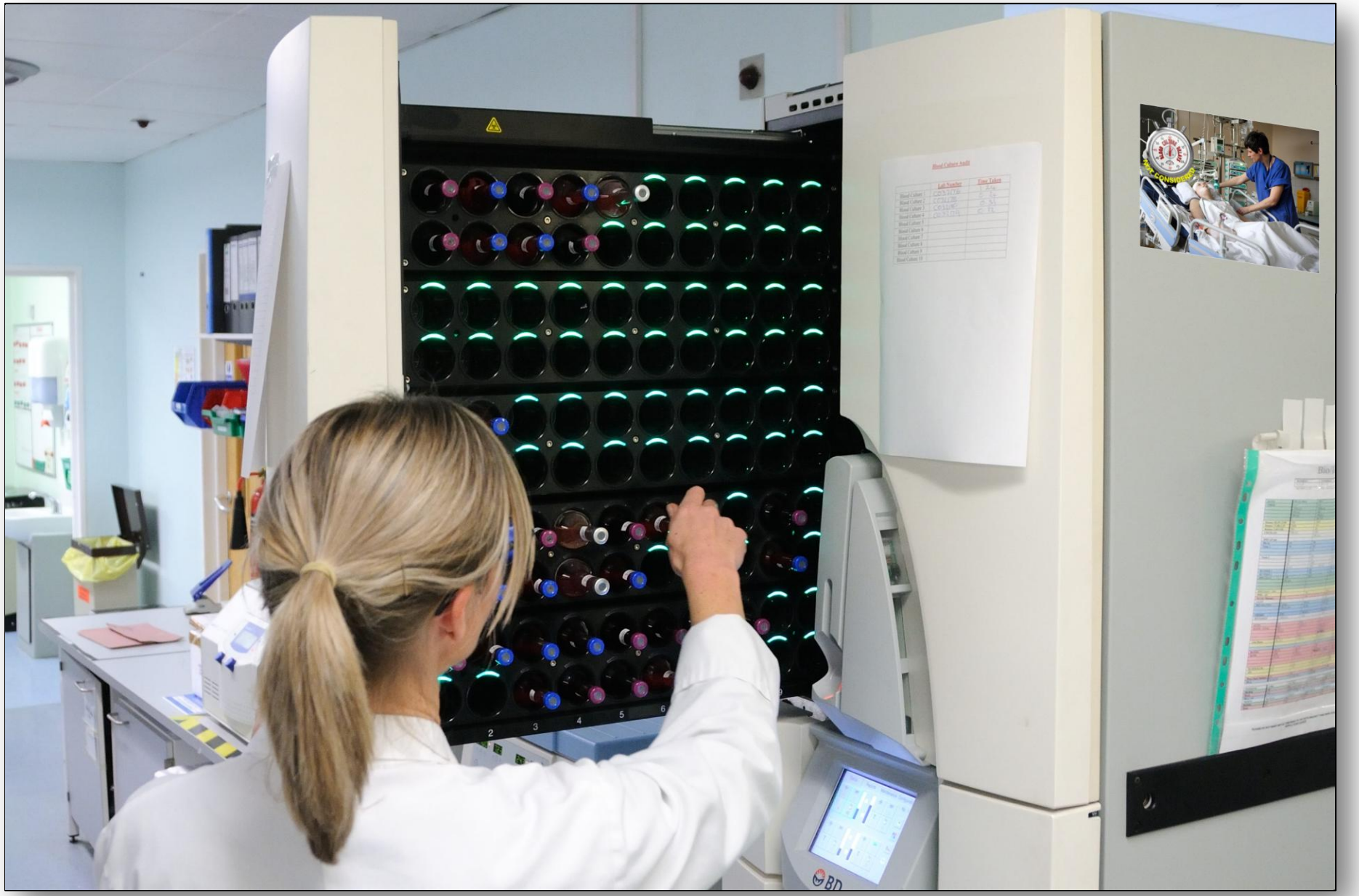
..plus Critical Care support to complete EGDT

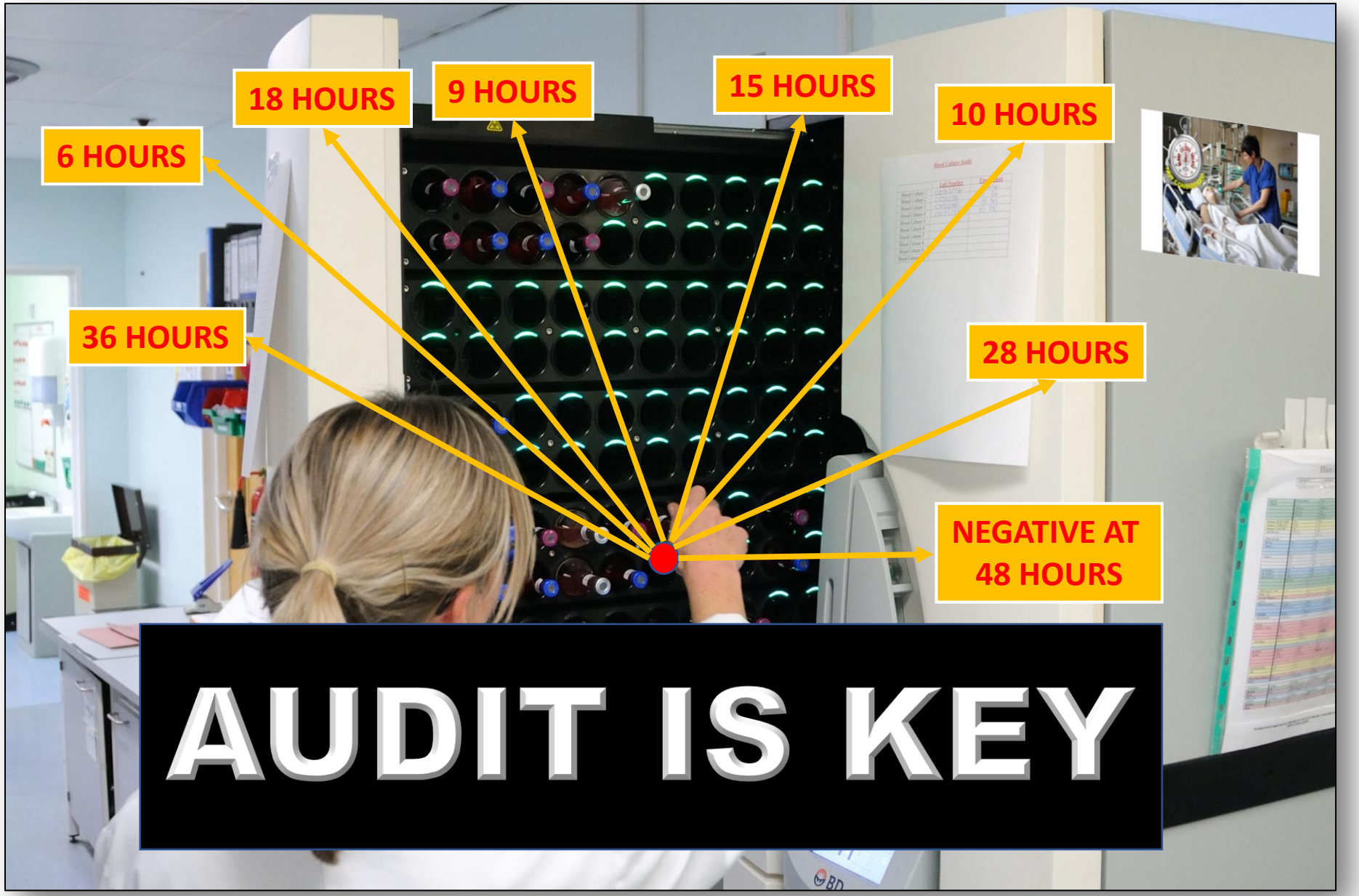
stop sepsis save lives



WAS A BLOOD CULTURE COLLECTED?

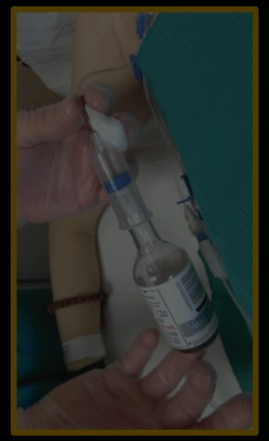






COLLECTION

1



Right patient / volume of blood to analyser with minimum delay

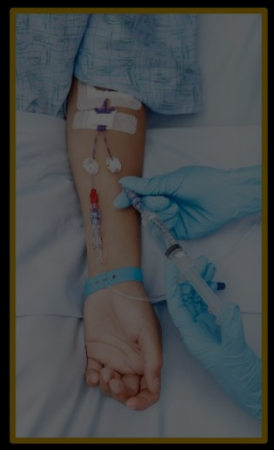
PROCESSING

2

SHORTEST TIME
KEY RESULT

MANAGEMENT

3



USE KEY RESULT TO MANAGE
TIENT WITH
DELAY

ISO STANDARDS

FINISH

One frequent pitfall is that accreditation can focus excessively on technical details rather than on patient value, which results in an inappropriate clinical service, i.e. quality being disconnected from the end-point target of improved patient care.

B. Lamy CMI 2018

A Healthcare Improvement Intervention Combining Nucleic Acid Microarray Testing with Direct Physician Response for Management of *Staphyloccocus aureus* Bacteremia

Joshua C. Eby[1#], Morgan M. Richey[2], James A. Platts-Mills[1], Amy J. Mathers[1,3], Wendy M. Novicoff[2], Heather L. Cox[1,4]

Results: 106 pre-intervention and 120 post-intervention subjects were assessed. Time to ID consultation after notification of a positive blood culture decreased 26.0 hours (95% CI 45.1 to 7.1 hours, p<0.001) post-intervention compared with pre-intervention. Time to initiation of targeted antibiotic decreased by a mean 21.2 hours (95% CI 31.4 to 11.0 hours, p<0.001) and time to targeted antibiotics for methicillin-sensitive *S. aureus* by a mean 40.7 hours (95% CI 58.0 to 23.5 hours, p<0.001). The intervention was associated with lower in-hospital (13.2% to 5.8%, p=0.047) and 30-day mortality (17.9% to 8.3%, p=0.025).

Conclusions: Compared to an ASP-directed response to traditionally detected SAB, an efficient physician response to NAM was associated with improved care and outcomes for SAB.

Clinical Infectious Diseases

VIEWPOINTS

Individualized Approaches Are Needed for Optimized Blood Cultures

Ritu Banerjee,[1] Volkan Özenci,[2] and Robin Patel[3,4]

[1]Department of Pediatric Infections Diseases, Vanderbilt University, Nashville, Tennessee; [2]Division of Clinical Microbiology, Karolinska Institutet, Karolinska University Hospital, Huddinge, Stockholm, Sweden; [3]Division of Clinical Microbiology, Department of Laboratory Medicine and Pathology, and [4]Division of Infectious Diseases, Department of Medicine, Mayo Clinic, Rochester, Minnesota

Before laboratories consider offering rapid matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-ToF MS) or expensive rapid panel-based molecular BC diagnostics, they should optimize preanalytical, analytical, and postanalytical processes and procedures surrounding BC systems.

The technology exists.

It is only our imaginations, beliefs which limit us

Summary

Blood sciences made this all possible