Medical Microbiology Advances and Infection Control

Patient Safety Dubai 2019

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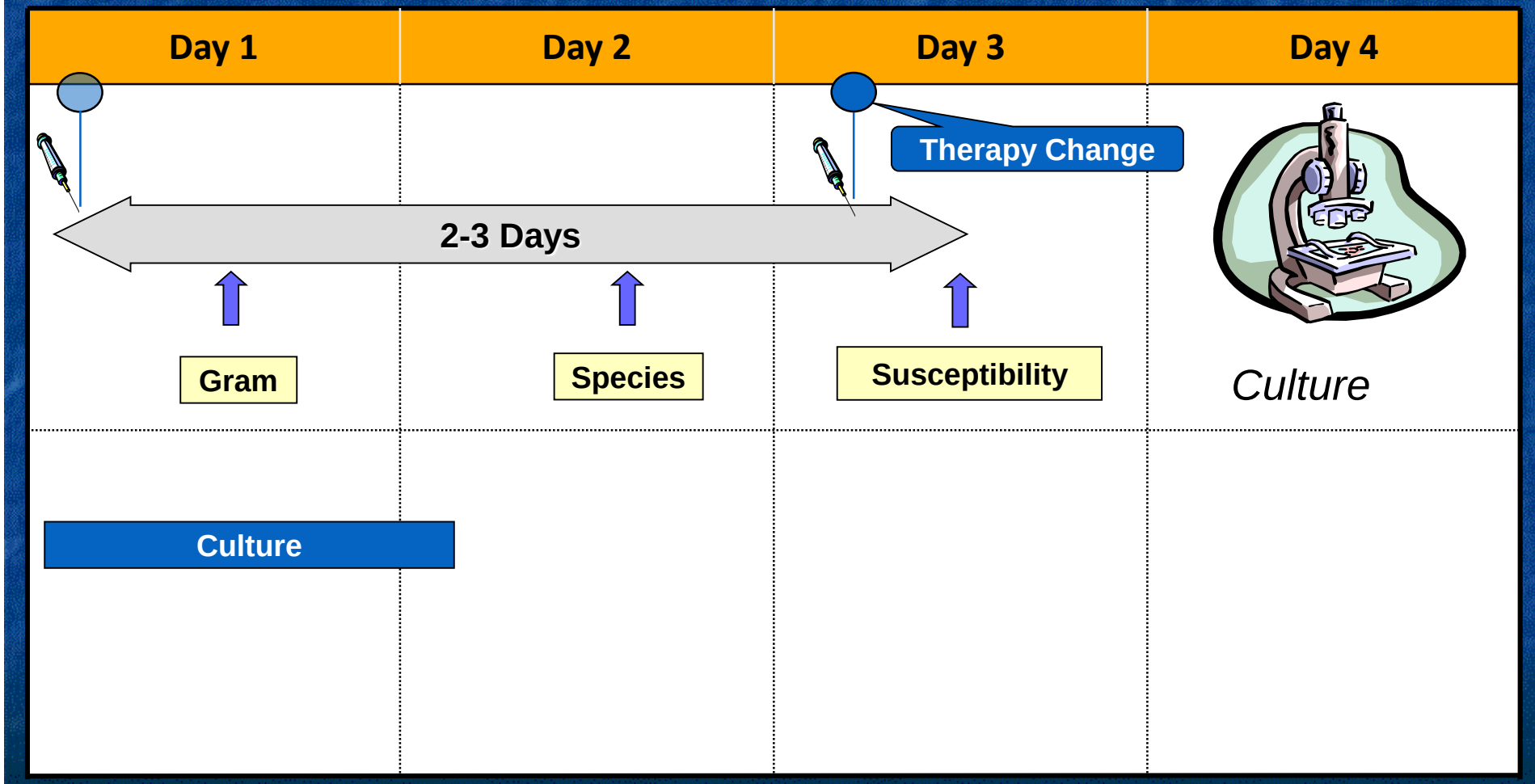
SEHA
Abu Dhabi Health Services Co.
صحة
شركة أبوظبي للخدمات الصحية

No disclosures

Objectives

- Explain the benefit of rapid microbiological diagnostic
- Summarize the value for Infection Control
- Know what are the challenges in the future

Timeline


Day 1
Day 2
Day 3
Day 4
Therapy Change
2-3 Days
Gram
Species
Susceptibility
Culture
Culture

The Role in Infection

- Surveillance
- Outbreak Detection
- Antibiotic Stewardship

Microbiology is Part of the Team now…

Surveillance

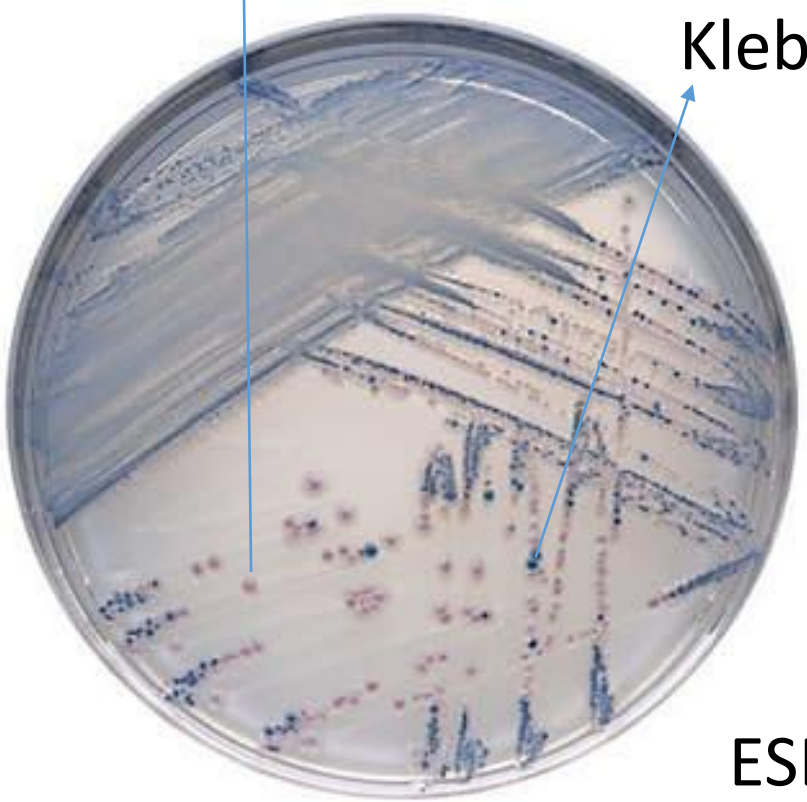
The Challenge

- Multi-Drug Resistant Organisms need to be detected
- Rapid identification of quickly spreading diseases

MDRO Detection

- Screening with chromogenic media
- Detection time: 24 hrs

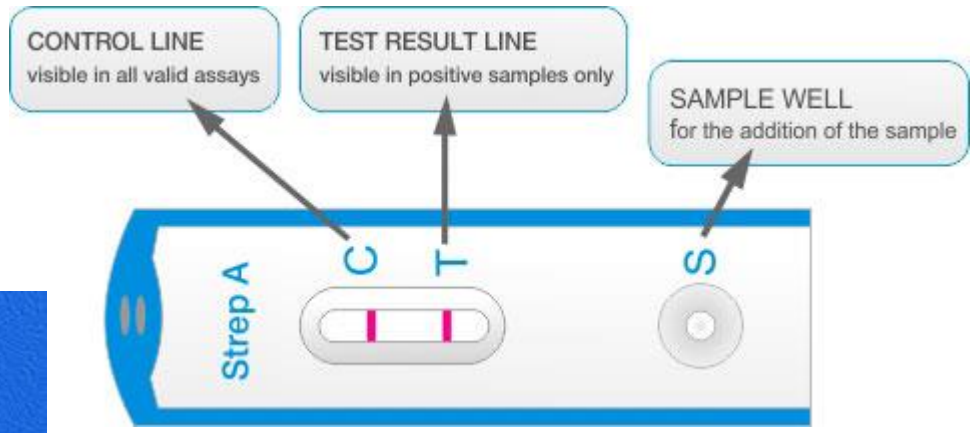
MRSA

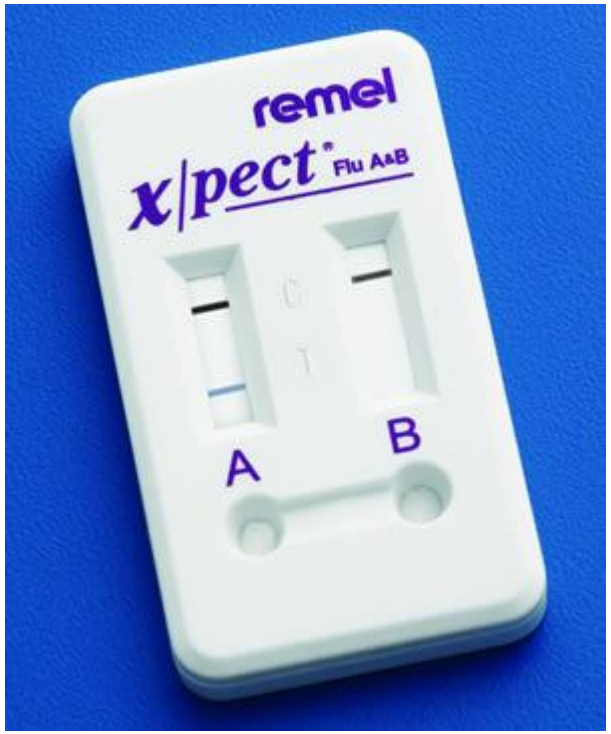


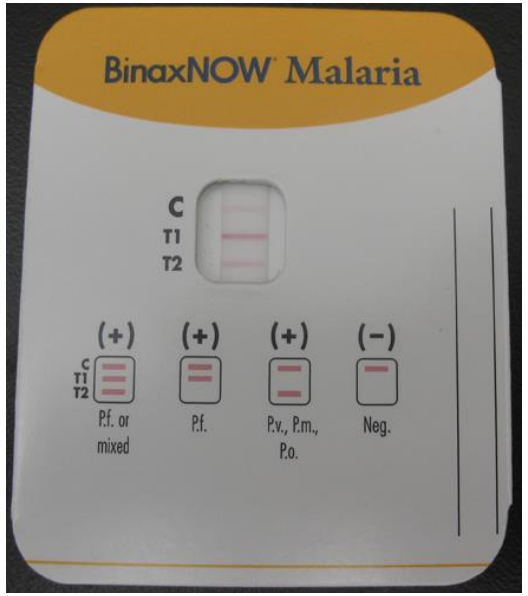
ESBL

Rapid Antigen Detection

- Strep A
- RSV
- Influenza
- Malaria
- H.pylori
- C.Diff
- E.coli Toxin







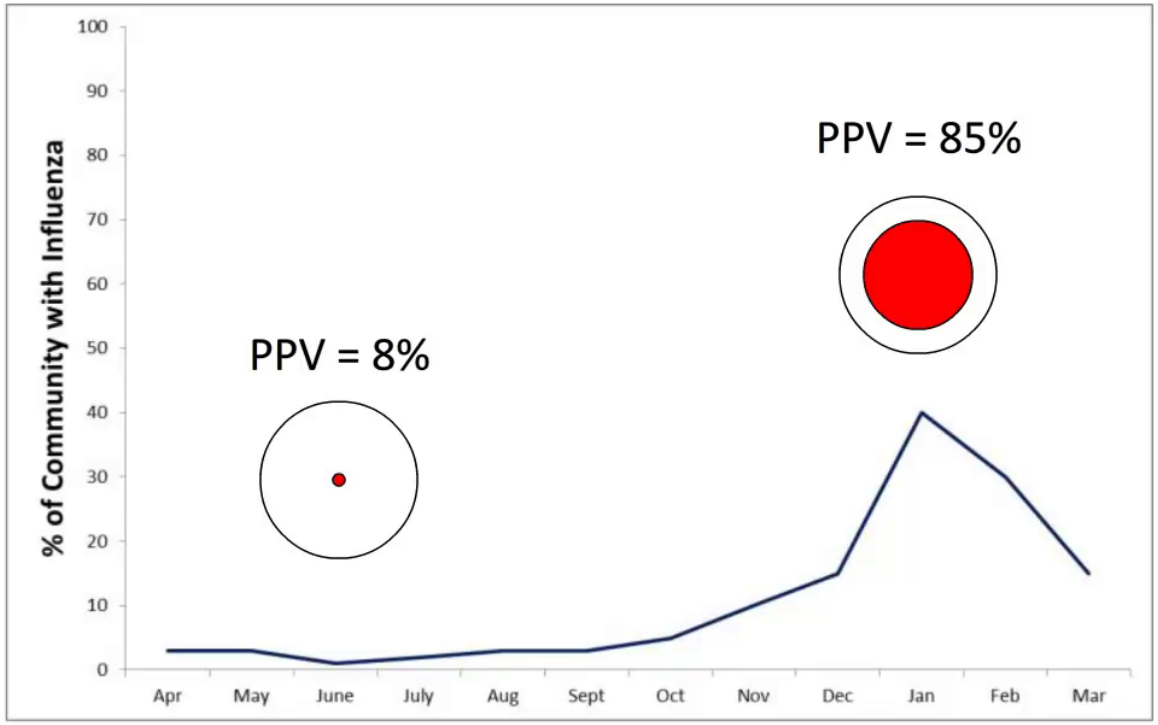
Antigen tests

Table 3 - Sensitivity, specificity, positive and negative predictive values and posite and negative LR for the medical opinion (physician) and the rapid test, considering the culture result as the diagnostic definition

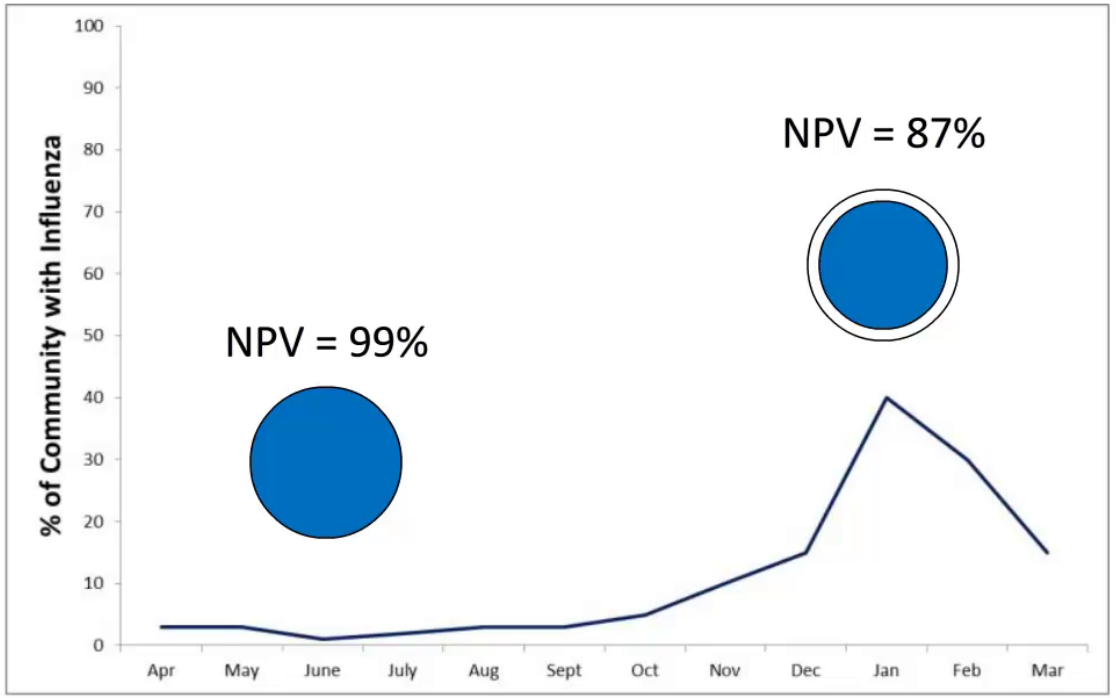
	Sensitivity	Specificity	Predictive value		LR	
			Positive	Negative	Positive	Negative
Physician	79.3	53.2	35.43	88.8	1.7	0.4
Rapid test	96.7	94.4	84.8	98.9	17.2	0.03

LR = likelihood ratio.

Rapid Antigen Test and Influenza Season



Rapid Antigen Test and Influenza Season



Keep in mind:

- Rapid antigen test support Clinical Decision Making
- The should always be confirmed by a reference method.

Miniaturized PCR

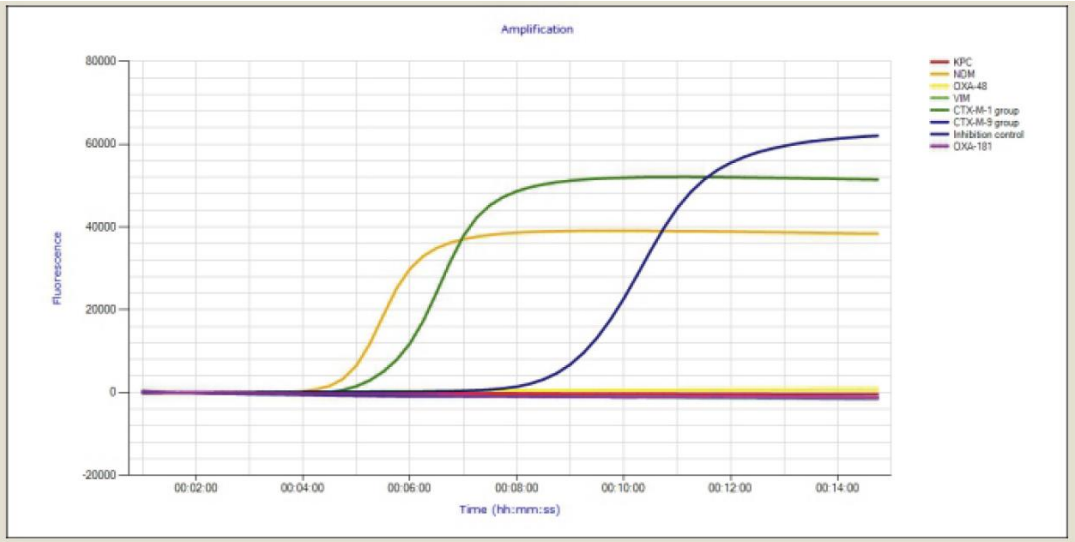
- No need for multiple rooms
- Staff can be trained easily
- Performance: Sensitivity > 95%, Specificity>99%
- Higher costs compared to culture
- Directly from patient sample
- Performance time: 45 – 150 min

Detection of

- MRSA
- MTb
- Enterovirus
- Influenza / RSV
- CT/NG
- Group-B Strep
- Carbapenemases
-
-

Carbapenemase Detection

- KPC
- NDM
- OXA-48
- VIM
- OXA-23 Gruppe
- OXA-40 Gruppe
- **OXA-58** Gruppe

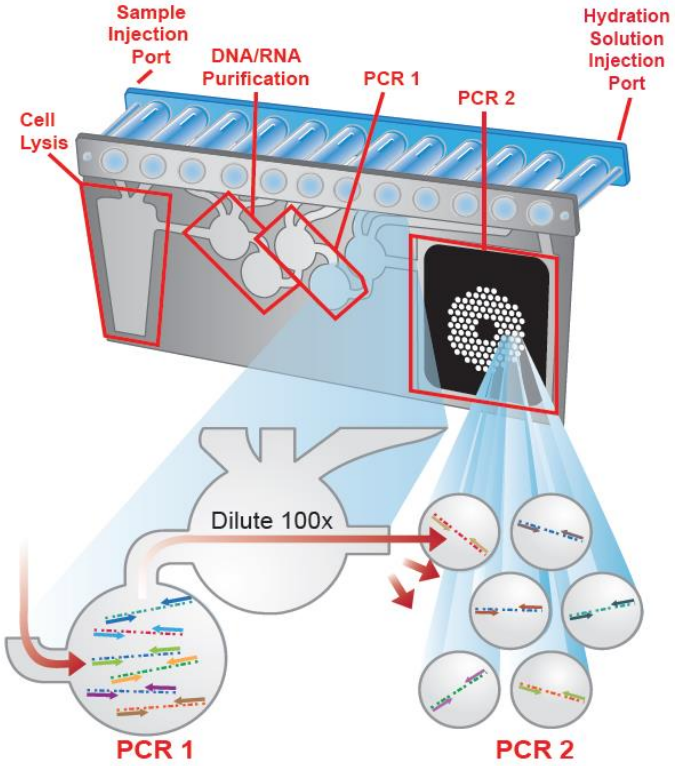


- KPC
- NDM
- OXA-48
- VIM
- OXA-23 Gruppe
- OXA-40 Gruppe
- **OXA-181**

Runtime: ~ 20 min

Syndromic Testing (more than 10 reactions)

- Meningitis
- Respiratory Diseases
- Gastro-intestinal Diseases
- Blood Cultures
- Easy to train staff
- Runtime: ~ 60 min
- Infection Control
  - Decision support when to end isolation



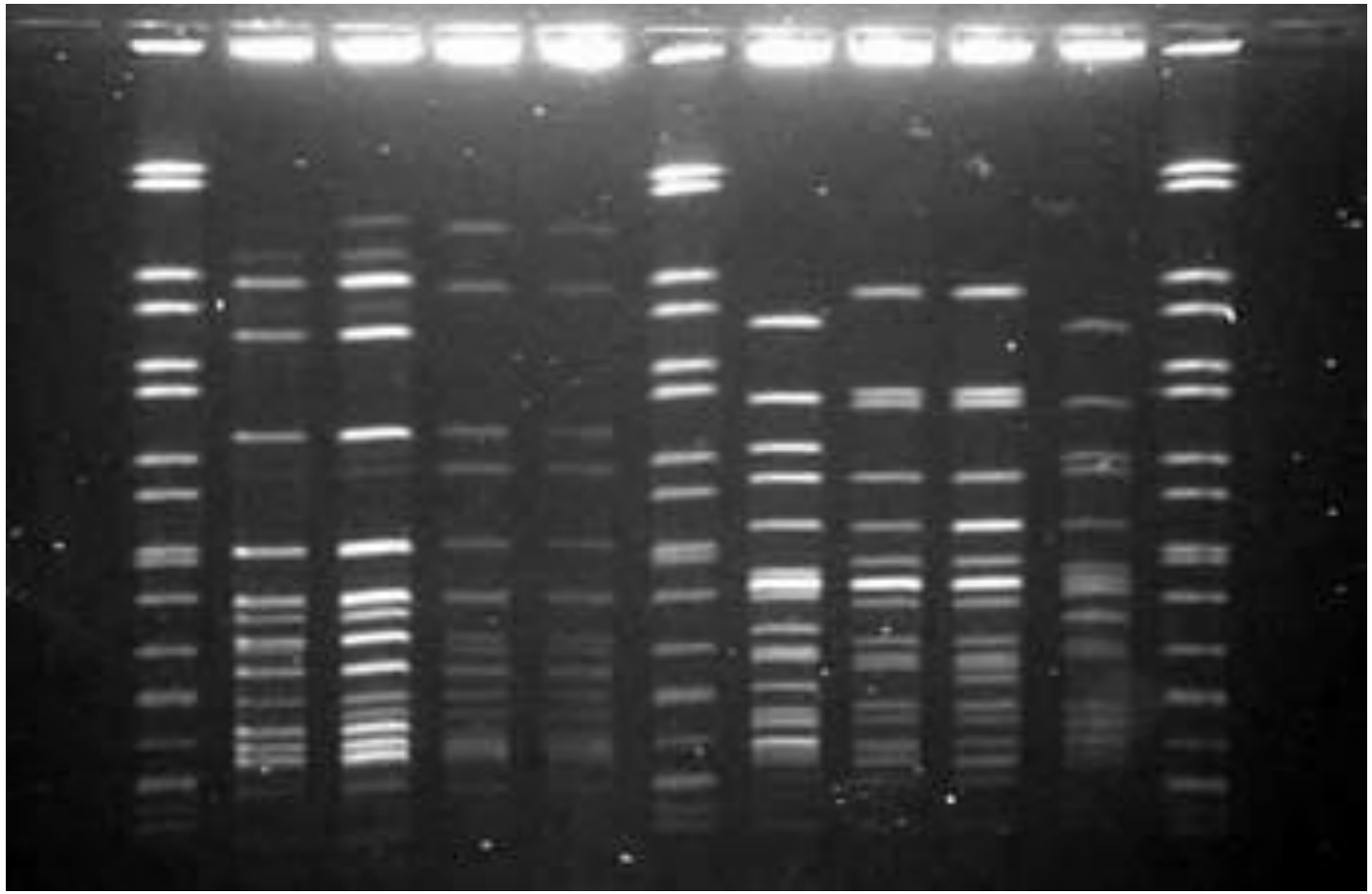
- Meningitis
  - *Escherichia coli* K1
  - *Haemophilus influenzae*
  - *Listeria monocytogenes*
  - *Neisseria meningitidis*
  - *Streptococcus agalactiae*
  - *Streptococcus pneumoniae*
  - Cytomegalovirus (CMV)
  - Enterovirus (EV)
  - Herpes simplex virus 1 (HSV-1)
  - Herpes simplex virus 2 (HSV-2)
  - Human herpesvirus 6 (HHV-6)
  - Human parechovirus (HPeV)
  - Varicella zoster virus (VZV)
  - *Cryptococcus neoformans/gattii*

- Respiratory Disease
  - Adenovirus
  - Human Coronavirus (incl. MERS!)
  - Human Metapneumovirus
  - Human Rhinovirus/Enterovirus
  - Influenza A
  - Influenza A/H1, H#
  - Influenza B
  - Parainfluenza Virus 1-4
  - Respiratory Syncytial Virus
  - *Bordetella parapertussis**
  - *Bordetella pertussis*
  - *Chlamydia pneumoniae*
  - *Mycoplasma pneumoniae*

Outbreak Detection

- Rapid Detection
  - Unusual susceptibilities
  - Unusual strains
  - Unusual numbers (above the seasonal endemic rate)
- Cluster Detection
  - SaTScan Software (integrated in WHOnet)
  - Retrospective and real time
  - Integrated software in HIS
- Clonal Identification

Pulsed Field Gel Electrophoresis (PFGE)



…. Long Turn-Around-Time … (3-4 days)

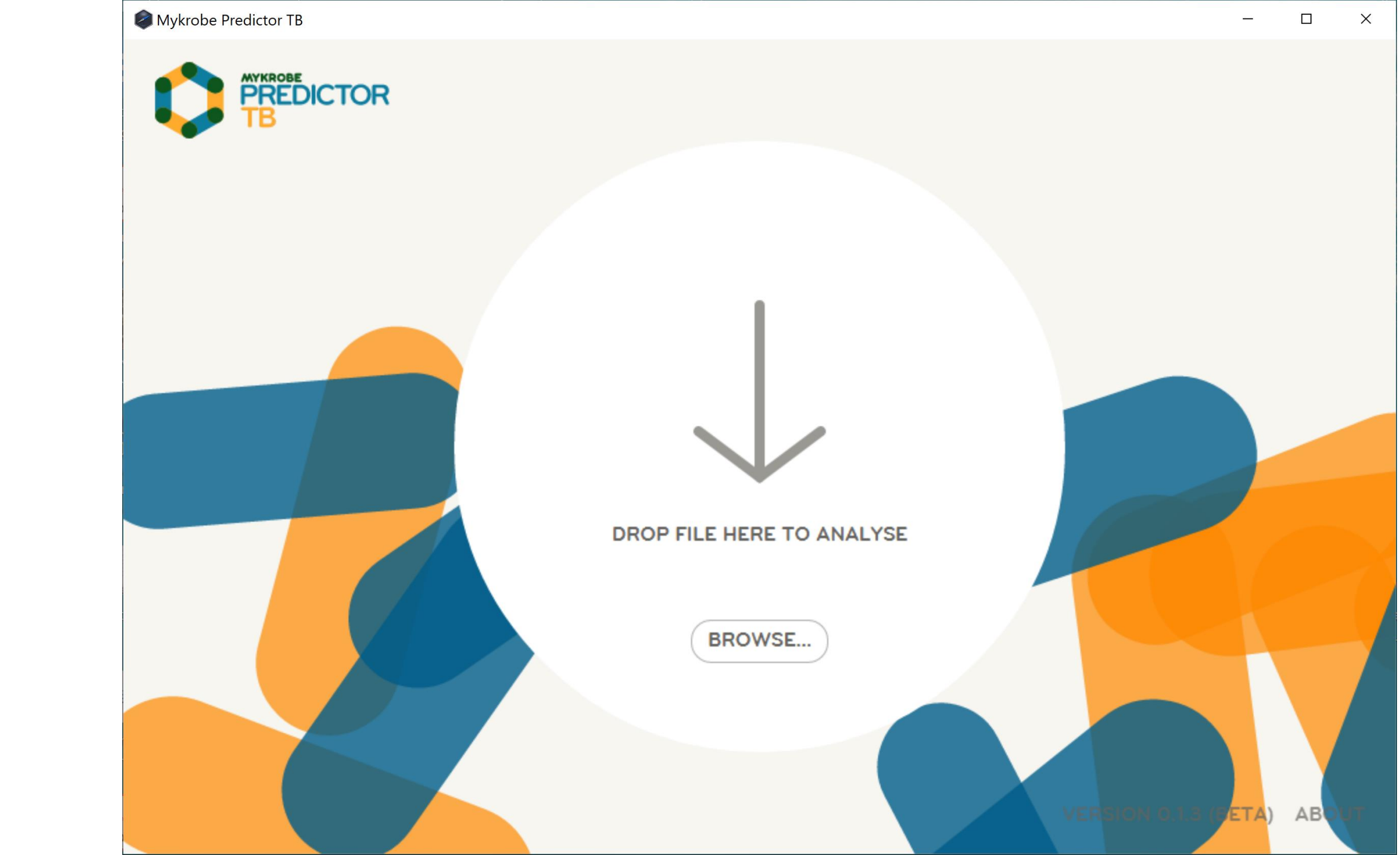
Next Generation / Whole Genome Sequencing

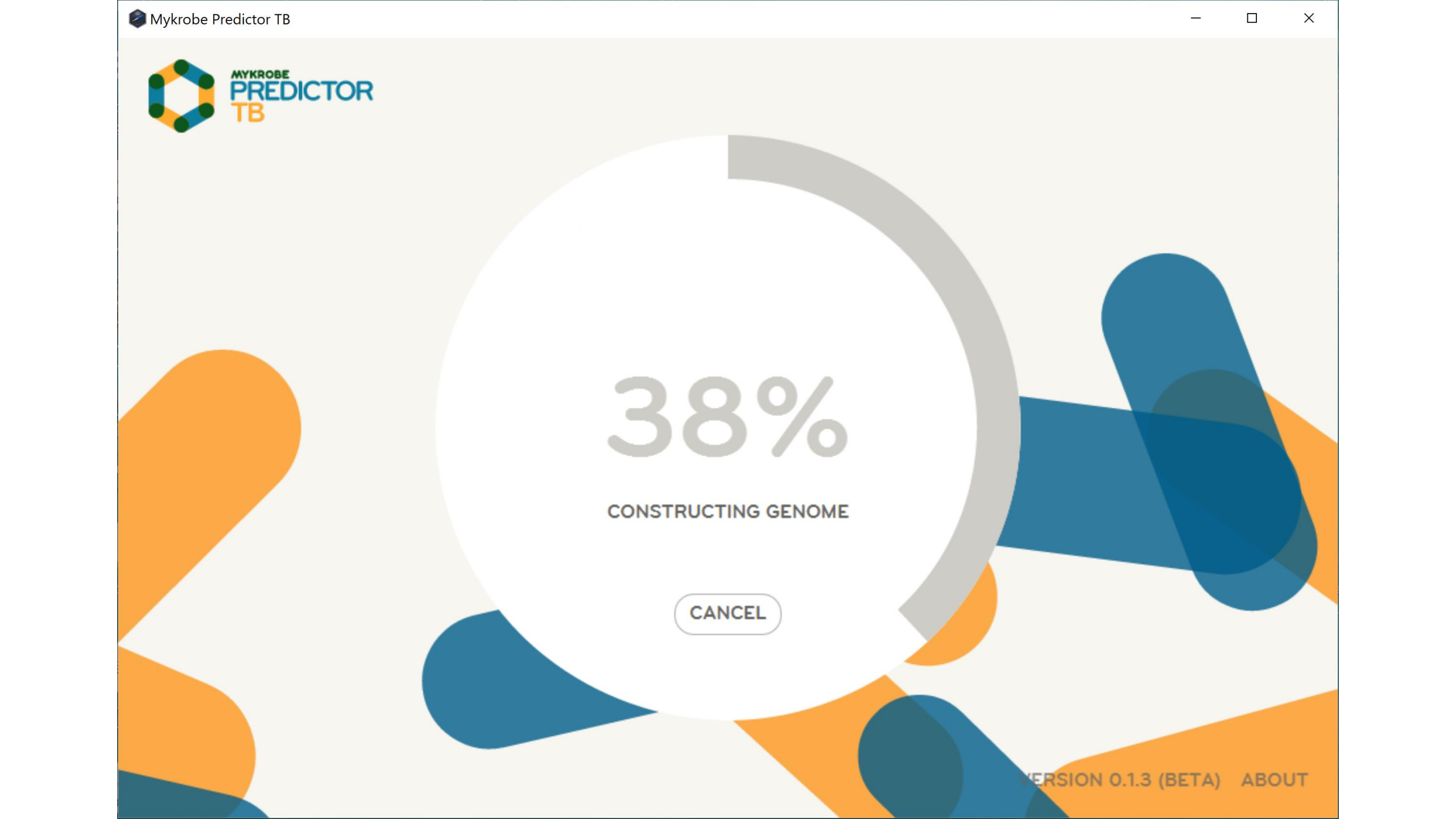
- Future method for identification, typing and susceptibility testing
- New instruments and software tools
- Applicability for diagnostic laboratories

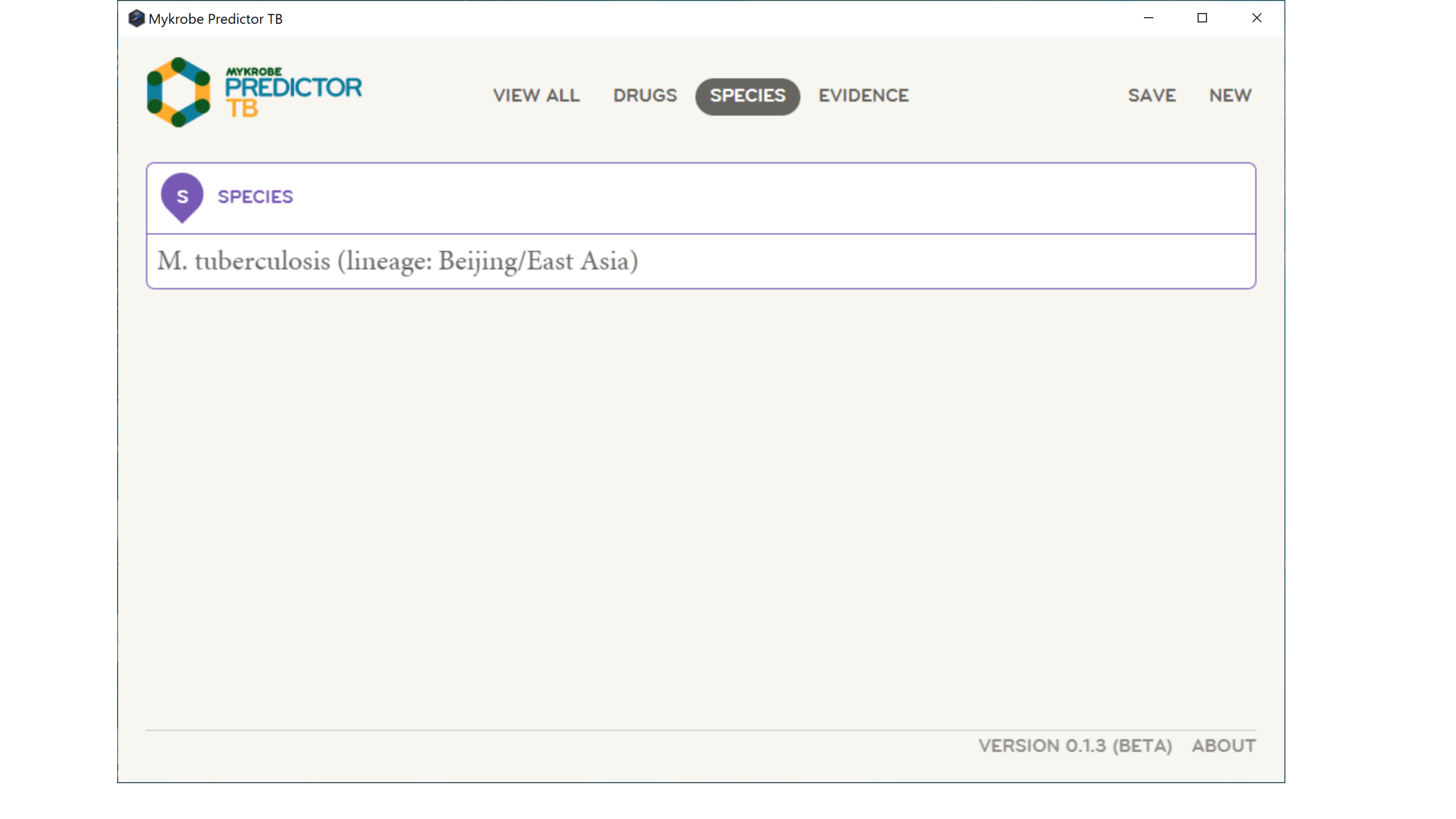
- Minion technology
- Time to whole sequence for bacterial genome
  - 1 day in Illumina
  - 3-5 hours

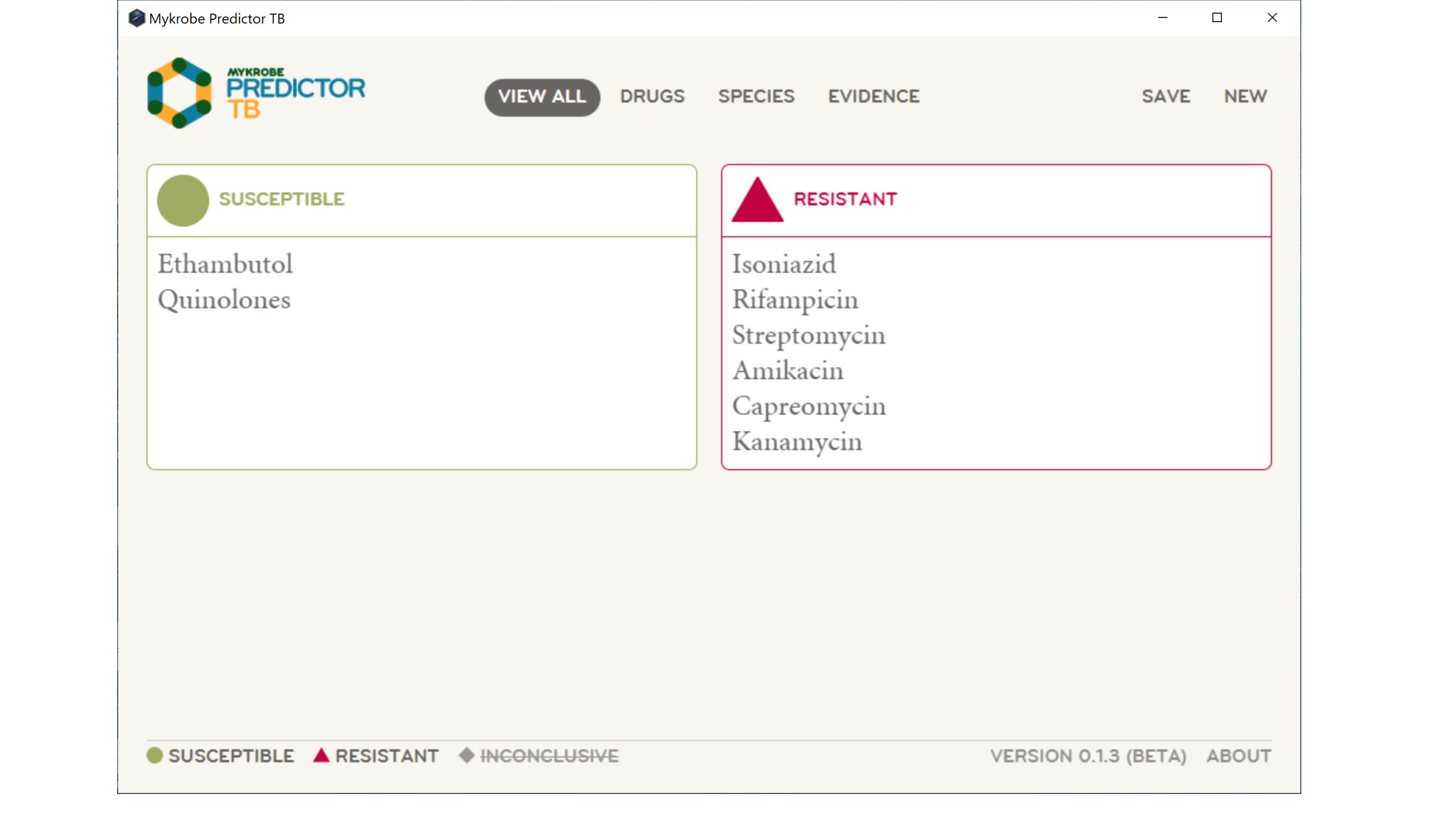

MinION
SpotON

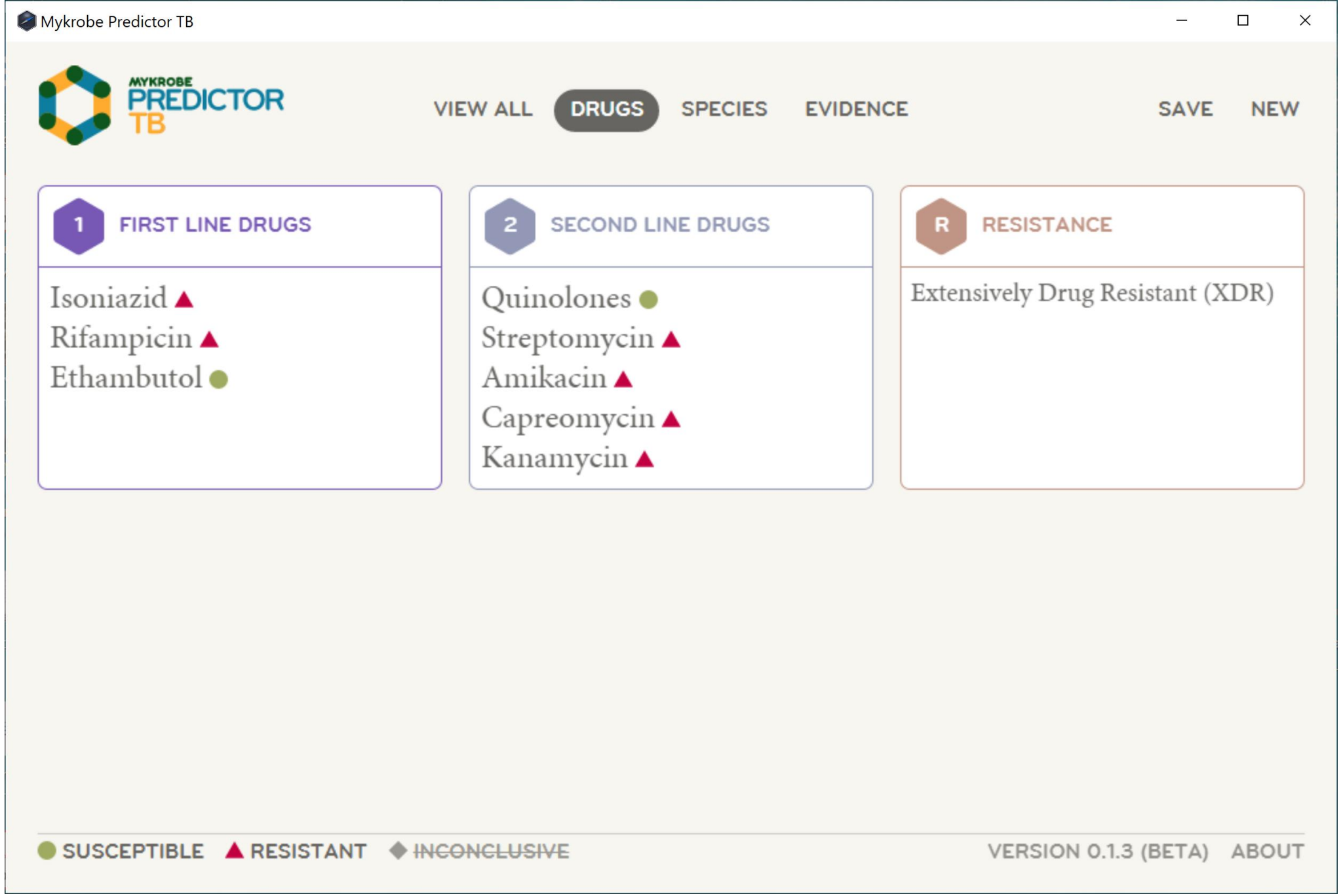
MinION


Mykrobe Predictor TB
MYKROBE
PREDICTOR
TB
DROP FILE HERE TO ANALYSE
BROWSE...
VERSION 0.1.3 (BETA)
ABOUT


Mykrobe Predictor TB
MYKROBE
PREDICTOR
TB
38%
CONSTRUCTING GENOME
CANCEL
ERSION 0.1.3 (BETA)
ABOUT

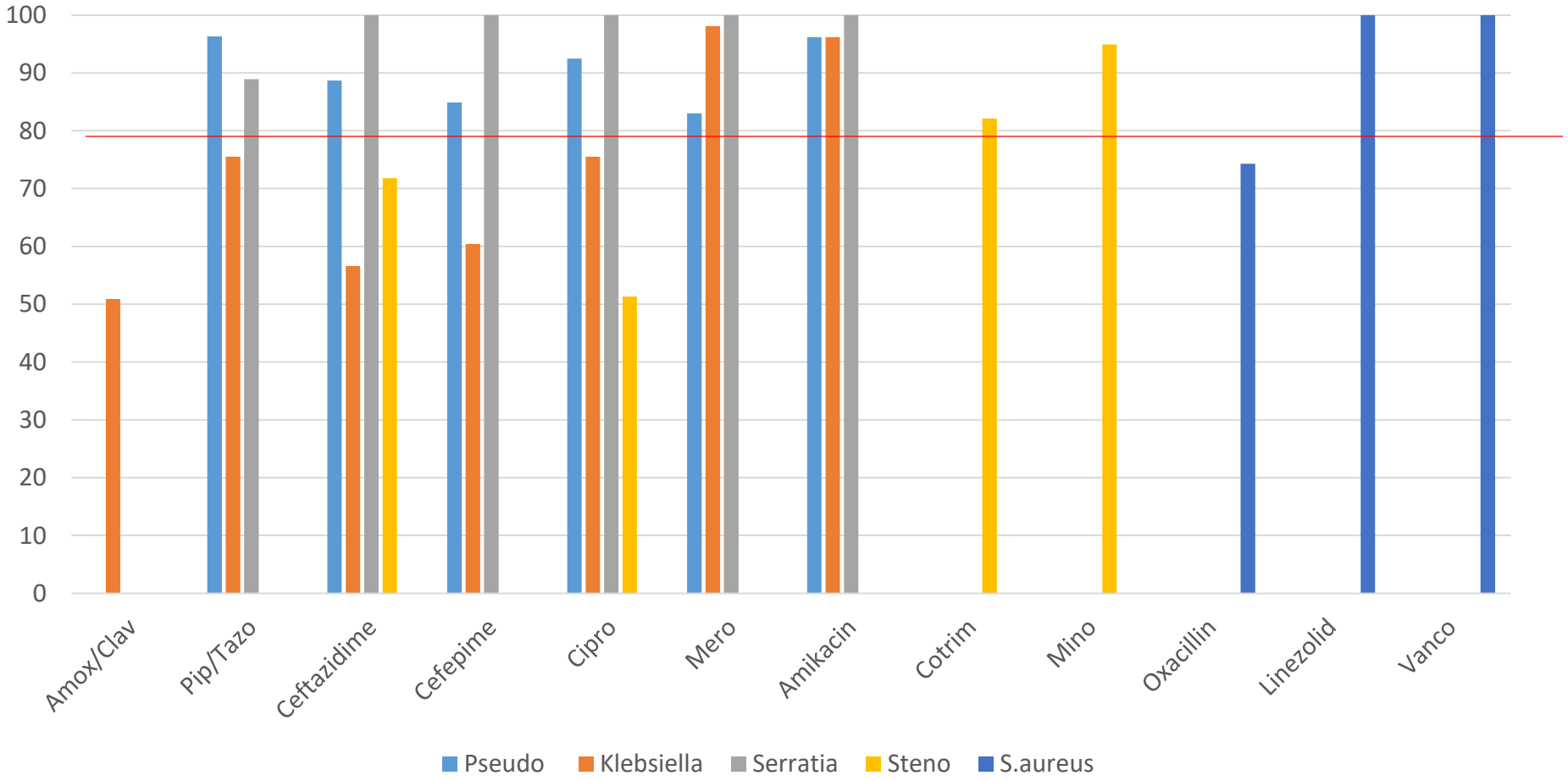

Mykrobe Predictor TB
MYKROBE PREDICTOR TB
VIEW ALL
DRUGS
SPECIES
EVIDENCE
SAVE
NEW
S
SPECIES
M. tuberculosis (lineage: Beijing/East Asia)
VERSION 0.1.3 (BETA)
ABOUT


Mykrobe Predictor TB
MYKROBE PREDICTOR TB
VIEW ALL
DRUGS
SPECIES
EVIDENCE
SAVE
NEW
SUSCEPTIBLE
Ethambutol
Quinolones
RESISTANT
Isoniazid
Rifampicin
Streptomycin
Amikacin
Capreomycin
Kanamycin
SUSCEPTIBLE
RESISTANT
INCONCLUSIVE
VERSION 0.1.3 (BETA)
ABOUT


Mykrobe Predictor TB
MYKROBE PREDICTOR TB
VIEW ALL
DRUGS
SPECIES
EVIDENCE
SAVE
NEW
1 FIRST LINE DRUGS
Isoniazid ▲
Rifampicin ▲
Ethambutol ●
2 SECOND LINE DRUGS
Quinolones ●
Streptomycin ▲
Amikacin ▲
Capreomycin ▲
Kanamycin ▲
R RESISTANCE
Extensively Drug Resistant (XDR)
● SUSCEPTIBLE ▲ RESISTANT ◆ INCONCLUSIVE
VERSION 0.1.3 (BETA)
ABOUT

Antibiotic Stewardship

Susceptibility of Selected PICU Respiratory Pathogens 2018



Summary and Recommendations

- Carbapenem resistance is still a concern, but numbers remain stable
- ICUs with high resistance rate should not use a Carbapenem as empiric therapy any more
- For *Pseudomonas aeruginosa,* Meropenem is no longer an option for empiric therapy.
- *S.maltophilia* high in ward X respiratory samples
- Low Acinetobacter incidence

Conclusion

- Infection Control and Microbiology are integral parts of safe patient care now
- They make important contributions to the Antimicrobial Stewardship Program
- Rapid diagnostic methods improve the decision making
- Sequencing method will improve outbreak control and prevention

Gram-Negatives 2018
Adult Population

Species (N)	Amp	Am/Cla	Pip/Taz	CXM	CTX	CAZ	CPM	GEN	TOB	AMK	MER	ERTA	SXT	CIP	Fosfo	Nitro	Tig/Min
E.Coli (937)	30.6	51.6	90.1			63.1	63.5	83.3		98.4	99.7	99.1	52.7	54.4	98.4	91.3	100
Pseudomonas aeruginosa (414)			95.2			89.0	89.0		96.1	96.4	81.3			89.0			
Klebsiella pneumoniae (507)	0	67.8	83.2			71.8	72.3	89.1		98.3	97.5	95.6	74.3	82.8	84.2	31.6	100
Stenotroph. maltophilia (103)						64.7					0		85.0	47.1			96.1
Enterobacter cloacae (63)	0	0	79.3			72.4	89.7	91.4		98.3	98.3	96.6	81.0	93.1	63.8	39.7	50.0
Serratia marcescens (83)	0	0	89.6			82.9	91.4	91.4		100	97.1	94.3	91.4	94.3	97.1	0	
Proteus mirabilis (91)	63.1	93.7	100			90.5	90.5	77.4		95.2	100	98.8	52.4	67.9	86.9	0	0
Acinetobact. Baumannii (70)		12.5 (Amp/ Sul)	62.5			60.4	68.8	79.2	83.3		70.8		89.6	64.6			87.5
Haemophilus influenza (56)	91.1	100		96.4	100								62.5	94.6			

References

- Diekema, D., Saubolle, M.A. Clinical Microbiology and Infection Prevention. 2011. J Clin Mic. 49 (9) Suppl., Sept 2011: S57-S60.
- Pfaller, M.A., Herwaldt, L.A. The Clinical Microbiology Laboratory and Infection Control: Emerging Pathogens, Antimicrobial Resistance, and New Technology. 1997. Clin Inf Dis Vol. 25 (4): 858-870.
- Dangel, A. et al. Genetic diversity and delineation of Salmonella Agona outbreak strains by next generation sequencing, Bavaria, Germany, 1993 to 2018. 2019. Eurosurveillance 24 (18):

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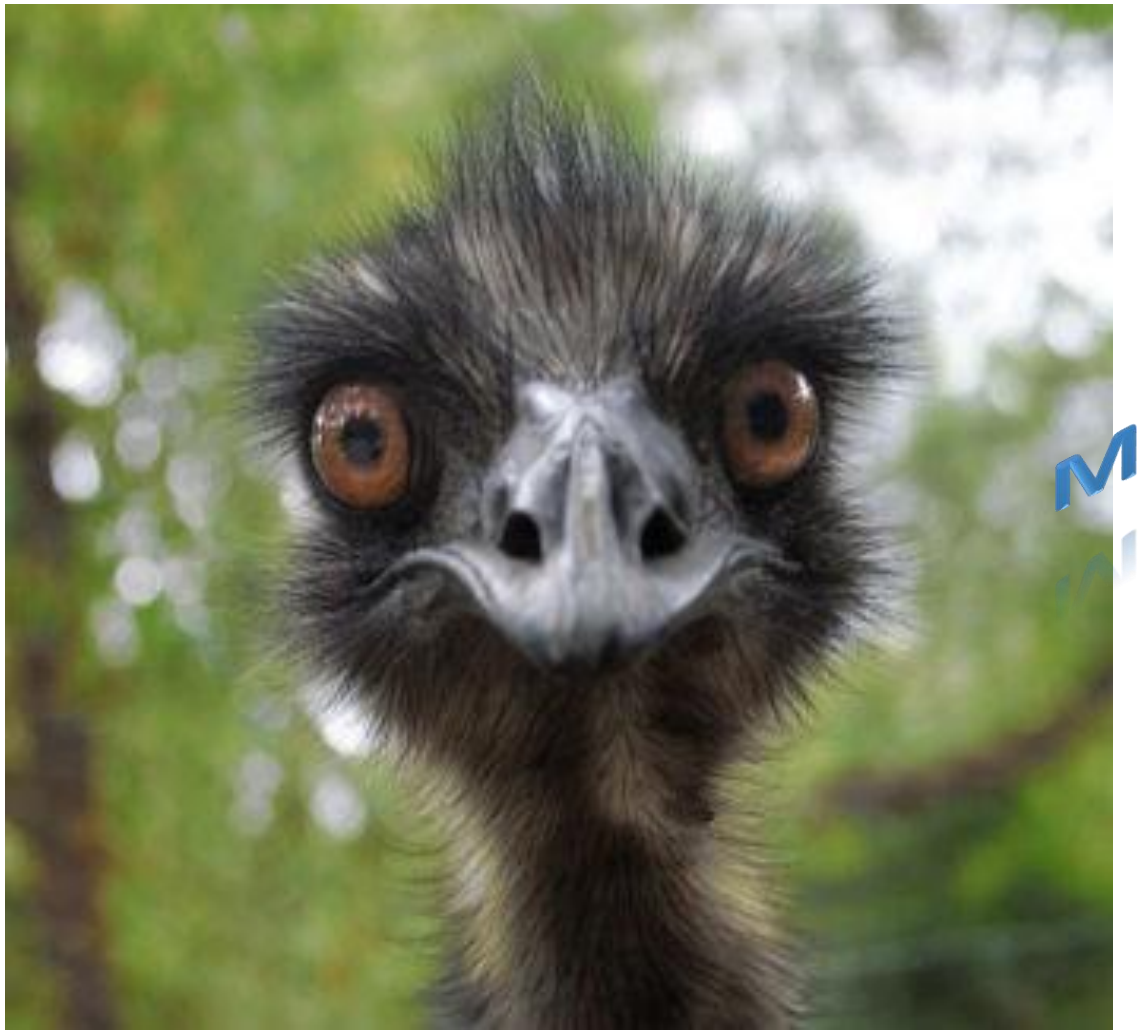
مدينة الشيخ خليفة الطبية



MORE QUESTIONS?

Thank you!