Schweizerischer Verein der Amts- und Spitalapotheker
Association suisse des pharmaciens de l'administration et des hôpitaux
Associazione svizzera dei farmacisti dell'amministrazione e degli ospedali
Swiss Association of Public Health Administration and Hospital Pharmacists

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Workshop (D)
Workshop (F)

Bern, 14.11.2018

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Therapeutic Drug Monitoring

Knowledge transfer from the EAHP Academy seminars

Quiz

1. To calculate the loading dose (LD) we need to know:
   a) Rate of Absorption (k_a)
   b) Rate of elimination (k_e)
   c) Volume of distribution (V_d)
   d) Area under the curve (AUC)

2. To calculate the maintenance dose (MD) we need to know
   a) Time to reach the steady state (T_{SS})
   b) Volume of distribution (V_d)
   c) Clearance (Cl)
   d) Rate of absorption (k_a)

3. Indicate one of the main advantages of chromatographic methods over immunoassays
   a) Low sample volume
   b) Less time of analysis
   c) Less cost
   d) More sensitivity
   e) Minimum sample preparation

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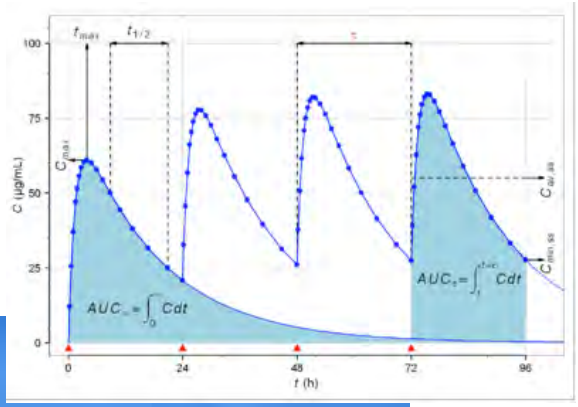
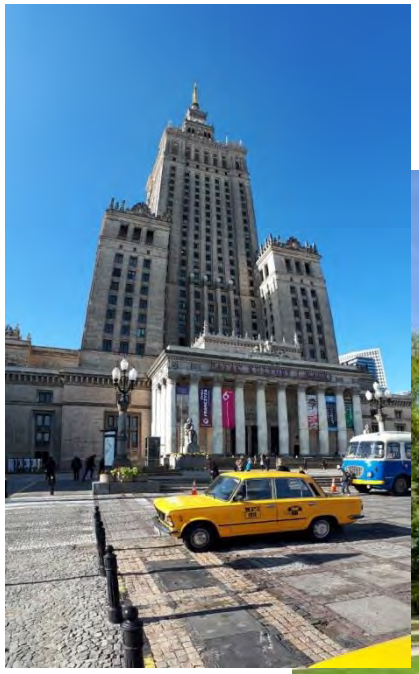
Quiz

4. How long is the Post Antibiotic Effect or Post MIC Effect of an aminoglycosides?
   a) 2 hours
   b) 7 hours

5. Do modern TDM tools require steady state conditions for valid analysis and forecasts?
   a) Yes
   b) No

EAHP Academy Seminar 2018 - Warszawa





Agenda

- Basic Clinical Pharmacokinetics
- Concept of TDM
- TDM in Antibiotic Therapy
- Clinical case on dose adjustments based on TDM of antibiotics

Basic Clinical Pharmacokinetics

Answer to questions:

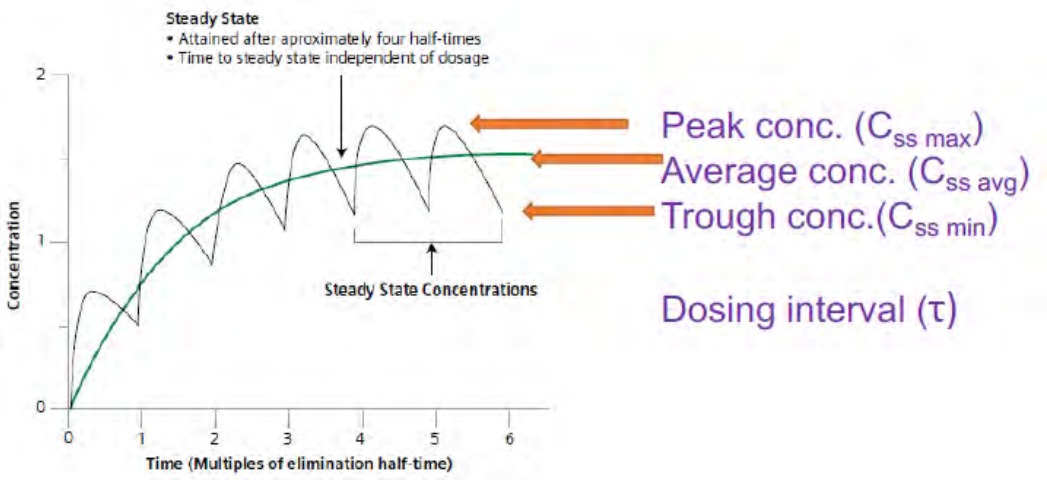
- What dose to give?
- How often to give it ?

 - When is steady-state achieved ?

- How to change the dose in certain medical conditions ?
- How some drug-drug interactions occur ?

- Bioavailability (F)
- Volume of distribution (Vd)
- Clearance (CL)
- Half-life ($t_{1/2}$)

- Peak conc. ($C_{ss\ max}$)
- Trough conc ($C_{ss\ min}$)
- Area under the curve (AUC)



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Bioavailability

Relevance:

If F<1 (100%)

Absorbed dose = administered dose x bioavailability

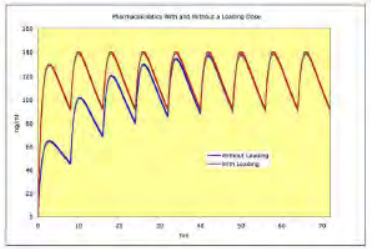
- Calculation of *p.o.* dose based on F and *i.v.* dose

Volume of distribution

- Relevance:

Loading Dose (LD) = a *dose* of drug sufficient to produce a plasma concentration of drug that would fall within the therapeutic window after only one dose over a very short interval.

$$LD = \frac{C \times Vd}{F}$$



Clearance

Relevance:

- **Maintenance Dose (MD)** = The dose needed to maintain the concentration within the therapeutic window when given repeatedly at a constant interval
- Dosing rate (mg/h) = D/τ

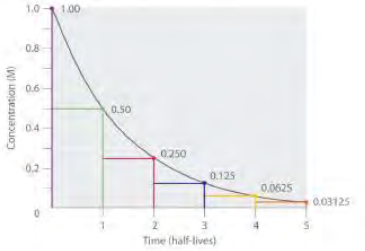
$$MD = \frac{C \times CL \times \tau}{F}$$

Half-life

Half life (linear kinetics) does not depend on:

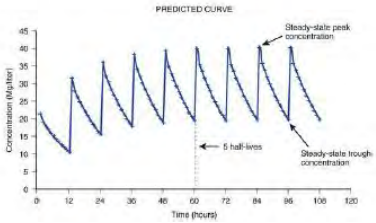
- dose
- dosage interval

- Relevance:
- Dose interval



- Time to completely eliminate the drug from the body

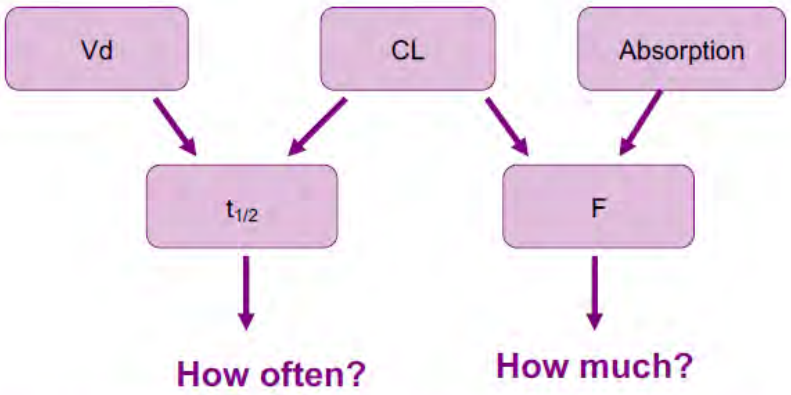
$(5 \times t_{1/2})$



- Time to reach steady state (Tss) depends on half life

$Tss = 4 - 5 \times t_{1/2}$

Contributing factors to dosing



+ age, gender, liver and kidney function, weight, other concurrent diseses, the other medicines…

- We can not control: CL, Vd, F
  - → Change in F will alter Cssavg (not Peak:Trough)
  - → Change in Vd will alter Peak:Trough (not Cssavg)
  - → Change in CL will alter both Peak:Trough and Cssavg

- We can control: dose, rate (D / τ)
  - → Necessary, if disease, age, renal/hepatic function, other drugs, … change CL, F, Vd

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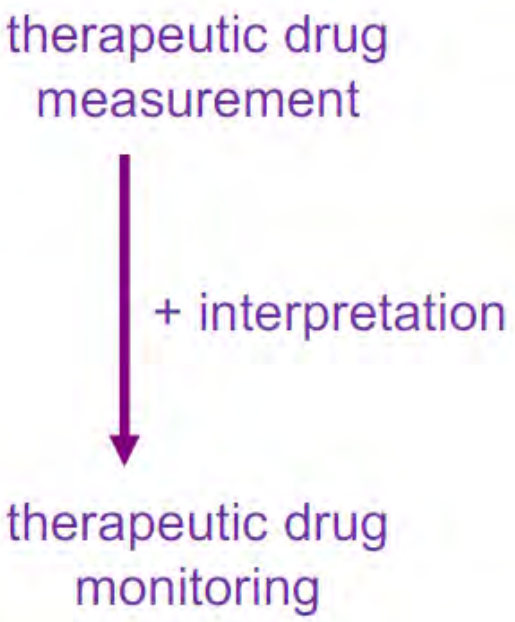
Concept of Therapeutic Drug Monitoring (TDM)

- TDM involves the measurement of drug concentrations in biological fluid and the interpretation of those concentrations.
- TDM is the clinical assessment of a drug's pharmacokinetic properties.
- **Interpretation** requires knowledge of the pharmacokinetics, sampling time, drug history and the patient's clinical condition.



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Indications for TDM (‘why do it’)

- Individualizing therapy (assessment of MD, τ; adjustment of D)
- Toxicity
  - diagnosing toxicity when the manifestation of toxicity and disease state are similar (theophylline)
  - Avoiding toxicity (aminoglycosides)
- Assessing compliance
- Diagnosing failed therapy (…ve drug treatment and non-compliance
- Change in…
- Mo…
- Guid…

Which d…

- narrow …
- significan… …bility
- no high int… …ic variability
- a reasonable … …tween plasma conc. and clinical effects
- established ta… …concentration range
- availability of cost-effective drug assay

Drugs subject to monitoring

Antibiotics
PK/PD Index

Antiepileptics
Imprecision in TI

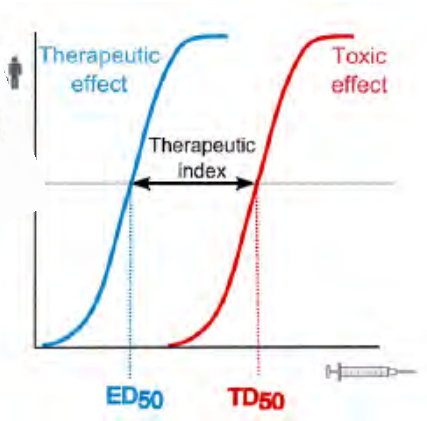
Antidepressants
Curvilineal relationship PK/PD

Anti-cancer drugs:
5-Fluouracil
Irinotecan
Taxanes
Doxorrubicin
MTX
TKI
Monoclonal antibody

Antipsicotics
Curvilineal relationship PK/PD

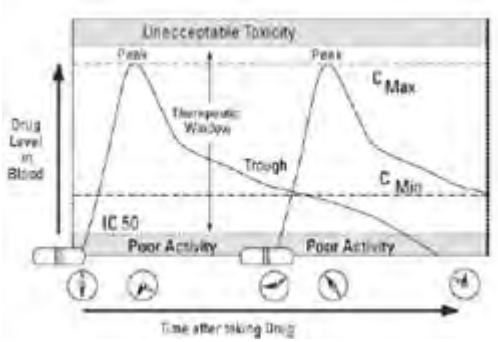
Cardiotonics
Need to control peripheral c.

Immunotherapy
Digestive
Rheumatology
Dermatology



Timing of the plasma sample (‘when to do it’)

- In most cases when SS is reached (earlier if toxicity is suspected)
- At the appropriate time in relation to the last dose
  - Generally measured in the elimination phase (correlates with C_{trough}); gives a more reliable guide to drug dosing
  - C_{peak} some antibiotics (aminoglycosides)
  - not during the distribution phase (not equilibrium between plasma and tissue conc.)



Therapeutic drug monitoring request (‘what to document’)

Details to include on the request form:

- Time sample collected
- Time dose given
- Dosage regimen (dose, duration, dosage form)
- Patient demographics (age / gender)
- Comedications
- Relevant co-morbidities (e.g. renal / liver disease)
- Indications for testing (e.g. toxicity, non-compliance)

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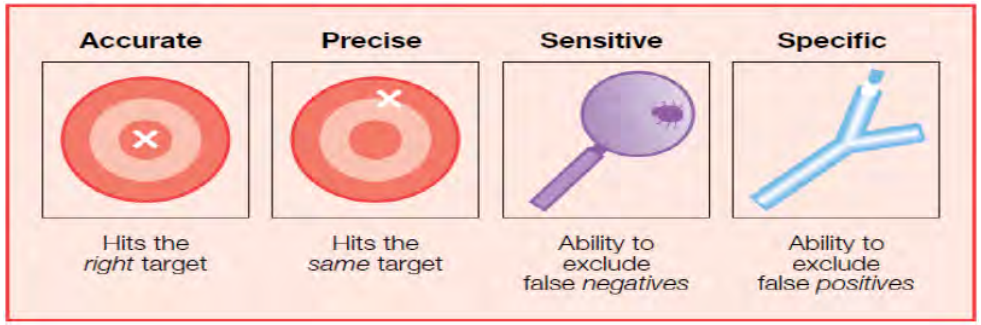
Bioanalytical methods for TDM



Immunoassays

Automated
Standarized methods
Low sample volume
No sample preparation (or minimum)
Less time of analysis
Fairly low cost (instruments, reagents)
Easy to use. Personal minimally qualified

Less sensitivity (heterogeneous > homogeneous)
Less specificity
Total dependence on provider
Limited supply of assays
No availability for new drugs

Chromatographic methods

Standarized and in-house methods
Good or high sensitivity (LC-MS/MS)
Good or high specificity (LC-MS/MS)

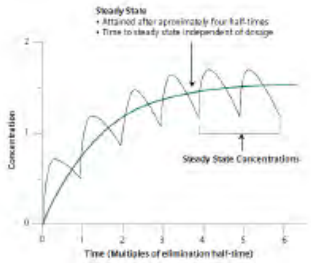
HPLC high sample volume required
Sample preparation required
Lengthy analysis (HPLC)
Moderate analysis length (LC-MS/MS)
Expensive instrumentation
Qualified and experienced staff

Interpretation

Sample concentration is

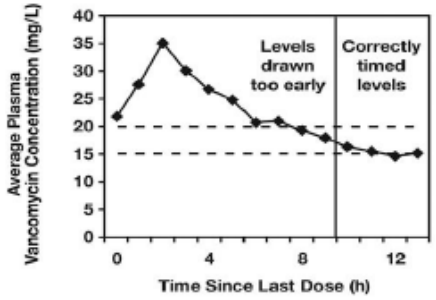
Lower than anticipated

- Patient noncompliance
- Error in dosage regimen
- Rapid elimination
- Poor bioavailability
- Drug-drug interaction (ind.)
- not achieved SS



Higher than anticipated

- Patient noncompliance
- Error in dosage regimen
- Slow elimination
- Decreased renal/hepatic function
- Drug–drug interaction (inh.)
- Time sampling



Interpretation

- Before making dose adjustments, consider:

- if the sample was taken at the correct time with respect to the last dose,
- if a steady state has been reached
- If the patient is adhered to the treatment
- If there is a drug-drug interaction
- If there is a liver/kidney dysfunction

+ the individual patient without rigid adherence to a target range.

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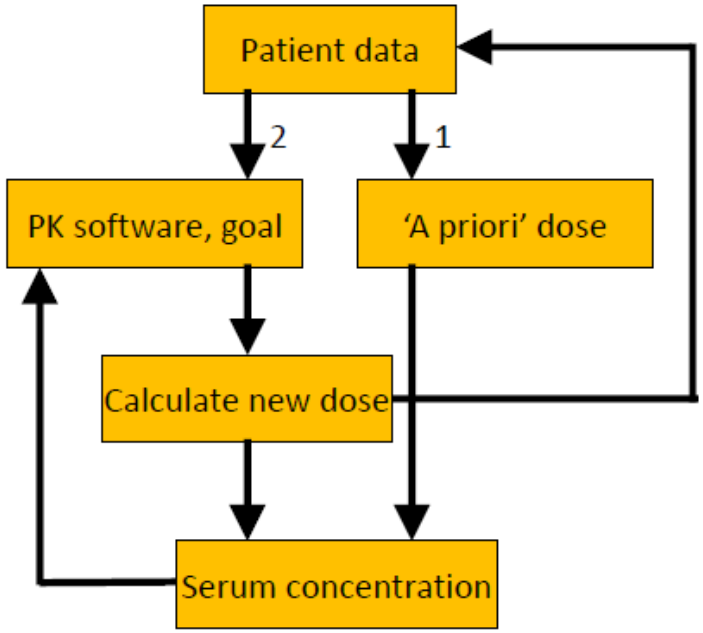
Methods available to individualize drug therapy

- Clinical pharmacokinetic principles using simple mathematical relationships that hold for all drugs that obey linear pharmacokinetics

$$D^* = \frac{Css^*}{Css} x\ D \qquad t = \frac{\ln Css - \ln Css^*}{K}$$

- Bayesian calculations represent the gold standard TDM approach

- (complex) computer programs that could cover more drugs.



What you need for TDM:

- PK / PD targets
- Population pharmacokinetic model for the 'a priori' dose
- Patient characteristics
- Knowledge when to take sample(s)
- Knowledge on the reliability of your assay results
- Pharmacokinetic software

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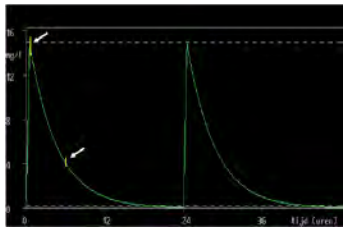
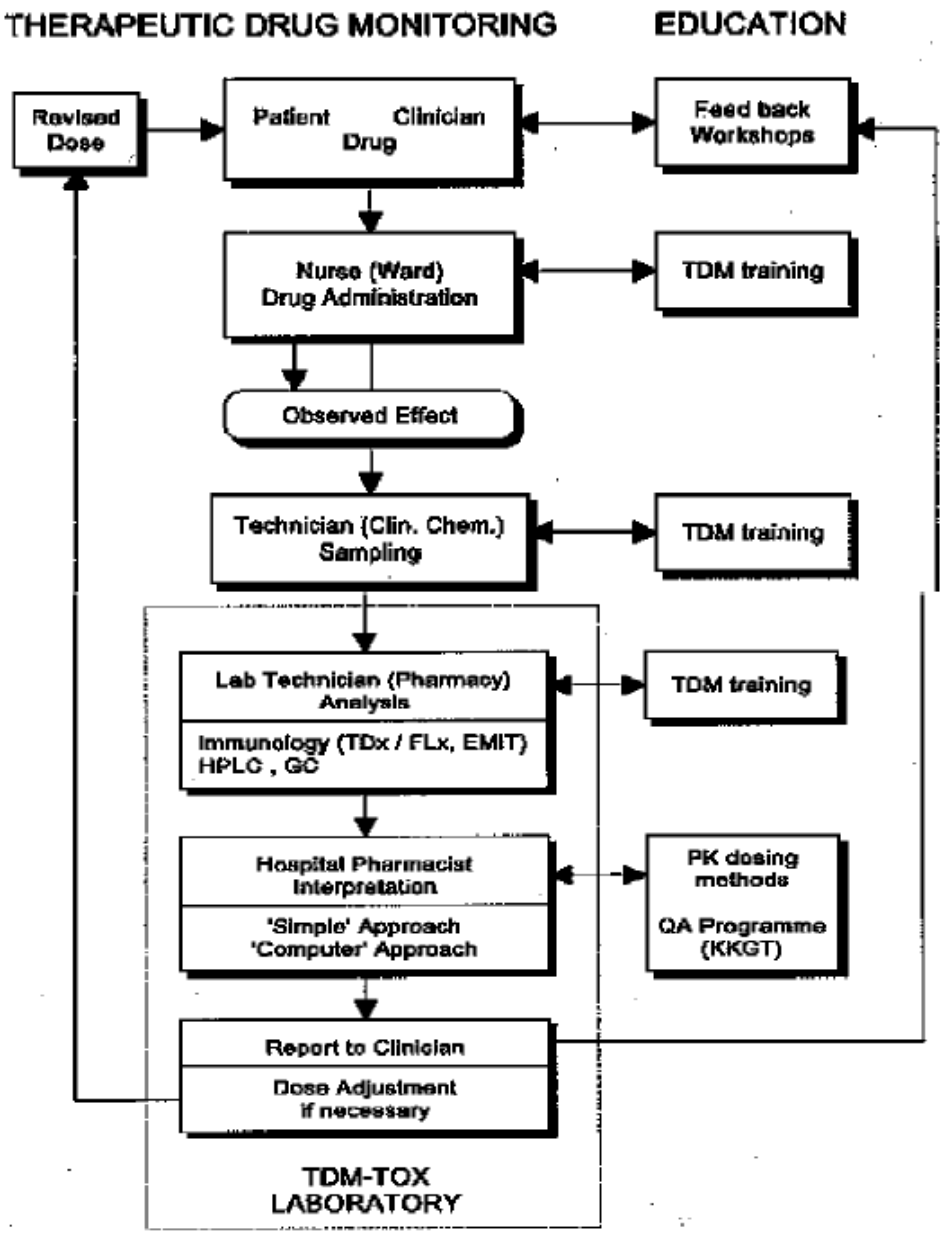
Process	Successful TDM service requires a coordinated effort among physicians, clinical pharmacists, and laboratory personnel.
Drug administration	Correct and standardized procedures
Sampling	When was it drawn? Record the time as military time, to the minute!!! 'Optimal sampling': – You want the most of the information from a limited number of samples – You want the best information from each sample, every sample has different information: Optimal sampling points: – 1. Cmax – 2. 1.5 x $t_{1/2}$ later 
Request Form	completed correctly (written in simple, clear language), should include patient data, drug data, concentration data, interpretation and comments; central access to patient data would be optimal (KIS)
Measurement	Simple, accurate, precise, fast, specific. Knowledge of the assay error over the entire range of the assay
Interpretation	Draw right conclusions. Potential errors: • Assuming patient is at steady-state • Assuming patient is adherent to the therapy • Not knowing the sampling time in relation to dose administration • Not considering decreased renal/hepatic function • Not considering drug interactions • Using reference range as absolute values
Use	Therapeutic ranges are recommended values, but interindividual variability exists. Beside the measured value you should consider the clinical effect in each patient: is the patient doing fine, the dose is ok and you should not change the dose→ treat the patient, not a value!



- TDM is interprofessional
- TDM training is crucial

Conclusion part 1

- Knowledge and understanding of basic principles of clinical pharmacokinetics are necessary for interpretation of measured concentration and individualization of drug dose.
- Measurement of serum drug conc. without appropriate interpretation is useless (or even misleading).
- TDM is complementary to and not a substitute for clinical judgement so it is important to treat the individual patient and not the laboratory value.
- Successful TDM service requires a coordinated effort among physicians, clinical pharmacists, and laboratory personnel.
- To have good control of every step of the TDM process is necessary for good dosing adjustment of drug therapy in each patient.
- You can´t do drug dosing adjustments if you don´t control all information, and if you don´t use the information correctly.

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TDM and dose optimisation of antibiotics

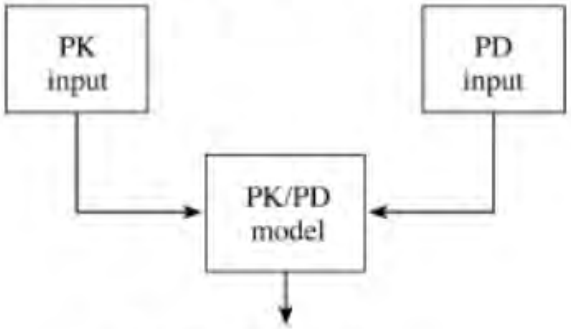
Prof Dr Daniel J. Touw, University Medical Center Groningen, The Netherlands

- PK/PD principles of antibacterial drugs
- Optimal sampling
- Workshop examples

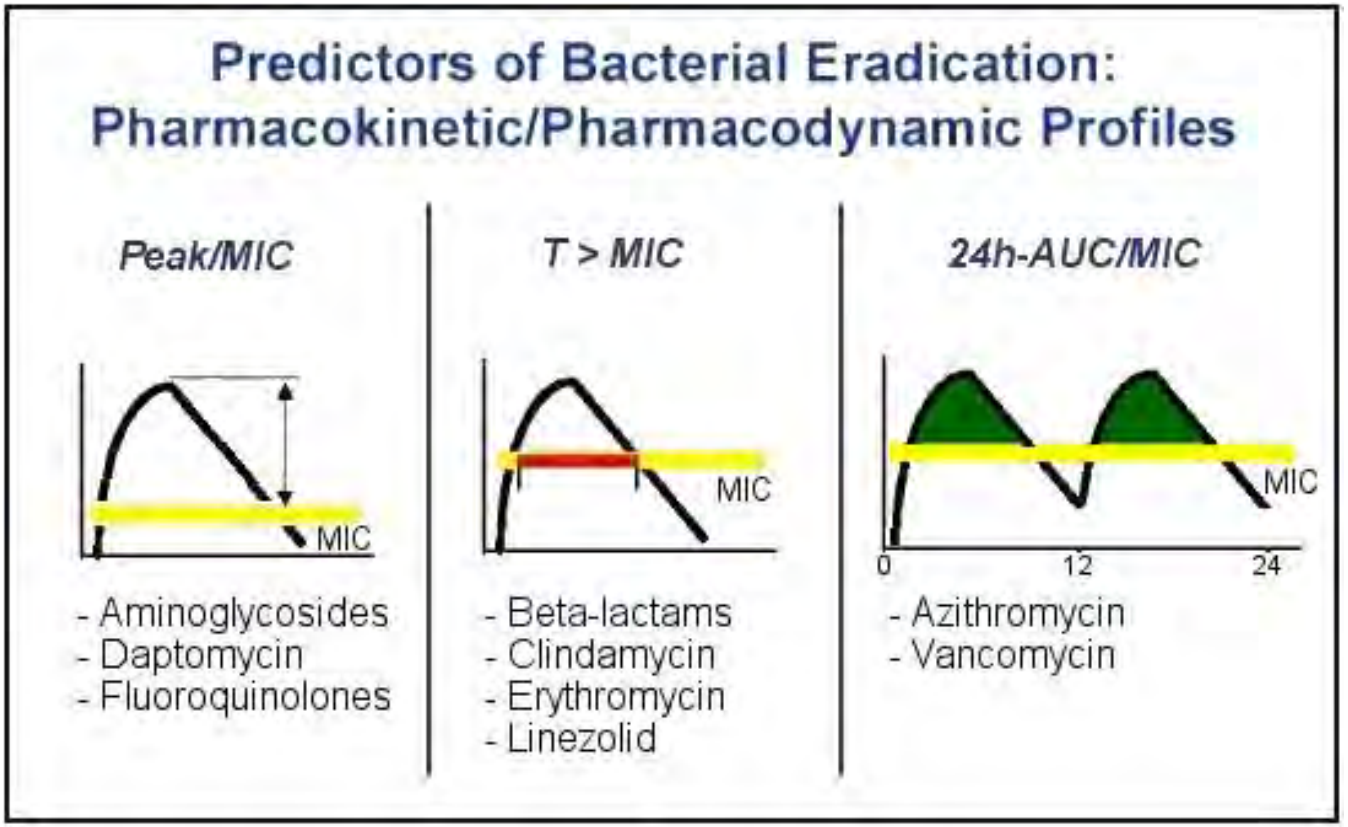
TDM and dose optimisation of antibiotics

Therapeutic Drug Monitoring

- Goal: To better integrate pharmacodynamic and pharmacokinetic knowledge for optimal dosing:



Pharmakodynamic Principles



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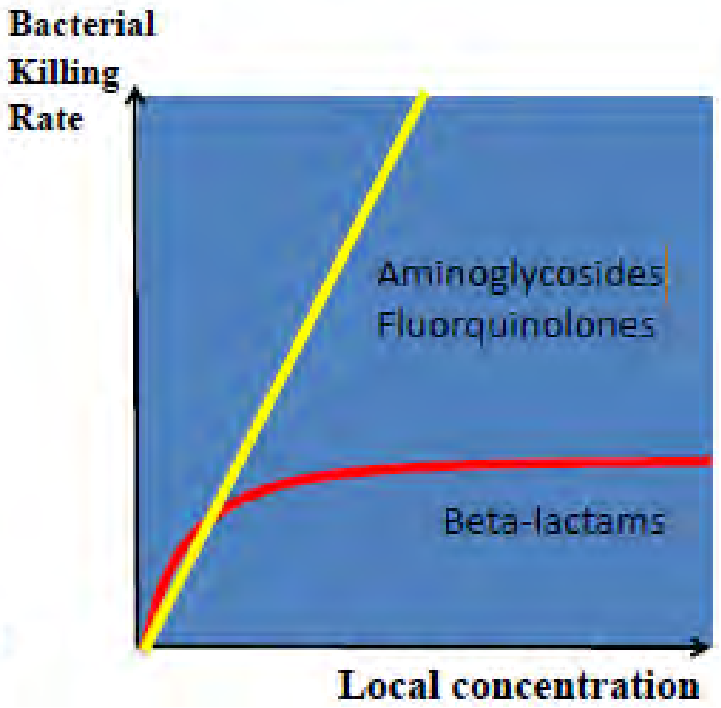
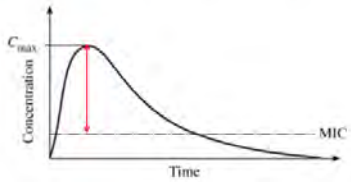
Pharmakodynamic Principles

- Pharmacokinetic/ Pharmacodynamic (PK/PD) principles in the relevant dosing range:
  - Concentration dependent antibiotics: bacterial killing increases with increasing concentration
  - Time dependent antibiotics: bacterial killing is independent from concentration



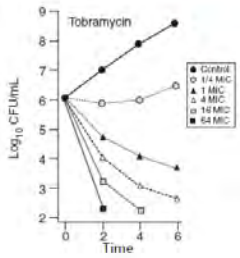


Summary Aminoglycosides

- Concentration dependent killing of bacteria
- Peak/MIC ratio >8-10
- Post-MIC effect (7 hours)
- Increasing dosing interval decreases renal toxicity
- Tobramycin most probably less nephrotoxic than gentamicin

Aminoglycosides, efficacy

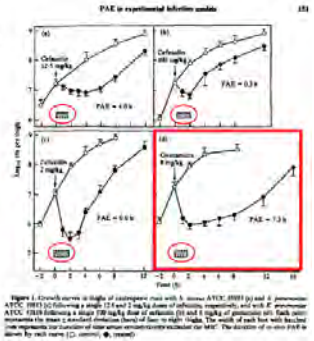
- Relationship between maximal concentration and bacterial killing over time in an **animal model of P aeruginosa infection:**



Craig, Scand J Inf Dis 1990

Post MIC effect

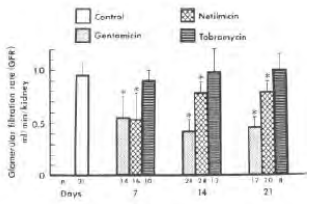
Time > MIC

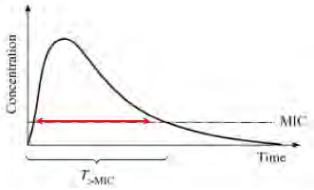


Craig, JAC 1993

Aminoglycoside, toxicity

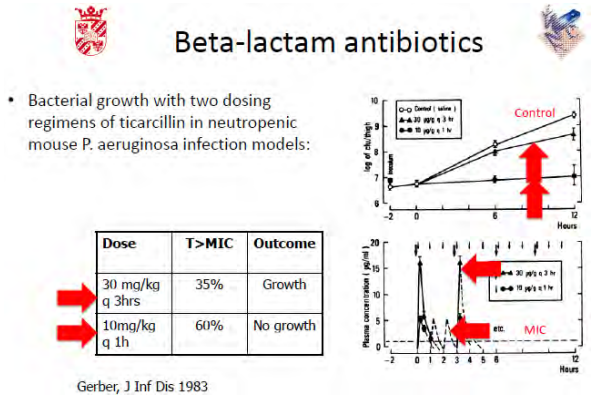
- GFR loss in animals related to drug and days of treatment





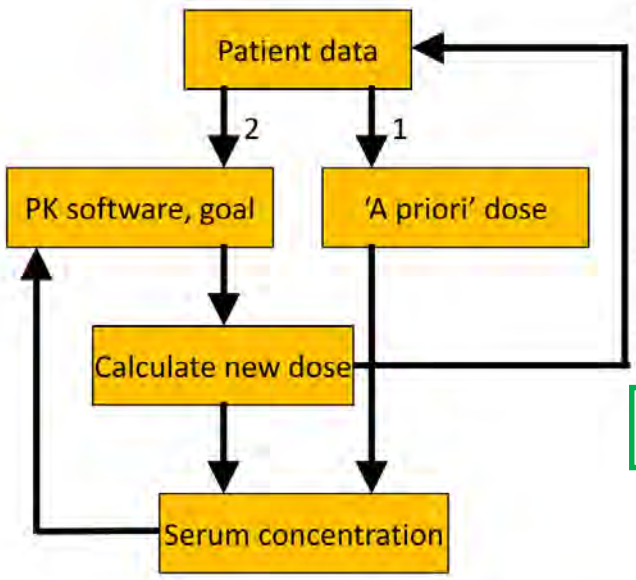
Summary Beta-lactam Antibiotika

- Time > MIC dependent killing of Bacteria
  - At least 50% (Car < Pen = Cef) [Andes and Craig, Int J Antimicrob Ag 2002]
- CSS free 4 x MIC
- Dauerinfusion Vorteilhaft ggü. Intermitt. Inf?
  - Nur in Tierstudien klar nachgewiesen; Humanstudien zeigen Nutzen für Risikopatienten (bspw. IMC, hepatologische)
- Proteinbindung: vernachlässigbar ausser bei Flucloxacillin (95%) und Ceftriaxon (90-95%)



How to integrate this into TDM?

- With the present PK software equipped with a population PK model there is no need to wait for steady-state. Besides, severely ill patients will never be in a steady-state.



- Goal-oriented, model-based dosing:
- Define the therapeutic goal.
- Start an optimal '*a priori*' dosing scheme based on a population PK model and patient data (gender, height, weight, renal function, ...).
- Draw blood samples at one or more optimally chosen moments.
- Feed the data to the PK software.
- Calculate the new dose.
- Look at the response of the patient

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How to integrate into TDM

- What you need for Therapeutic drug monitoring:
  - PK/PD targets
  - Population pharmacokinetic model for the '*a priori*' dose
  - Patient characteristics
  - Knowledge when to take sample(s)
  - Knowledge on the reliability of your assay results
  - Pharmacokinetic software (e.g. OPT, MWPharm)

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How to integrate into TDM

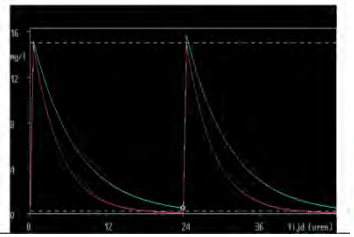
Optimal Samplin

Trough level is the least reliable

- Suppose you only measure a trough level and the result is <0.5 mg/L. This means that the real result is somewhere between 0 and 1 mg/L.

– Red graph (trough = 0.1 mg/L): AUC=66

– Green graph (trough = 1 mg/L): AUC=104

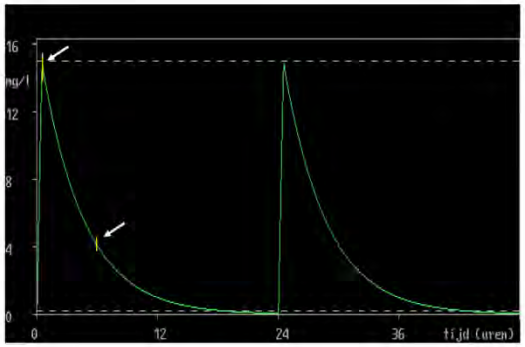


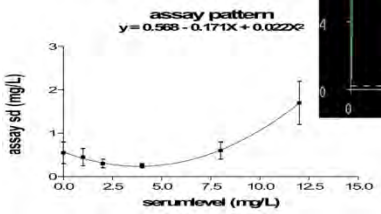
Optimal sampling

- Why optimal sampling?
  - You want the most of the information from a limited number of samples.
  - You want the best information from each sample.

D-Optimal sampling

- Optimal sampling points:
  - 1. Cmax
  - 2. 1.5 x T1/2 later
- Opportunity to optimize the dose before the 2nd dose





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Conclusions TDM studies

- TDM of aminoglycosides:
  - Improves patients outcomes,
  - Decreases morbidity (renal toxicity),
  - Reduces time spent in hospital,
  - Is cost-effective,
- … only if serum samples are drawn at the right moment and the right dose is calculated using goal oriented and model based

Clinical case on dose adjustments based on TDM of antibiotics – Starting Dose

Case tobramycin

Male, born 8th june 1978

1,86m, 75 kg

serum creat 91 micromol/L.

Urinary infection, started with beta-lactam + tobramycine

What is your initial tobramycin dose and why?

A) 225 mg

B) 375 mg

C) 525 mg

D) 750 mg

PD parameter tobramycin: Cmax/MIC = 10, assume MIC of 2 mg/L

Cmax = Dos/V = 20 mg/L

Vd = 0.2-0.3 L/kg

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Case tobramycin

Male, born 8th june 1978

1,86m, 75 kg

serum creat 91 micromol/L.

Urinary infection, started with beta-lactam + tobramycine

PD parameter tobramycin: Cmax/MIC = 10, assume MIC of 2 mg/L

Cmax = Dos/V = 20 mg/L

Vd = 0.2-0.3 L/kg, take 0.25 L/kg * 75 kg = 18.75 L

Dos = 20 * 18.75 = 375 mg (= 5 mg/kg)

Case tobramycin

Male, born 8th june 1978

1,86m, 75 kg

serum creat 91 micromol/L.

Pulmonary infection with sepsis, started with beta-lactam + tobramycine

What is your initial tobramycin dose now?

A) 225 mg

B) 375 mg

C) 525 mg

D) 750 mg

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Case tobramycin

Male, born 8th june 1978

- 1,86m, 75 kg
- serum creat 91 micromol/L.
- Pulmonary infection with sepsis, started with beta-lactam + tobramycine

PD parameter tobramycin: Cmax/MIC = 10, assume MIC of 2 mg/L

Cmax = Dos/V = 20 mg/L

Vd = 0.3-0.4 L/kg, take 0.35 L/kg * 75 kg = 26.25 L

Dos = 20 * 26.25 = 525 mg (= 7 mg/kg)

Case tobramycin

Male, born 8th june 1978

1,86m, 75 kg

serum creat 91 micromol/L.

Exacerbation of his cystic fibrosis, started with beta-lactam + tobramycine

What is your initial tobramycin dose?

A) 225 mg

B) 375 mg

C) 525 mg

D) 750 mg

Case tobramycin

Male, born 8th june 1978

- 1,86m, 75 kg
- serum creat 91 micromol/L.
- Exacerbation of his cystic fibrosis, started with beta-lactam + tobramycine

European Consensus Cystic Fibrosis

Cmax = Dos/V = 25-30 mg/L (due to limited penetration into sputum)

Vd = 0.28-0.38 L/kg, take 0.33 L/kg * 75 kg = 25 L

Dos = 30 * 25 = 750 mg (= 10 mg/kg)

Summary Tobramycin

Efficacy determined by Cmax/MIC

Often poor penetration into pulmonary tissue

Cmax mainly determined by Volume of distribution, target 20 mg/L

Vd normally:	0.2 – 0.3 L/kg
Vd in sepsis:	0.3 – 0.4 L/kg

Standard dose (based on Vd):

Non-sepsis:	5 mg/kg
Sepsis:	7 mg/kg
CF:	10 mg/kg

Note: in obese patients, take the ideal bodyweight

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Clinical case on dose adjustments based on TDM of antibiotics – following doses

Case tobramycin

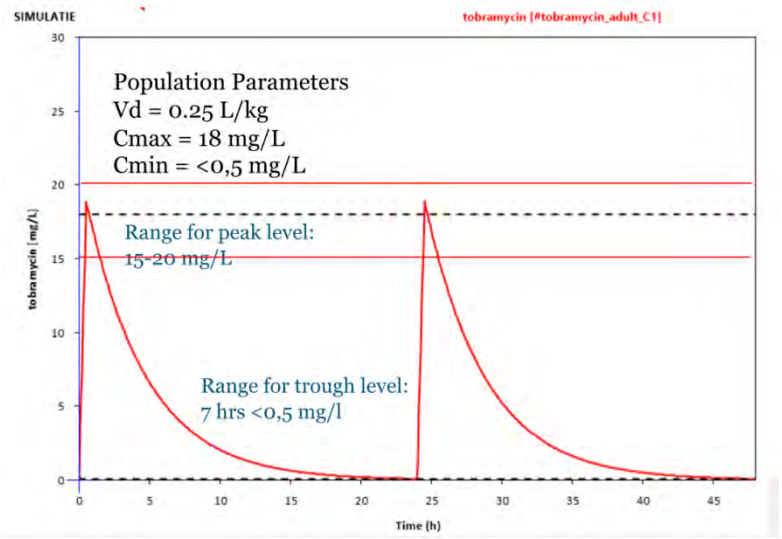
Male, born 8th june 1978

1,86m, 75 kg

serum creat 91 micromol/L.

Pulmonary infection, started with beta-lactam + tobramycine

Initial dose (5 mg/kg) 375 mg o.d. (Standard practice based on epidemiological susceptibility values and population Vd value: 5 mg/kg o.d. with a moderate renal function)



Case tobramycin

Male, born 8th june 1978

1,86m, 75 kg

serum creat 91 micromol/L.

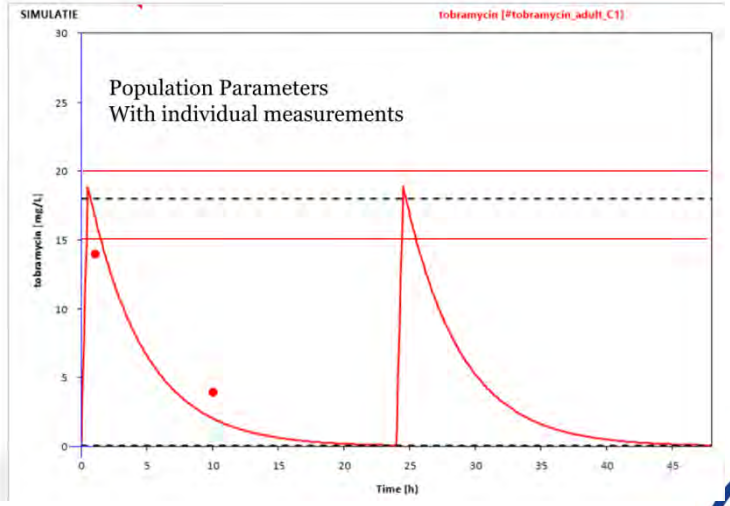
Pulmonary infection, started with beta-lactam + tobramycine

Initial dose 375 mg o.d. (Standard practice 5 mg/kg o.d. with a moderate renal function)

Blood samples

1 h after start (peak level): 14 mg/L

after 10 h: 4 mg/L.



Your advice:

A) Maintain dose and interval

B) Decrease dose and maintain interval

C) Increase dose and increase interval

D) Decrease dose and increase interval

Case tobramycin

Male, born 8th june 1958

1,86m, 75 kg, serum creat 91 micromol/L.

Pulmonary infection, started with beta-lactam + tobramycine

Initial dose: 375 mg o.d. (Standard practice 5 mg/kg o.d. with a moderate renal function)

Blood samples: 1 h after start (peak level): 14 mg/L; after 10 h: 4 mg/L.

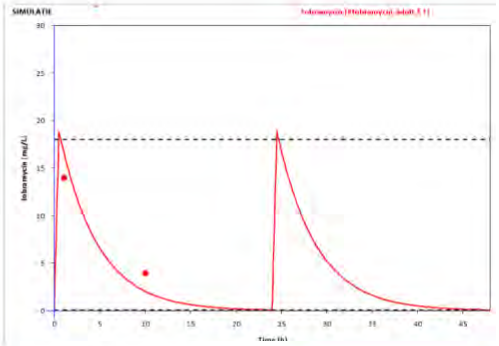
Your advice:

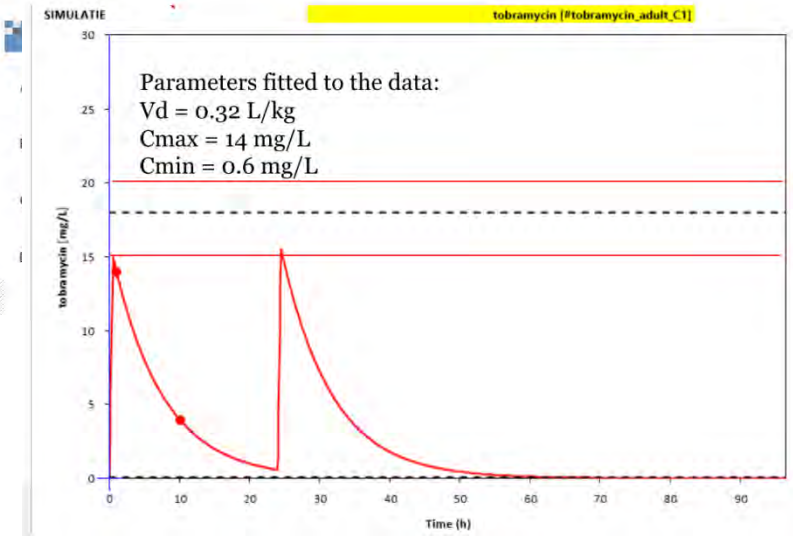
A) Maintain dose and interval

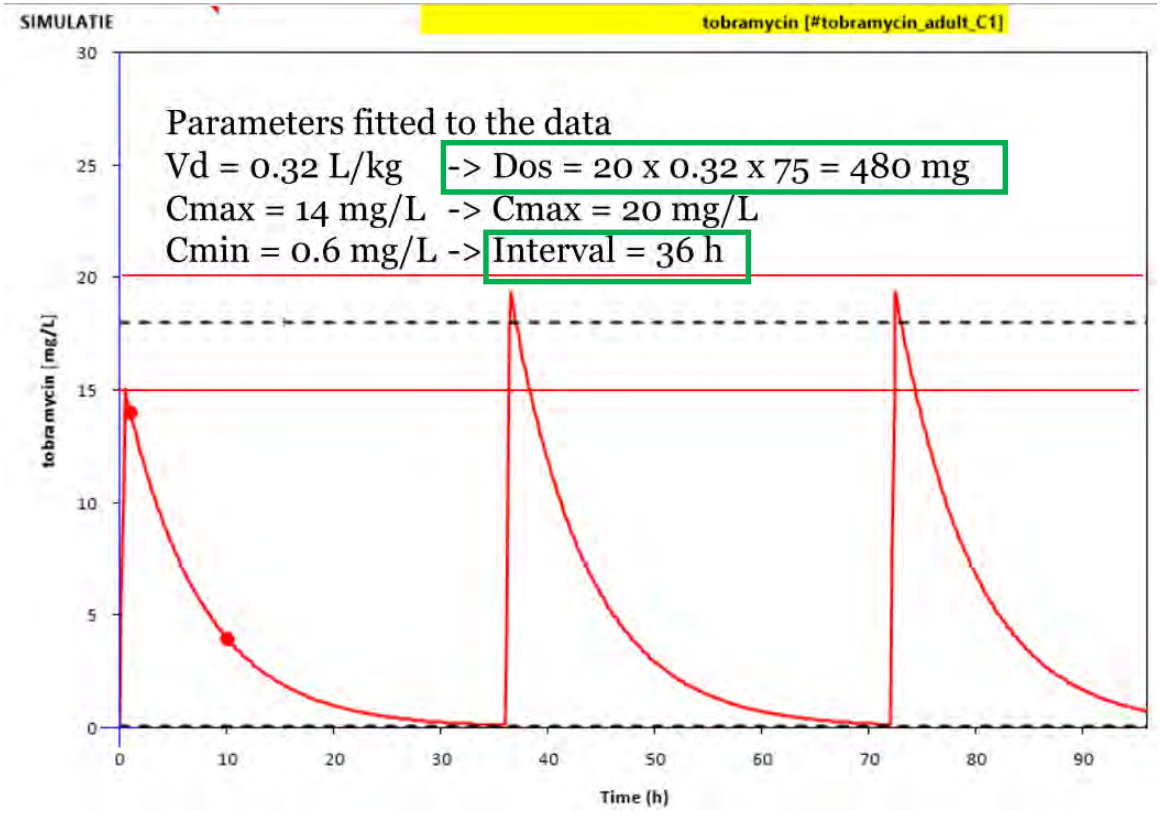
B) Decrease dose and maintain interval

C) Increase dose and increase interval

D) Decrease dose and increase interval






SIMULATIE
tobramycin [#tobramycin_adult_C1]
Parameters fitted to the data
Vd = 0.32 L/kg -> Dos = 20 x 0.32 x 75 = 480 mg
Cmax = 14 mg/L -> Cmax = 20 mg/L
Cmin = 0.6 mg/L -> Interval = 36 h
tobramycin [mg/L]
Time (h)
0
5
10
15
20
25
30
0
10
20
30
40
50
60
70
80
90

Case gentamicin

Neonate, prematurely born, birth weight 1.6 kg, open ductus botalli, treated with indomethacin i.v., signs of infection.

Indication for antibiotics (amoxicillin/gentamicin)

gentamicin started with 5 mg/kg once every 36 hours according to local protocol for neonates with infection

Target drug levels are 9-11 (peak) and ≤1 (trough) mg/L

Do you expect levels are met?

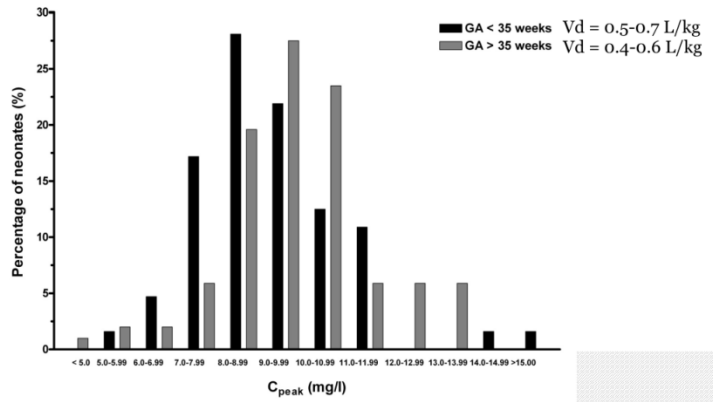
A) Peak Yes, trough higher
B) Peak higher, trough higher
C) Peak lower, trough Yes
D) Peak lower, trough higher

Premature neonates

Volume of distribution (in L/kg) increase with decreasing gestation

Term:	0.4-0.6 L/kg
Preterm:	0.5-0.7 L/kg
Extremely premature:	0.6-0.8 L/kg

Distribution of the peak level in 115 neonates treated with 5 mg/kg



Open ductus Botalli

Blood vessel connecting the main pulmonary artery to the proximal descending aorta to bypass the fetus's fluid-filled non-functioning lungs

Closure is normally spontaneous at birth, but can be done by NSAID treatment

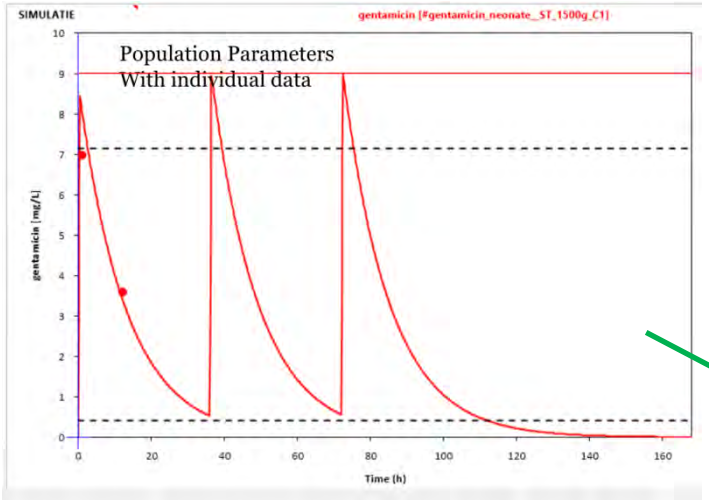
NSAID's reduce renal blood flow and renal drug clearance

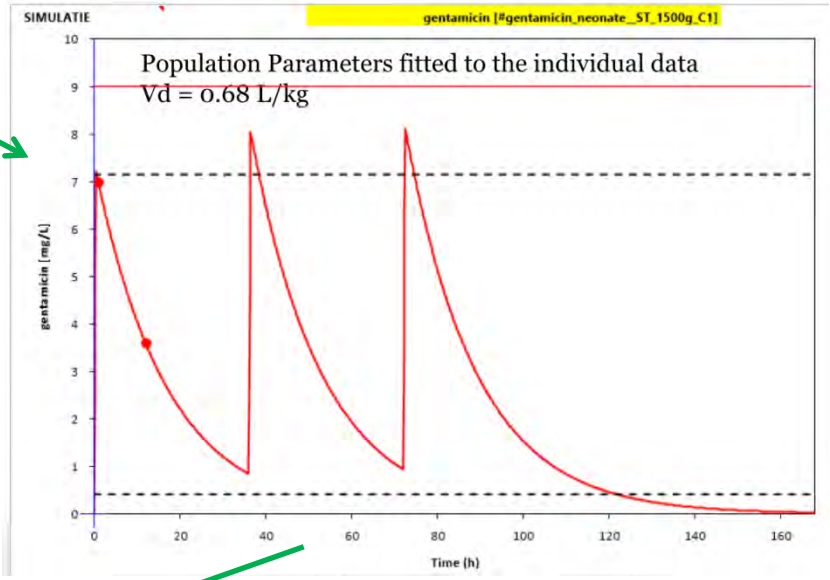
Case gentamicin in premature neonate

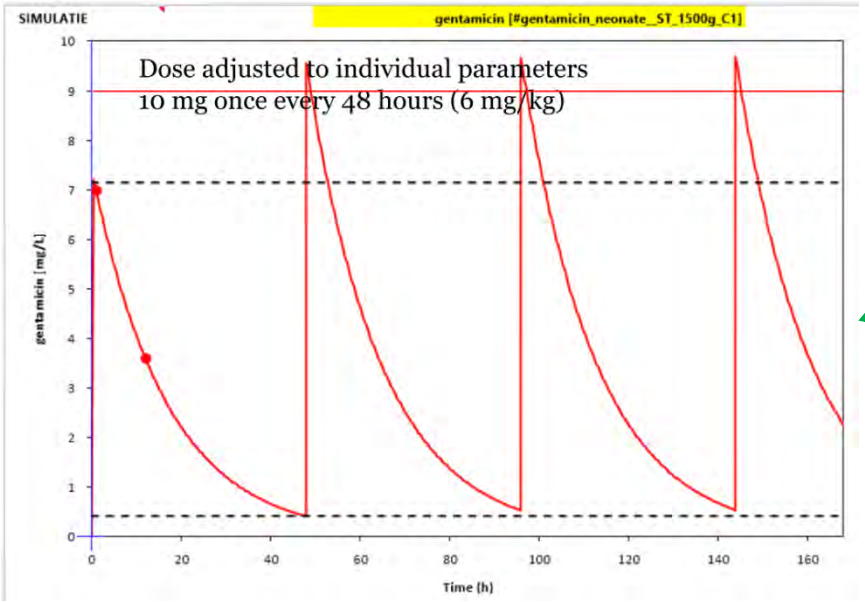
Expected higher Vd and lower clearance

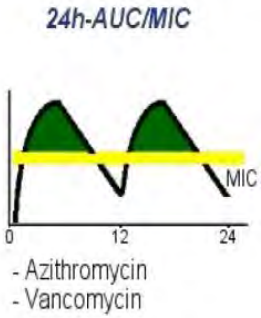
Expected lower peak and higher trough levels

Take samples immediately after dose and about 12 hours after dosing for dose optimisation


SIMULATIE
gentamicin [#gentamicin_neonate_ST_1500g_C1]
Population Parameters
With individual data
gentamicin [mg/L]
Time (h)


SIMULATIE
gentamicin [#gentamicin_neonate_ST_1500g_C1]
Population Parameters fitted to the individual data
Vd = 0.68 L/kg
gentamicin [mg/L]
Time (h)


SIMULATIE
gentamicin [#gentamicin_neonate_ST_1500g_C1]
Dose adjusted to individual parameters
10 mg once every 48 hours (6 mg/kg)
gentamicin [mg/L]
Time (h)



Case vancomycin

ICU patient (female, 63 y/o, 80 kg, 1.75 m, creatinine 180 micromol/L), catheter related infection, treated with vancomycin, 2000 mg/day continuous infusion, start 13.00.

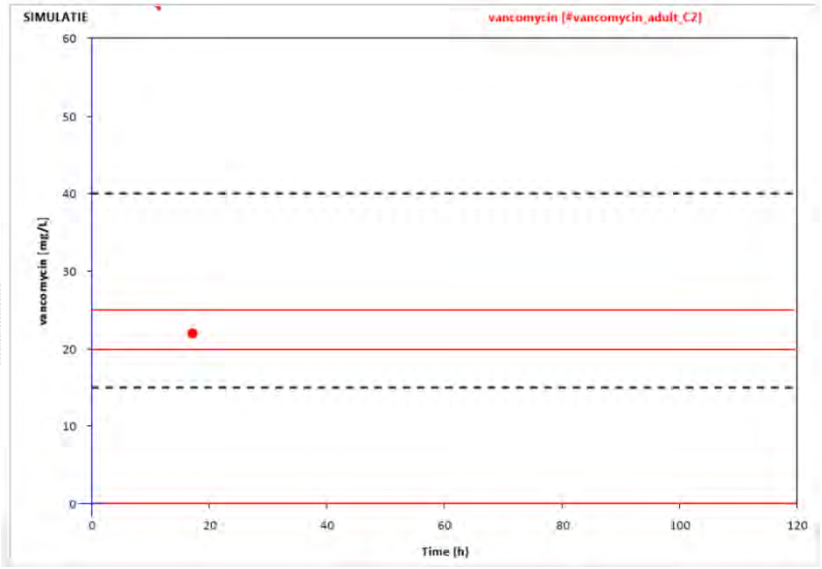
Next day, a sample is drawn at 06.00 and the vancomycin concentration is 22 mg/L (based on AUC>400 mg*h/L target is 18-25 mg/L)

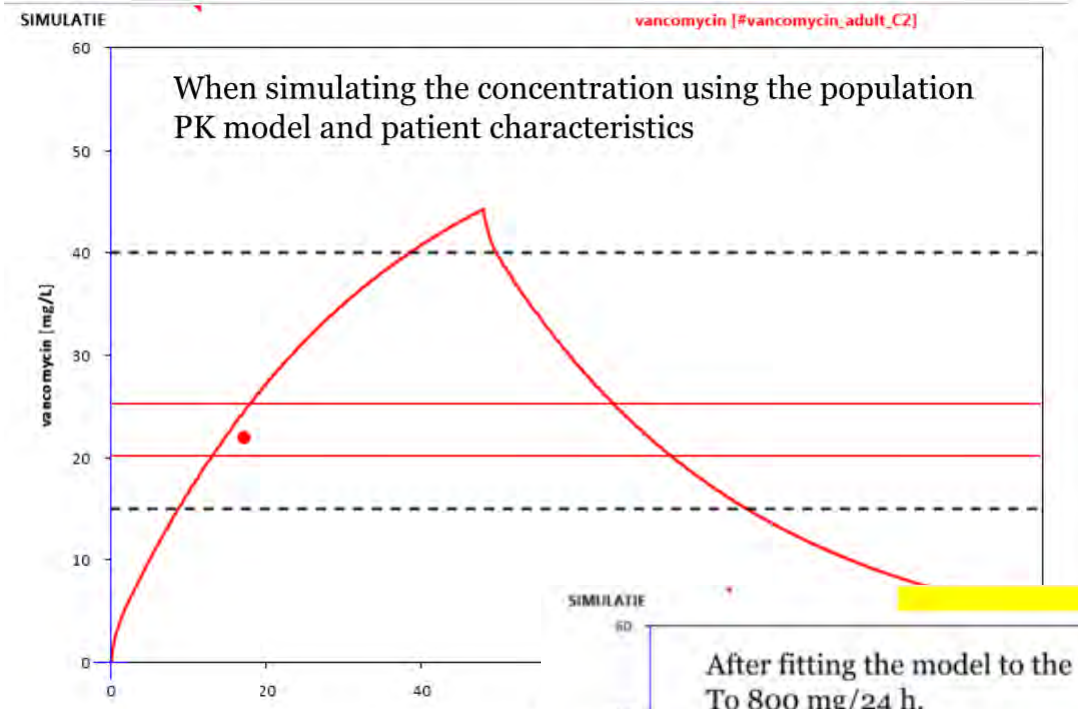
What is your opinion:

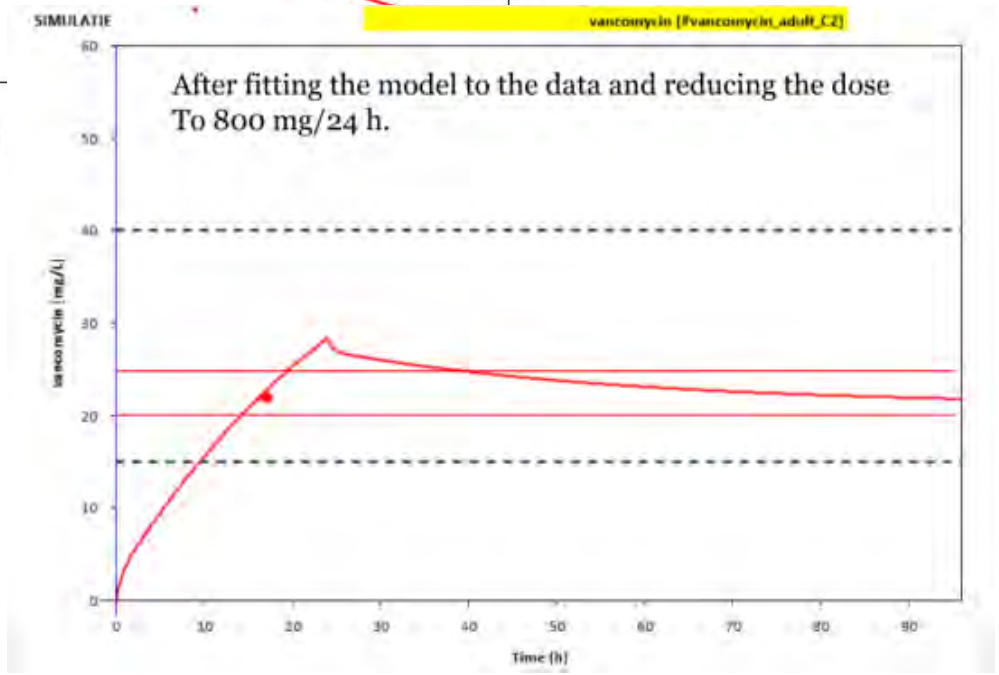
A) Dose is fine

B) Dose is too low

C) Dose is too high




SIMULATIE
vancomycin [#vancomycin_adult_C2]
When simulating the concentration using the population PK model and patient characteristics
vancomycin [mg/L]
60
50
40
30
20
10
0
0
20
40


SIMULATIE
vancomycin [#vancomycin_adult_C2]
After fitting the model to the data and reducing the dose To 800 mg/24 h.
vancomycin [mg/L]
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
Time (h)

Case flucloxacillin

ICU patient (male, 63 y/o, 80 kg, 1.80 m, creatinine 89 micromol/L, albumin 40 g/L) is treated with flucloxacillin because of an infectious endocarditis, **MIC of the infecting micro-organism is 2 mg/L**

Initial dose is 12000 mg/day as continuous infusion

Do you measure a level?

A) No, level is OK

B) Yes, level may be too high

C) Yes, level may be too low

Case flucloxacillin

Flucloxacillin

Vd = 0.25v L/kg

Half life = 1 h

Cstst = (F*D/T) * 1,44 * $T_{1/2}$/Vd

Cstst = 12000/24 * 1.44 * 1/(0.25 * 80)

Cstst = 500 * 1.44 * 1/20 = 36 mg/L

Seems OK ?

Case flucloxacillin

ICU patient (male, 63 y/o, 80 kg, 1.80 m, creatinine 89 micromol/L, albumin 40 g/L) is treated with flucloxacillin because of an infectious endocarditis, **MIC of the infecting micro-organism is 2 mg/L**

Initial dose is 12000 mg/day as continuous infusion

Do you measure a level?

A) No, level is OK

B) Yes, level may be too high

C) Yes, level may be too low

Case flucloxacillin

Flucloxacillin

Vd = 0.25 L/kg, half life = 1 h

Cstst = (F*D/T) * 1,44 * $T_{1/2}$/Vd = 36 mg/L

Protein binding is 95%

Free concentration is 0.05 * 36 = 1.8 mg/L

So yes, because level may be too low.

Case flucloxacillin

ICU patient (male, 63 y/o, 80 kg, 1.80 m, creatinine 89 micromol/L, **albumin 20 g/L**) is treated with flucloxacillin because of an infectious endocarditis, MIC of the infecting micro-organism is 2 mg/L **and the patient shows twitches**

Initial dose is 12000 mg/day as continuous infusion

Do you measure a level?

A) No, level is OK

B) Yes, level may be too high

C) Yes, level may be too low

Case flucloxacillin

Flucloxacillin

Vd = 0.25 L/kg, half life = 1 h

Cstst = (F*D/T) * 1,44 * $T_{1/2}$/Vd = 36 mg/L

Patient suffers from hypoalbuminemia

Free concentration is increased

Patient may develop neurological side effects

So yes, because level may be too high

Erkrankungen des Nervensystems
Sehr selten: Nach hohen Dosen parenteraler Anwendung sind vor allem bei niereninsuffizienten Patienten neurologische Störungen mit Konvulsionen möglich.

[Swissmedicinfo]

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Persönliches Fazit / Highlights

- Komplexität des TDM Prozesses
- TDM als interessantes Wirkungsfeld für Pharmazeuten kennengelernt
- Weitere Verbesserung bereits bestehender Therapien durch TDM
- Kosteneinsparungen durch TDM
  (Verweis auf Workshop 9 “Business case” on implementation of TDM in hospital, u.a.)

Quiz

1. To calculate the loading dose (LD) we need to know:
   a) Rate of Absorption
   b) Rate of elimination
   c) Volume of distribution
   d) Area under the curve

2. To calculate the maintenance dose (MD) we need to know
   a) Time to reach the steady state
   b) Volume of distribution
   c) Clearance
   d) Rate of absorption

3. Indicate one of the main advantages of chromatographic methods over immunoassays
   a) Low sample volume
   b) Less time of analysis
   c) Less cost
   d) More sensitivity
   e) Minimum sample preparation

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Quiz

4. How long is the Post Antibiotic Effect or Post MIC Effect of an aminoglycosides?
   a) 2 hours
   b) 7 hours

5. Do modern TDM tools require steady state conditions for valid analysis and forecasts?
   a) Yes
   b) No

Quiz - Answers

1. To calculate the loading dose (LD) we need to know:
   a) Rate of Absorption
   b) Rate of elimination
   c) Volume of distribution
   d) Area under the curve

2. To calculate the maintenance dose (MD) we need to know
   a) Time to reach the steady state
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Quiz - Answers

4. How long is the Post Antibiotic Effect or Post MIC Effect of an aminoglycosides?
   a) 2 hours
   b) 7 hours

5. Do modern TDM tools require steady state conditions for valid analysis and forecasts?
   a) Yes
   b) No

Anhang I – Gesamtübersicht Präsentationen

1. Concept of therapeutic drug monitoring (TDM)
2. Practical consideration to TDM
3. Population pharmacokinetic analysis of TDM in optimising therapy
4. TDM and dose optimisation of antibiotics and antifungals
5. TDM and dose optimisation of antiepileptic and antipsychotic drugs
6. An overview of therapeutic drug monitoring software
7. TDM and dose optimisation of immunosuppressive and oncolytic agents
8. Workshop. Clinical cases on dose adjustments based on TDM of immunosuppressives and oncolytic agents
9. Workshop “Business case” on implementation of TDM in hospital
10. Workshop. Clinical cases on dose adjustments based on TDM of antibiotics and antifungals
11. Workshop. Clinical cases on dose adjustments based on TDM of antiepileptic and antipsychotic drugs

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Anhang II - Link zu Originalpräsentationen:

- PP / Videoaufzeichnung:

http://www.eahp.eu/events/academy/academy-seminar-2018-warsaw-poland/PresentationsS2