

Continuous monitoring of drug concentrations in situ - an opportunity for photonics technologies?

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Who am I?

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Physician by training

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Previously spent 17 years in Pharma Industry, Project Leader, Research Physician

Problem in need of solution

Pharmaceuticals that are used to treat life-threatening conditions....

- Are often toxic, i.e. overdose must be avoided
- Need to promptly achieve efficacious levels in relevant tissues

→ Choosing the right dosing regimen is critical!

→ Continuous monitoring of tissue concentrations would be of immense benefit and could facilitate automated control of ongoing drug administration

Could application of photonics technology offer a solution?



How is the problem handled today?

An initial dose is selected based on various patient related factors (e.g. age, gender, body weight, renal function)

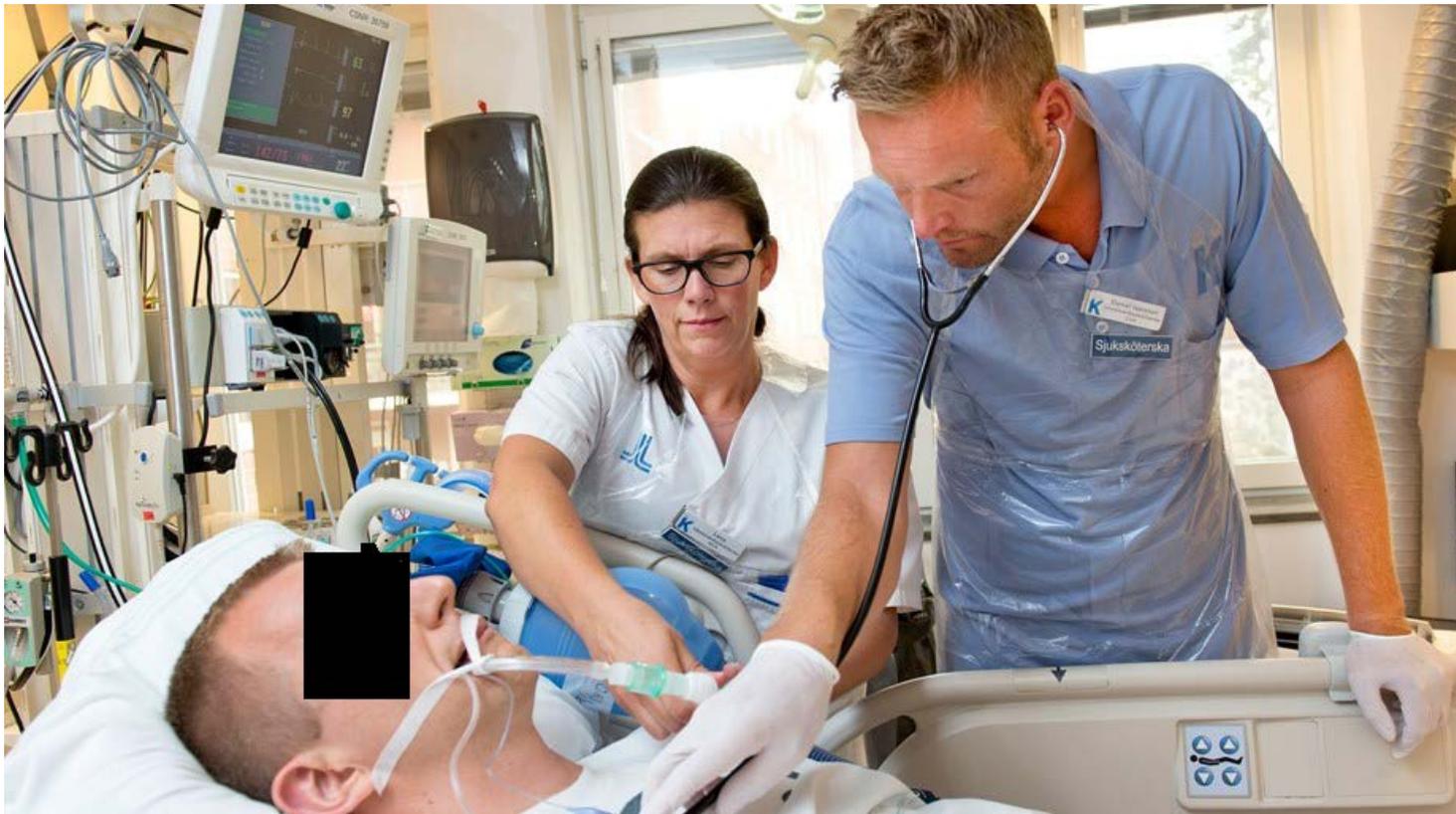
A blood sample is drawn (typically before the third dose is given)

The concentration is measured, analysis results often arrive after >3 hours

Depending on the results, the following doses are adjusted

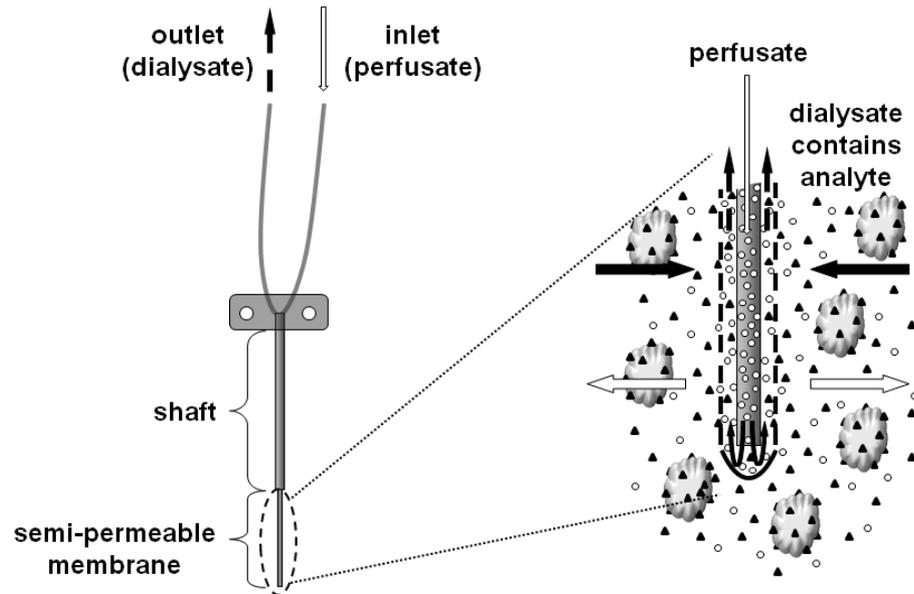
More sophisticated variants to this use modelling and simulation to calculate the anticipated concentration time-course in certain tissues and guide the adjustment of dosing regimen.

Application of mathematical models in Intensive Care patients is problematic due to rapid changes in organ function and physiology.



Source: <http://www.karolinska.se/om-oss/centrala-nyheter/2015/10/iva-arbetsvaxling/>

Microdialysis is sometimes used to measure *in situ*



Source: <https://en.wikipedia.org/wiki/Microdialysis>

Challenges with microdialysis:

- Permeability through membrane
- Efficiency varies
- Absorption to probe/tubing
- Dialysis per se affects concentration
- Turn-a-round time for analysis

Photonic ideas/questions

An optical fiber inserted into target tissues and application of spectroscopic methods for continuous measurement of drug concentrations *in situ*

Base line (zero) measurements can be made before the drug is given the first time

Certain toxic drugs (e.g. chemotherapeutics) are fluorescent

Can fluorescence spectroscopy be used via an optical fiber to measure their concentrations?

Many drugs have characteristic FTIR spectra. Within process chemistry the use of Michelson interferometers can obtain data of crude mixtures in chemical reactors.

Can FTIR spectroscopy be used via an optical fiber to obtain quantitative data of drugs in tissues of a patient?

Is it feasible?

Are spectroscopic methods sensitive enough?

Concentrations are often in the order of milligrams per liter, or less.

Any other photonics technologies that could be used?