

Objective medication adherence calculator – a tool to aid patient adherence and optimise drug dosage

A novel data-driven method for adherence and dosage calculations

Background:

The need for a reliable adherence measure

Assessing adherence to medication is an essential element in the ongoing treatment of patients with chronic disease as well as in the development and trialling of new drugs. In a clinical setting, any attempt to determine the effectiveness of a medication on an individual patient can be hopelessly confounded by a lack of accurate adherence information, potentially leading to inappropriate or over-prescription.

The current standard methods of adherence assessment are known to be inadequate, being either entirely subjective - e.g. patient self-report (SR) - or reliant on heavily biased proxy measures such as prescription refill rate (PR). As a result, standard assessments provide at best an upper-bound on actual adherence, and often bear little relation to patient behaviour.

over the course of treatment, with no information on when, or indeed if, these doses were taken. The recent development of numerous electronic monitoring devices presents a possible solution to this problem. However, to take advantage of the rich data obtained from these devices, we require novel statistical techniques.

Applications

Objective Adherence Assessment

Beginning with data from INCA™, an electronic monitoring device for inhalers developed at RCSI, we have derived a model-based and data-driven approach to adherence calculations. **The resulting method can be applied to any medication whose use is electronically monitored.**

Our novel algorithm combines monitoring data with clinical measures of patients' wellbeing to model the relationship between dose-timing, drug concentration, and health. This gives a functional measure of adherence based on the level of effective treatment actually received, which is not subject to bias due to erratic use or over-dosing.

Comparison with other methods

	Our method	Self-report	Prescription refill rate
Unbiased	✓	✗	✗
Objective	✓	✗	✓
Accounts for timing	✓	✗	✗
Accounts for technique	✓	✗	✗
Predictive of outcomes	✓	✗	✗

Optimised dosage calculation

Joint modelling of dose-timing and outcome data allows us to simultaneously assess a patient's adherence, and model the drug concentration needed to maintain optimal health.

As a result we can explicitly calculate the dosage needed to effectively treat a particular condition or patient cohort. With the growing use of electronic monitoring of medication, this presents a great opportunity for the development of personalised treatment plans for chronic disease.

A selection of recently developed timing devices for medication adherence. Our method is applicable to any programme of medication which can be accurately timed.



Top: The INCA™ device for inhaler adherence (Jointly developed by RCSI and TCD)

Middle: The Bee+™ Insulin Tracker (Vigilant Inc)



Bottom: The Philips Medido™ pill dispensing system.



While the effectiveness of a treatment generally depends on the precise timing and spacing of doses, standard adherence assessments typically rely on crude estimates of the number of doses received