Medimate Mini-lab Lithium validation results part 3
Patient self-test at home

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Introduction

Lithium is globally used to treat and prevent manic or depressive episodes in bipolar disorder. The drug has a small therapeutic window, and is in potention a toxic substance. Since the difference between therapeutic window and a toxic concentration is small, close monitoring of the lithium concentration is necessary.

The Medimate Minilab makes it possible to assess the lithium concentration in serum as well as fingerstick whole blood. The system is suitable for professional and self test use.

The Medimate Minilab combines a measurement apparatus called the Multireader and a disposable cartridge called the lab-chip. A measurement is performed after applying the sample at the lab-chip and inserting the lab-chip into the Multireader. The device detects the lab-chip and performs the measurement. After 9 minutes the Multireader displays the measured lithium concentration, see Figure 1.

The test results are part of an extensive validation study approved by the Medical Ethical Committee Twente in the Netherlands with reference number: NL34961.044.10

The objective of the study was to investigate the performance of the Medimate Minilab when used at home by a patient.

Figure 1: Photo of Medimate minilab measurement steps. 1. Perform fingerstick, 2. Apply blood droplet, 3. Insert Cartridge, 4. Readout result

Method

5 patients are requested to perform at 5 different days three measurements within an hour. The measurement is performed 10 hours after medication intake to minimize the influence on the measurement results by a changing lithium reference level in the patient. The test is performed according to EP15-A2.

To minimize stress and external influence it is chosen solely to focus on precision and not to perform reference measurement for accuracy information.

After receiving a training conform the normal procedure the patient obtains a Medimate Minilab package consisting of a Multireader and 20 lab-chips. Then the patient is requested to perform measurements at home. The patient is allowed to perform multiple measurements to get familiar with the system prior to start the official test. When the test is finished the measurement results are collected. The measurement results are written down by the patient on a form and independently stored in the Multireader. After the test the measurement data is verified by comparison of both data sets.

Acceptance criteria

To show that the measurement results meet the performance criteria of 0,15 mmol/l or 15% for fingestick a precision budget of 0,117 mmol/l or 11,7% with a 95% confidence interval is chosen. Measurement results are evaluated against this precision budget. In this case the standard deviation should be less than half the precision budget.

Results & discussion

The individual test results are shown in Figure 2. Each measurement result is within the precision limits.

Table 1 states the measurement data analysis results where the mean per patient over 5 days is shown as well as the number of measurements and residual evaluation.

Outliers are detected based on a difference of lithium outcome larger than 0,20 mmol/l or 20% from the mean of the two other outcomes. Test results showed no outliers.

100% of the measurement results are within the 95% specification boundary indicating that the acceptance criteria are met.

Patient 5 performed the fourth measurement day after 1½ hour after medication intake, instead of the minimum 10 hours as is stated in the protocol. This caused measurement results of 1,52 1,40 1,29. The variation observed is expected to come from changing level in the blood during the test period. The measurement results are for this reason rejected from analysis.

The observed standard deviation is approximate a factor two better than is allowed. This can be explained by reduction of stress of the patient during the measurement and by reliability improvements of the Minilab made by Medimate, as result of a continuous effort to improve the product.
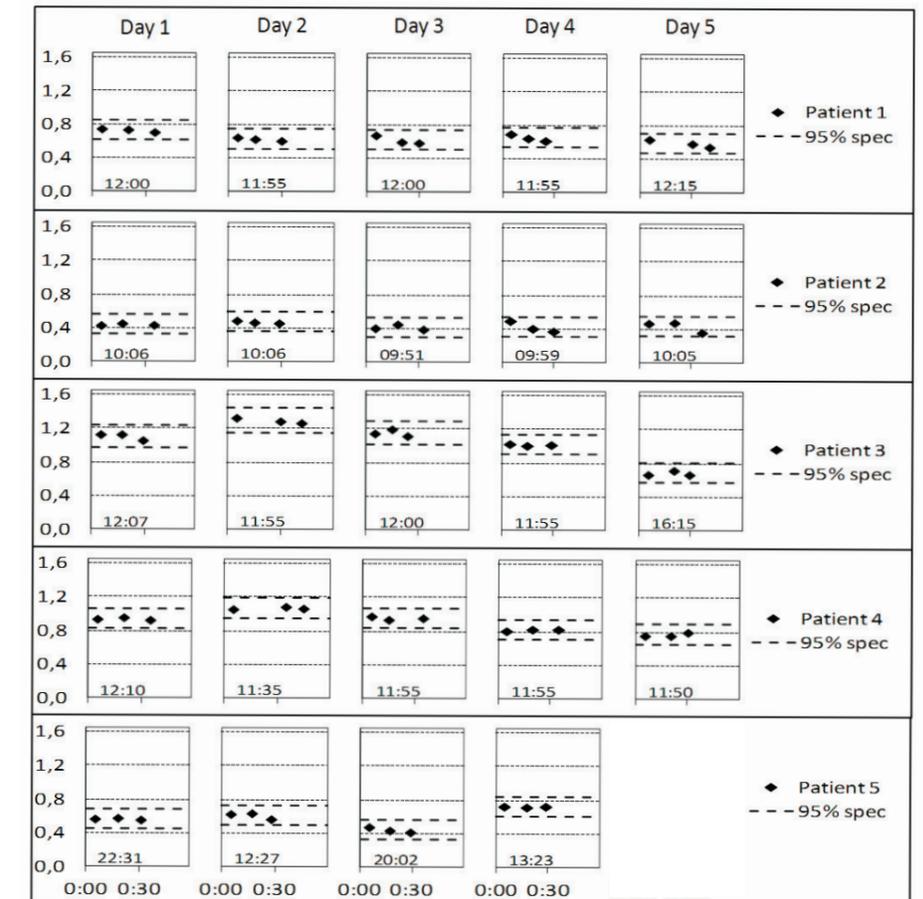

Figure 1: Patient test results at home. For each patient 5 measurement days with each three measurements are plotted horizontally. X-axis: time [h:min], Y-axis: lithium [mmol/l] Medimate Minilab.

	Mean	Measure-ments	Min dif	Max dif	Pooled stdev	Pass criteria	Evaluation	BIN results %		
	mmol/l	#	mmol/l	mmol/l	mmol/l	mmol/l	Pass/No pass	< 0,06	< 0,12	> 0,12
Patient 1	0,65	15	-0,04	0,06	0,035	0,067	Pass	93	100	100
Patient 2	0,44	15	-0,07	0,07	0,037	0,067	Pass	87	100	100
Patient 3	1,05	15	-0,05	0,04	0,030	0,071	Pass	100	100	100
Patient 4	0,91	15	-0,02	0,03	0,017	0,067	Pass	100	100	100
Patient 5	0,75	12	-0,04	0,03	0,021	0,067	Pass	100	100	100
Total	0,76	72	-0,07	0,07	0,028	n.a.	Pass	96	100	100

Table 1: Home test lithium analysis results. For each patient and each day the standard deviation is determined. The average of the standard deviation is the pooled standard deviation, which is evaluated versus the pass criteria. The BIN results show the number of measurements as percentage within the interval in mmol/l.

Conclusions

Measurements show excellent results for home testing by patients. The acceptance criteria are met.