Storage conditions of insulin in domestic refrigerators and carried by patients: insulin is often stored outside recommended temperature range

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K. Braune1, L.A. Kraemer2, A. Zayani2, J. Weinstein2, L. Heinemann3;
1Department of Paediatric Endocrinology and Diabetes, Charité - Universitätsmedizin Berlin, Berlin, 2MedAngel BV, Nijmegen, Netherlands, 3Science & Co, Düsseldorf, Germany.

Background and aims: Not much is known about how patients with diabetes store their insulin in daily life. Objective of our study was to monitor temperature of refrigerated and carried insulin in industrialized countries to investigate how often storage conditions do not meet the manufacturers' recommendations regarding temperature range.

Materials and methods: Patients (n=338; 46% located in the US, 41% in the EU) put a total number of 400 temperature loggers (MedAngel ONE, Netherlands) next to their insulin into their refrigerator or diabetes bag. Temperature was measured every 3 min (up to 480 times per day). Measurements were automatically sent to an app and stored in a protected online database. Whenever temperature exceeded the recommended range (2-8°C for refrigerated insulin, 2-30°C when opened or carried as a spare), the user was notified by an alarm. Data was collected from Nov 2016 to Feb 2018 with an average protocol length of 49 days.

Results: A total number of 400 temperature logs from individual sensors were analyzed (230 for refrigerated, 170 for carried insulin). Deviations were found in 315 (78.8%) logs (230 (100%) refrigerated, 85 (50%) carried). For refrigerated insulin, temperature recorded by an average sensor was out of the 2-8°C range for 11.31% of the time (10.10%-13.10%; 2h43min per day) with an average deviation of 3.68K (SD 5.02K). For carried insulin, temperatures were out of 2-30°C range 0.54% of the time (0.48%-0.64%; 8min per day) with an average deviation of 1.11K (SD 1.24K). 16.5% of sensors measured temperatures below 0°C (57 for refrigerated, 9 for carried insulin).

Conclusion: Long-term storage conditions of insulin are known to have an impact on its blood-glucose lowering effect. These observational data showed that in a significant number of cases insulin was exposed to temperatures outside the recommended range, especially when refrigerated. Thus, domestic refrigerators may pose an underestimated risk for insulin quality. The extent of how temperature deviations in storage affect insulin efficacy and patient outcomes needs further systematic Investigation.

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