

OBSERVATIONS

# Can Trained Dogs Detect a Hypoglycemic Scent in Patients With Type 1 Diabetes?

In persons with type 1 diabetes (T1D), hypoglycemia is common and sometimes serious. Anecdotal reports suggest that dogs can detect hypoglycemia in their human companions. The current study was undertaken to assess whether dogs can detect hypoglycemia by scent alone.

**RESEARCH DESIGN AND METHODS**—The study was approved by the Human Institutional Review

Board and the Animal Care and Use Committee at Legacy Research Institute (Portland, OR). Three patients with T1D were enrolled (age 25–57 years; duration of diabetes 2–21 years; none were hypoglycemic unaware). These people were unfamiliar to the dogs that were studied. For each of two hypoglycemic periods (capillary blood specimens  $\leq 60$  mg/dL), each subject collected two sterile cotton swab samples by rubbing them on the skin of both arms. Additional samples were collected during two normoglycemic episodes (capillary glucose 100–150 mg/dL). This procedure was chosen because the dog-training organization affiliated with one of the authors used this method to train dogs to respond to hypoglycemia in their human companions. The three adult dogs used in this study had been trained to respond to hypoglycemia by pressing a bell after sniffing the open-capped container with the hypoglycemic swab. Each of these dogs had been placed in the home of a person

with T1D. The owners and trainer believed that the dogs chosen for this study were consistently able to detect hypoglycemia in the home.

Investigators were blinded to sample identity. Each dog was tested with each of the 24 samples by presenting the sample to the animal for 30–45 s. An alert was recorded by a blinded investigator if the dog activated the bell.

**RESULTS**—Results are presented in Table 1. The values for sensitivity, specificity, and percent of samples that were correctly identified were each  $\sim 50\%$ . We considered the possibility that volatile compounds may have already evaporated during later tests. However, the first test was not more accurate than later tests.

**CONCLUSIONS**—Trained dogs were largely unable to identify skin swabs obtained from hypoglycemic T1D subjects. We chose to test with skin swabs because 1) dogs are well known to respond to scents carried on human skin (1) and 2) the trainers had reported success with this method in training the animals to respond to hypoglycemia. To our knowledge, this is the first controlled study to address whether dogs can detect a hypoglycemic scent, though there are anecdotal and case reports suggesting that dogs can respond to hypoglycemia (2–4). Our results addressed only whether there is a detectable hypoglycemia scent on the skin. In future studies, it may be helpful to include behavioral elements, such as studies in the presence of human companions. It might also be helpful to obtain swabs from the usual human companions of the dogs. We found that trained dogs were unable to correctly identify skin swabs obtained during hypoglycemia in subjects with T1D. Further studies are needed to address the role of other factors that the animals might use, such as behavioral cues.

Table 1—Human data and canine results

| Sample no. | Glucose (mg/dL) | Test order | Human subject         | Dog 1 | Dog 2 | Dog 3 |
|------------|-----------------|------------|-----------------------|-------|-------|-------|
| 1          | 47              | 20         | 1-male                | Y     | N     | Y     |
| 2          | 47              | 6          | 1-male                | Y     | Y     | Y     |
| 3          | 58              | 12         | 1-male                | N     | N     | Y     |
| 4          | 58              | 5          | 1-male                | N     | N     | Y     |
| 5          | 125             | 9          | 1-male                | N     | Y     | Y     |
| 6          | 125             | 8          | 1-male                | Y     | N     | Y     |
| 7          | 130             | 4          | 1-male                | N     | N     | Y     |
| 8          | 130             | 2          | 1-male                | Y     | Y     | N     |
| 9          | 56              | 19         | 2-female              | N     | Y     | N     |
| 10         | 56              | 14         | 2-female              | Y     | Y     | Y     |
| 11         | 57              | 23         | 2-female              | N     | Y     | Y     |
| 12         | 57              | 15         | 2-female              | Y     | N     | N     |
| 13         | 119             | 10         | 2-female              | Y     | N     | Y     |
| 14         | 119             | 22         | 2-female              | Y     | N     | N     |
| 15         | 112             | 16         | 2-female              | N     | Y     | N     |
| 16         | 112             | 18         | 2-female              | Y     | Y     | Y     |
| 17         | 56              | 21         | 3-male                | N     | Y     | N     |
| 18         | 56              | 11         | 3-male                | Y     | Y     | N     |
| 19         | 59              | 17         | 3-male                | N     | N     | Y     |
| 20         | 59              | 3          | 3-male                | Y     | Y     | N     |
| 21         | 128             | 24         | 3-male                | N     | N     | Y     |
| 22         | 128             | 13         | 3-male                | N     | N     | N     |
| 23         | 101             | 1          | 3-male                | N     | N     | Y     |
| 24         | 101             | 7          | 3-male                | N     | Y     | N     |
|            |                 |            | Percent correct, each | 54.2  | 58.3  | 50.0  |
|            |                 |            | Percent correct, all  |       | 54.2  |       |
|            |                 |            | Sensitivity, each dog | 50.0  | 58.3  | 58.3  |
|            |                 |            | Sensitivity, all      |       | 55.5  |       |
|            |                 |            | Specificity, each dog | 58.3  | 58.3  | 41.7  |
|            |                 |            | Specificity, all      |       | 52.8  |       |

N, no alert; Y, alert.

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permission, carried out the animal study, analyzed the data, and wrote the manuscript. K.T. trained the dogs and carried out the animal study. J.L.H., E.L., and K.H. played important roles in designing the human and animal study protocols. B.B. and A.J.A. carried out the animal study. W.K.W. obtained Human Institutional Review Board approval, supervised the human element of the study, carried out the animal study, analyzed the data, and wrote the manuscript. K.D. and W.K.W. are the guarantors of this work and, as such, had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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