Measuring, and determining factors affecting performance of glycaemic alert dogs

Nicola Rooney, Claire Guest, Clara Wilson & Steve Morant









Type I diabetes

1.25 million people in USA are currently living with Type 1 diabetes

Hypoglycaemia is a common side effect

- distressing
- presents risk of serious neurological & cardiovascular consequences

Some patients lose the early warning signs.

Fear of hypoglycaemia is very common especially night episodes, common cause of death.



Patients "running their blood sugars high" with associated health risks.



Medical alert dogs





Glycaemia alert dogs reported to vastly improve quality of life in people with diabetes.

Imperative real efficacy is assessed



Changes post-dog allocation

CLIENT	low blood sugar	unconscious episodes	paramedic call outs
1	-	NEVER SINCE GETTING DOG	
2			DECREASED SINCE DOG
3a			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			

"Alerts" more likely to be outside the target range



Medical Model Detection Dogs

Initial pilot study

- first published demonstration
 - trained dogs perform above chance,
 - dogs afford improvements to client well-being.
- points to the potential value for
 - increasing glycaemic control,
 - client independence, quality of life,
 - reducing the costs of long-term health care.

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nvestigation co Clients wi dicola J. Rooney 🖬, Stev Published: August 7, 2013	n into the Value of th Type I Diabetes e Morant, Claire Guest • https://doi.org/10.1371/journal.pone	Trained Glycaem	nia Aler	rt Dogs	14,467 View
Article	Authors Metrics	Comments	Media Co	verage	Downloa Print
Abstract	Abstract				
Introduction Methods	Previous studies have sugges state. Here, we show that trai	sted that some pet dogs respond to th ned olycaemia alert dogs placed with	eir owners' hy clients living v	poglycaemic vith diabetes	Check
Analysis	afford significant improvemen reliably respond to their owne	ts to owner well-being. We investigat rs' hypoglycaemic state, and whether	ed whether tra	ined dogs ience	. (A) -
Results	facilitated tightened glycaemi	c control, and wider psychosocial ben	efits. Since ob	taining their	O
Discussion	outs, decreased unconscious	episodes and improved independent	e. Owner-reco	orded data	
Acknowledgments	snowed that dogs alerted the low and high blood sugar. Eig	r owners, with significant, though vari ht out of the ten dogs (for which own	able, accuracy ars provided a	dequate	Cogni
References	records) responded consister be outside, than within, target	tly more often when their owner's blo range. Comparison of nine clients' ro	od sugars wer outine records	e reported to showed	Neuro
Reader Comments (1) Media Coverage (0)	significant overall change after higher proportion of routine te small, non significant reductio shown, for the first time, that it points to the potential value o and consequent quality of life	er obtaining their dogs, with seven clie sts within target range after obtaining in after dog allocation. Based on own rained detection dogs perform above f alert dogs, for increasing glycaemic and even reducing the cost or finon-	ents recording a dog. HbA10 er-reported dar chance level. control, client term health ca	a significantly C showed a ta we have This study independence re.	
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Small sample



Largest study

30 dog-clients pairs

PLOS ONE

RESEARCH ARTICLE

How effective are trained dogs at alerting their owners to changes in blood glycaemic levels?: Variations in performance of glycaemia alert dogs

Nicola J. Rooney. 1.2+, Claire M. Guest², Lydia C. M. Swanson², Steve V. Morant.

1 Animal Welfare and Behaviour Group, Bristol Veterinary School, University of Bristol, Bristol, United Kingdom, 2 Medical Detection Dogs, Greenway Business Park, Mitton Keynes, United Kingdom 3 Medicines Monitoring Unit, University of Dundee, Dundee, United Kingdom

Nicola Rooney @bristol.ac.uk

Abstract

Aims

OPEN ACCESS

Citation: Rooney NJ, Guest CM, Swanson LCM. Morant SV (2019) How effective are trained dogs at alerting their owners to changes in blood glycaemic levels? Variations in performance of pycaemia alert dogs. PLoS ONE 14(1): e0210092. https://doi.org/10.1371/journal.pone.0210092 Editor: Carolyn J. Walsh, Memorial University of Newfoundland, CANADA Received: May 30, 2018 Accepted: December 17, 2018

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Data Availability Statement: An anonymised data Results set is uploaded in the University of Bristol repository (10.5523/bris. 2b9v4onfieltos2nhdtosmatam#3

Funding: I can confirm that this research did not was carried out by the primary author during normal working hours, and by Steve Morant in a oluntary capacity. This research required no additional expenses. C Guest and L Swanson are

Domestic dogs are trained to a wide variety of roles including an increasing number of cal assistance tasks. Glycaemia alert dogs are reported to greatly improve the quality of owners living with Type 1 diabetes. Research into their value is currently sparse, or numbers of dogs and provides conflicting results. In this study we assess the reliability large number of trained glycaemic alert dogs at responding to hypo- and hyper-glycae (referred to as out-of-range, OOR) episodes, and explore factors associated with variation in their performance

Methods

Routine owner records were used to assess the sensitivity and specificity of each of 2 dogs, trained by a single UK charity during almost 4000 out-of-range episodes. Sensit and positive predictive values are compared to demographic factors and instructors' r of the dog, owner and partnership.

Dogs varied in their performance, with median sensitivity to out-of-range episodes at (25th percentile = 50, 75th percentile = 95). To hypoglycaemic episodes the median se ity was 83% (66-94%) while to hyperglyaemic episodes it was 67% (17-91%). The m Fandler: Laa contine that the instance do not incervia ary specific automitanti gampionia in the public, commercial or non-tar-prefit sectors. It when glucose levels were out of target range. For four dogs, PPV was 100%. Individu characteristics of the dog, the partnership and the household were significantly assoc with performance (e.g., whether the dog was previously a pet, when it was trained, wh its partner was an adult or child).

4197 OOR episodes



Rooney, Guest Swanson, Morant (2019) PLoS ONF



Medical detection dogs help diabetics regulate

insulin levels

UPER EARLY BIRD

Medical 🌆 **Detection Dogs**

Sensitivity - % out of range episodes alerted to

Specificity – positive predictive value (PPV)



Owner-reported data

Medical Detection Dogs

What is needed?

Owner-independent study





Continuous trace



Do dogs accurately alert their owners?

- Mean sensitivity to low blood glucose is 56%
 - (range 33.3% 91.7%).
- Mean PPV is 70%
 - (range 45.2% 92.9%).

in Veterinary Scie	Christen Histancer published 27 March 2019 PICCE star 10 January 400
	An Owner-Independent Investigation of Diabetes Alert Dog Performance
	Clara Wilson ¹ , Steve Morant ² , Sarah Kane ^{1,2} , Claire Pesterfield ⁴ , Claire Guest ⁴ and Nicola J. Rooney ¹⁴
	¹ Annul Wallan and Behavior Group, Brand Helenary School, Brank (Lhisd Alrahom, ¹ Maltrine Montong Lint (MEMD), School of Medicine, ¹ Ne University of Darobes, Davider, Delet Ringston, ¹ The Department of Biology Hambur Callege, Clinter, NY, Deleta States, ¹ Medical Danctine Dapp, Miller Keynes, Linked Ringston
	Objective: To quantify Diabetes Alert Dog (DAD) performance by using owner-independent measures.
	Research Design and Methods: Eight connexs of accredited DASs used a TresSilye Libre Riaht Glauces Monitoring System (FGMS), Concurrent Closed Circuit Stevision (ICTV) footage was caleted to between 5 and 14 days in each owner's home or workplace. The bodage was birth-coded to days' alariting between. The structure failer Positive Rule and Positive Pendiditive Values (PPV) dog's alart to out-of-maps
OPEN ACCESS	(OCR) episodes were calculated. Batings for 11 attributes describing participant's litestyle and compliance (taken from each dog's instructor) and the percentage of DAD alerts responded to by the owner as per training protocol (taken from CCTV locitage) were
Edited by: Lyradie Arnauri Hart	assessed for association with dog performance.
University of California, Davis, United States Reviewed Inc.	Results: Dogs alerted more often when their owners' glucose levels were outside vs. inside target range (hypoglycaemic 2.80-fold, p = 0.001; hyperglycaemic 2.29-fold,
Hani Yi Wang, Pundar University, University University	p = 0.005). Sensitivity to hypogycaemic episodes ranged from 33.3 to 91.7%, the mean was 55.9%. Mean PPV for OOR episodes was 69.7%. Sensitivity and PPV were
Queen's University Bufast,	associated with aspects of the dog and owner's behavior, and the owner's adherence to training protocol.
Convespondence: Convespondence: Nicola J. Roomy Nicola Roomy Renaula et al.	Conclusions: Owner-independent methods support that some dogs alert to hypo- and hyperglycaemic events accurately, but performance varies between dogs. We find that DAD performance is affected by trails and between of both the dog and owner.
Specially another This article was submitted to Astma Delwaves and Waltam, a sanchers of the poserod Providers in Velokinary Sciences	Combined with existing research showing the perceived psychosocial value and reduced ortical health care needs of DAD users, this study supports the value of a DAD as part of a diabetes care plan. It also highlights the importance of ongoing training and continued monitorists to ensure another electromance.
Received: 00 December 2018 Accepted: 05 Men/r 2019 Dublighed: 05 Men/r 2019	Kaywondic hypoglycaamia, hyporglycaamia, diabataa, akari, canina, bahavkor
Citation: Wilcon C, Morant S, Kana S,	INTRODUCTION
Patterfeld C, Guad C and Ronny NJ (2018) An Overar-Independent Investigation of Diabetes Alert Dog Performance: Proc. Vet. Sci. 8:91. doi: 10.3388/vete.3018.20091	There are an estimated 4.6 million people in the United Kingdom living with diabetes (1). Of those, =000,000 are currently living with Type 1 diabetes, the incidence of which is increasing by around 4% cated year (2). Whother extranous intuil intervention, bloed glucoue levels are susceptible to becoming too high (hyperglycarmia) or too low (hypoglycarmia). This results from

Wilson, Morant, Guest Kane, Rooney 2019 *Frontiers in Veterinary Sciences*

Confirmed dogs perform role via owner-independent measures



Differences between OOR and IR

When out of range greater variability in: Playing with Owner, Jump Up, Sniff Owner, Bark, Paw Owner, Lick Owner

Individual dogs showed distinctive behaviours

Attention-seeking, Locomotion/Standing, Playing with Owner Yawning Licking Lips.



Wilson, Morant, Guest Kane, Rooney submitted *Applied Animal Behaviour Science*

Medical Model Detection Dogs

Partnerships varied in performance



Specificity



Which factors affect performance?



Which factors affect performance?

Features of household

Dogs in busy households

more likely to false alert

Partnered with a child

more likely to miss OOR episodes less likely to false alert

Owner attitude and behaviour

Dogs missed fewer episodes if owners rated higher for:

Communication with Instructor Willingness to Reward their Dogs Confidence in the Dog's Ability





Which factors affect performance?

Features of dog

Missed fewer episodes if

more motivated/ enjoying task higher strength of indication more willing to try new behaviours and "get it wrong"



What's next?



Sharyn Bistre (PhD student)

perform	ance		letection	i aog		
Required						
Ideal Medica	I Detection	n Dog				
In this section, a ra detection tasks, wi IDEAL dog used fo high as possible (1 For example, if you should choose 1 (inge of 40 diffe ill be presented r the discipline 5), High (4), Inte a consider that As low as poss	erent individu i to you. Plea you work in ermediate (3 your ideal di ible) for 'Ter	al traits, potentially see indicate the leve would have. Please), Low (2), As low as og would never be d idency to be distrac	important f l of each tra use the sc possible (1 istracted wi ted when w	for medical ait you think the ale of 1 to 5: A 1). hen working you orking'.	
A) Ideal level	levels of each trait *					
	1. As low as possible	2. Low	3. Intermediate	4. High	5. As high as possible	
Aculty of sense of smell - sharpness of nose	0	0	0	0	0	
Tendency to search by smell alone	0	0	0	0	0	
Tendency to investigate humans by sniffing	0	0	0	0	0	
Tendency to explore areas by sniffing	0	0	0	0	0	
Level of motivation when working	0	0	0	0	0	
Willingness to						

Can we predict differences in dogs prior to training?

Important traits

- Reward preferences
- Human directed behaviour

Medical 🌆

Detection Dogs

 Willingness to try new behaviours



How do they do it?

Thermal desorption gas-chromatography time-of-flight mass spectrometry (TD-GC-MS-TOF)







Differences in odour profiles with glycaemic state

5 compounds needed to detect hypoglycaemia, (Wheatstone 2017).



What about dog-child partnerships?















Addison's crisis alert dog



PoTs syndrome



Postural Tachycardia Syndrome





Thank you for your attention!



Medical Model Detection Dogs



