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ORIGINAL RESEARCH

# Healthcare Professionals' Knowledge of and Attitudes Towards the Use of Time in Range in Diabetes Management: Online Survey Across Seven Countries

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## ABSTRACT

***Introduction***: Time in range (TIR) is a metric of glycaemic target management derived from continuous glucose monitoring (CGM) data. This study aimed to understand knowledge of and attitudes towards use of TIR among healthcare professionals (HCPs), and gain insights into benefits and barriers to its use in clinical practice.

***Methods***: An online survey was disseminated across seven countries. Participants were sampled from online HCP panels and were aware of TIR (defined as amount of time in, below, and above target range). Participants were HCPs classified as specialists (SP), generalists (GP), or allied HCPs (AP; diabetes nurse specialists, diabetes educators, general nurses, nurse practitioners/physician assistants).

***Results***: Respondents included 741 SP, 671 GP and 307 AP. Most HCPs (approximately 90%) agreed TIR is likely/somewhat likely to become the standard of diabetes management. Perceived benefits of TIR included helping to optimise medication regimen (SP, 71%; GP, 73%; AP, 74%), giving HCPs the knowledge and insights to make informed clinical decisions (SP, 66%; GP, 61%; AP, 72%), and empowering people with diabetes with information to successfully manage their diabetes (SP, 69%; GP,

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77%; AP, 78%). Barriers to wider adoption included limited CGM access (SP, 65%; GP, 74%; AP, 69%) and lack of HCP training/education (SP, 45%; GP, 59%; AP, 51%). Most participants considered integration of TIR into clinical guidelines, recognition of TIR by regulators as a primary clinical endpoint, and recognition of TIR by payers as a parameter for diabetes treatment evaluation as key factors for increased use.

***Conclusions***: Overall, HCPs agreed on the benefits of using TIR for diabetes management. Besides raising awareness among HCPs and people with diabetes, more training and healthcare system updates are needed to facilitate increased TIR use. In addition, integration into clinical guidelines and recognition by regulators and payers are needed.

## PLAIN LANGUAGE SUMMARY

'Time in range' is the proportion of time in a day that a person's glucose level is within a particular range. The purpose of this study was to understand knowledge of and attitudes towards use of TIR among healthcare professionals. The study was carried out using an online survey and participants from seven countries were included. Participants were healthcare professionals classified as specialists (SP), generalists (GP), or allied healthcare professionals (AP; diabetes nurse specialists, diabetes educators, general nurses, nurse practitioners, or physician assistants). Overall, 1719 participants were included in the study. Most healthcare professionals (approximately 90%) agreed that time in range is likely/somewhat likely to become the standard of diabetes management. Participants reported the following benefits of time in range: helping to optimise medication regimen, giving healthcare professionals the knowledge and insights to make informed clinical decisions, and empowering people with diabetes with information to successfully manage their diabetes. The most common barrier to wider time in range adoption was limited access to continuous glucose monitoring (SP, 65%; GP, 74%; AP, 69%), followed by lack of healthcare professionals' training/education (SP, 45%; GP, 59%; AP, 51%). Most participants considered integration of time in range into clinical guidelines, recognition of time in range by regulators as a primary clinical endpoint, and recognition of time in range by payers as a parameter for evaluation of diabetes treatment as key factors for the increased use of time in range.

**Keywords:** Clinical practice; Continuous glucose monitoring; Diabetes management; Glycaemic management; Time in range

**Key Summary Points**

***Why carry out this study?***

Time in range (TIR) is a metric of glycaemic target management derived from continuous glucose monitoring (CGM) data and can be complementary to the data provided by glycated haemoglobin (HbA1c).

TIR can be a useful tool in diabetes management by providing actionable insights that can improve glycaemic target management.

This study aimed to understand knowledge of and attitudes towards the use of TIR among healthcare professionals (HCPs), and to gain insights into the benefits and barriers to its use in clinical practice.

***What was learned from the study?***

Overall, HCPs agreed on the benefits of using TIR for diabetes management, with approximately 90% agreeing that it is likely/somewhat likely to become the standard of diabetes management.

However, there are barriers to the wider adoption of TIR in clinical practice, including limited access to CGM for people with diabetes, and lack of training and education for HCPs.

Our results demonstrate the need for further HCP education and training on TIR, incorporation of TIR into clinical guidelines, and recognition by regulators and payers in order to increase and optimise the use of TIR in clinical practice.

Although most HCPs who use ambulatory glucose profile (AGP) reports indicated that they are very comfortable or comfortable interpreting them, a sizeable minority indicated that they are only somewhat or not comfortable, suggesting a potential need for more training on the interpretation of AGP reports.

## INTRODUCTION

The assessment of glycaemic target management is central to informing and directing good diabetes management [1, 2]. For several decades, the gold standard for monitoring long-term glycaemic stability and assessing the risk of diabetes-related complications has been glycated haemoglobin (HbA1c), which provides an average of blood glucose levels over approximately the last 120 days [3–5]. However, HbA1c does not provide information on the magnitude and frequency of intra- and inter-day blood glucose fluctuations, nor does it reflect the risk of acute hypo- or hyperglycaemic events [6]. Furthermore, HbA1c may be an unreliable measure of glycaemic stability and variability in individuals with conditions that affect red blood cell lifespan, e.g. anaemia or certain haemoglobinopathies [7], and can vary across different ethnicities, e.g. HbA1c is 0.4% higher in African American and Hispanic people than in Caucasian people for the same mean glucose concentration [8].

Continuous glucose monitoring (CGM) devices measure glucose levels within the interstitial fluid continuously over a 24-h period [9]. Therefore, CGM enables healthcare professionals (HCPs) and people with diabetes to view more comprehensive daily glucose profiles and better assess glycaemic variability [10]. Guidelines recommend real-time CGM (rt-CGM) or intermittently scanned CGM (is-CGM) in adults with diabetes on multiple daily injections or continuous subcutaneous insulin infusion for management of their diabetes [11]. The use of CGM is now increasing in many countries, but differences between countries still exist depending on healthcare systems and resources [12, 13].

Time in range (TIR), time above range (TAR), and time below range (TBR) are emerging glycaemic metrics based on CGM data and can be complementary to the data provided by HbA1c [6, 11]. Guidance on target glucose ranges and recommendations for time spent within these ranges have been provided by an International Consensus on Time in Range (IC-TIR) for different diabetes populations [14]. For the

majority of people with type 1 diabetes (T1D) or type 2 diabetes (T2D), > 70% of readings within the target range 70–180 mg/dl (3.9–10.0 mmol/l) and < 4% below 70 mg/dL are recommended [14].

TIR has previously been evaluated as an outcome measure for diabetes clinical trials and has been shown to correlate with risk of complications. A study published in 2019 by Beck et al. demonstrated that the mean TIR (70–180 mg/dl [3.9–10.0 mmol/l]) derived from 7-point self-monitored blood glucose (SMBG) profiles had a strong association with the risk of development of retinopathy and microalbuminuria, and with progression of retinopathy. Using public data sets from the Diabetes Control and Complications Trial (DCCT), the authors determined that the adjusted hazard rates for development of retinopathy progression and of microalbuminuria significantly increased by 64% (95% CI 51–78) and 40% (95% CI 25–56), respectively, for each 10%-point decrease in SMBG-derived TIR [15]. Several studies in which CGM data were used have demonstrated that lower TIR was associated with microvascular complications (presence of neuropathy, retinopathy, or nephropathy), and with hypoglycaemia or ketoacidosis [10, 14–17]. The use of TIR in clinical practice also offers the potential for a personalised approach to diabetes management [14, 18, 19].

To review implementation and optimise TIR use in clinical practice, it is important to understand current awareness and attitudes of HCPs to the metric. The aim of the current quantitative survey was to establish a benchmark for the current levels of knowledge and attitudes towards use of TIR among HCPs (specialists, generalists, and allied HCPs). In addition, we sought to survey the key drivers and barriers of using TIR in clinical practice with a view to identifying the support required for potential integration of TIR into clinical practice.

# METHODS

## Study Design

This quantitative survey involved disseminating an online questionnaire across seven countries (Brazil, Canada, South Korea, Spain, Sweden, UK, and the USA) between 17 November 2021 and 4 February 2022. The country selection was based on providing international generalisability and representing countries that have shown early adoption of technology and therefore moderate-to-high use of CGM [20]. The survey was designed by The Harris Poll in partnership with Novo Nordisk and an expert review panel. The survey was hosted by The Harris Poll on a secure website and took approximately 20 min to complete. All HCPs who completed the survey received honorarium for participation that was in line with the fair market value in each of the countries.

HCPs were identified through online panels and targeted by specialty; the overall sampling was managed by The Harris Poll. All panellists had opted into receiving survey invitations and had agreed to take part in online research. Once identified, HCPs were invited to a secure website or member portal via email to be screened and, if they qualified, to complete an online self-administered questionnaire. Each invitation contained a unique password-protected survey link to ensure anonymity and prevent participants from completing the survey more than once.

## Participants

To qualify for survey completion, participants had to have been in practice for at least 1 year, spend at least 70% of their time in direct patient care, and be aware of TIR as a metric for diabetes management. The 70% threshold for time in direct patient care was used to limit the proportion of HCPs who, although they may be knowledgeable about TIR, spend a considerable amount of time teaching and/or in academia. Participants in the study were HCPs classified as specialists, generalists, or allied HCPs. Classification was by participants self-identifying as part of the questionnaire and according to a

combination of different factors and responses to the screening questions (see Q1000 section of the questionnaire in the electronic supplementary material). Most specialists had their primary specialty in endocrinology or diabetology ('specialist' also included those whose primary specialty was family practice/general practice/primary care/internal medicine, who had a specialisation in endocrinology and saw at least 50 people with diabetes per month), and generalists had their primary specialty in family practice, general practice, primary care, or internal medicine and saw at least five people with diabetes. In Brazil and Sweden, cardiologists and geriatricians were classified as generalists, as they are often the first contact for people with diabetes with T2D. Allied HCPs were diabetes nurse specialists, diabetes educators, general nurses, nurse practitioners, or physician assistants and saw at least five people with diabetes. See Table S1 in the electronic supplementary material for the full criteria for each HCP subgroup.

### Survey Questionnaire

The survey captured characteristics of the participants, including years in practice (there was no upper limit for years in practice), location and setting of their practice, average duration of time spent in direct patient care, and number of people with diabetes seen per month. Statements regarding the importance, potential benefits, and impact of TIR, as well as barriers to adoption of TIR, were also included in the questionnaire, which is available in the online supplementary material. For the purpose of this study, people with diabetes were defined as adults aged $\geq$ 18 years with T1D or T2D, CGM was defined as rt-CGM (e.g. Dexcom G5 or G6, Guardian 3, Enlite, Eversense) or is-CGM (e.g. FreeStyle Libre 1, 2, or Pro), and TIR was defined as the amount of time spent in range, below range, and above range.

### Statistical Methods

Results were not weighted and are only representative of HCPs who participated in the study. Data were collected and analysed by HCP subgroup: specialists, generalists, or allied HCP, and statistical testing was performed to compare differences in responses between these subgroups. These differences were tested at the 95% level of confidence. The *t* test of means and *Z* test of proportions were used. No multiple comparison adjustments were made.

### Compliance with Ethics Guidelines

Participants provided consent to take part in the study and were given the option to waive confidentiality in the event of any safety or adverse event information reported to the sponsor's pharmacovigilance department. The study was performed in accordance with the Helsinki Declaration of 1964. This study adhered to the EphMRA Code of Conduct 2019, page 15, section 1.3.

## RESULTS

### Participant Characteristics

In total, 1719 participants were included in the study: 741 specialists, 671 generalists, and 307 allied HCPs. The profiles of the three HCP subgroups are presented in Table 1. In each HCP subgroup, the majority of participants were based at urban practices, with the proportion being slightly higher in the specialist subgroup (Table 1). A numerically greater proportion of generalists were based in rural practices compared with specialist or allied HCPs (Table 1). The mean number of years in practice was similar across the three HCP subgroups (17–-20 years) (Table 1).

### Current Perception of TIR

Approximately 90% of participants believed that TIR is very or somewhat likely to become the standard of diabetes management; this was

**Table 1** Characteristics of participants

| | **Specialists (*n* = 741)** | **Generalists (*n* = 671)** | **Allied HCPs (*n* = 307)** |
|---|---|---|---|
| Country, *n* (%) | | | |
| Brazil | 142 (19) | 100 (15) | 51 (17) |
| Canada | 92 (12) | 131 (20) | 50 (16) |
| South Korea | 100 (13) | 120 (18) | 50 (16) |
| Spain | 120 (16) | 101 (15) | 32 (10) |
| Sweden | 35 (5) | 29 (4) | 15 (5) |
| UK | 151 (20) | 50 (7) | 47 (15) |
| USA | 101 (14) | 140 (21) | 62 (20) |
| Practice location, *n* (%) | (*n* = 599) | (*n* = 571) | (*n* = 256) |
| Urban | 431 (72) | 357 (63) | 167 (65) |
| Suburban | 136 (23) | 146 (26) | 66 (26) |
| Rural | 32 (5) | 68 (12) | 23 (9) |
| Practice setting, *n* (%) | (*n* = 599) | (*n* = 571) | (*n* = 256) |
| Family/general/IM practice (single specialty) | 106 (18) | 448 (78) | 44 (17) |
| Endocrinology/diabetology practice (single specialty) | 179 (30) | 20 (4) | 45 (18) |
| Multi-specialty practice | 152 (25) | 71 (12) | 60 (23) |
| Hospital | 151 (25) | 21 (4) | 82 (32) |
| Community practice (UK only) | 9 (2) | 2 (0) | 13 (5) |
| Other | 2 (0) | 9 (2) | 12 (5) |
| Duration in practice, mean (SD), years | 17 (7) | 20 (9) | 18 (10) |
| Proportion of time spent in direct patient care, mean (SD), % | 90 (9) | 92 (9) | 87 (11) |
| Mean number of people with diabetes seen per month, *n* | | | |
| T1D | 54 | 16 | 38 |
| T2D | 198 | 141 | 106 |
| Mean proportion of people with diabetes using CGM, % | | | |
| T1D | (*n* = 735) | (*n* = 630) | (*n* = 292) |
| | 49 | 45 | 52 |
| T2D | (*n* = 739) | (*n* = 671) | (*n* = 307) |
| | 23 | 24 | 31 |
| T2D not taking insulin | (*n* = 739) | (*n* = 671) | (*n* = 307) |
| | 10 | 11 | 13 |

*CGM* continuous glucose monitoring, *HCP* healthcare professional, *IM* internal medicine, *n* number of participants, *SD* standard deviation, *T1D* type 1 diabetes, *T2D* type 2 diabetes

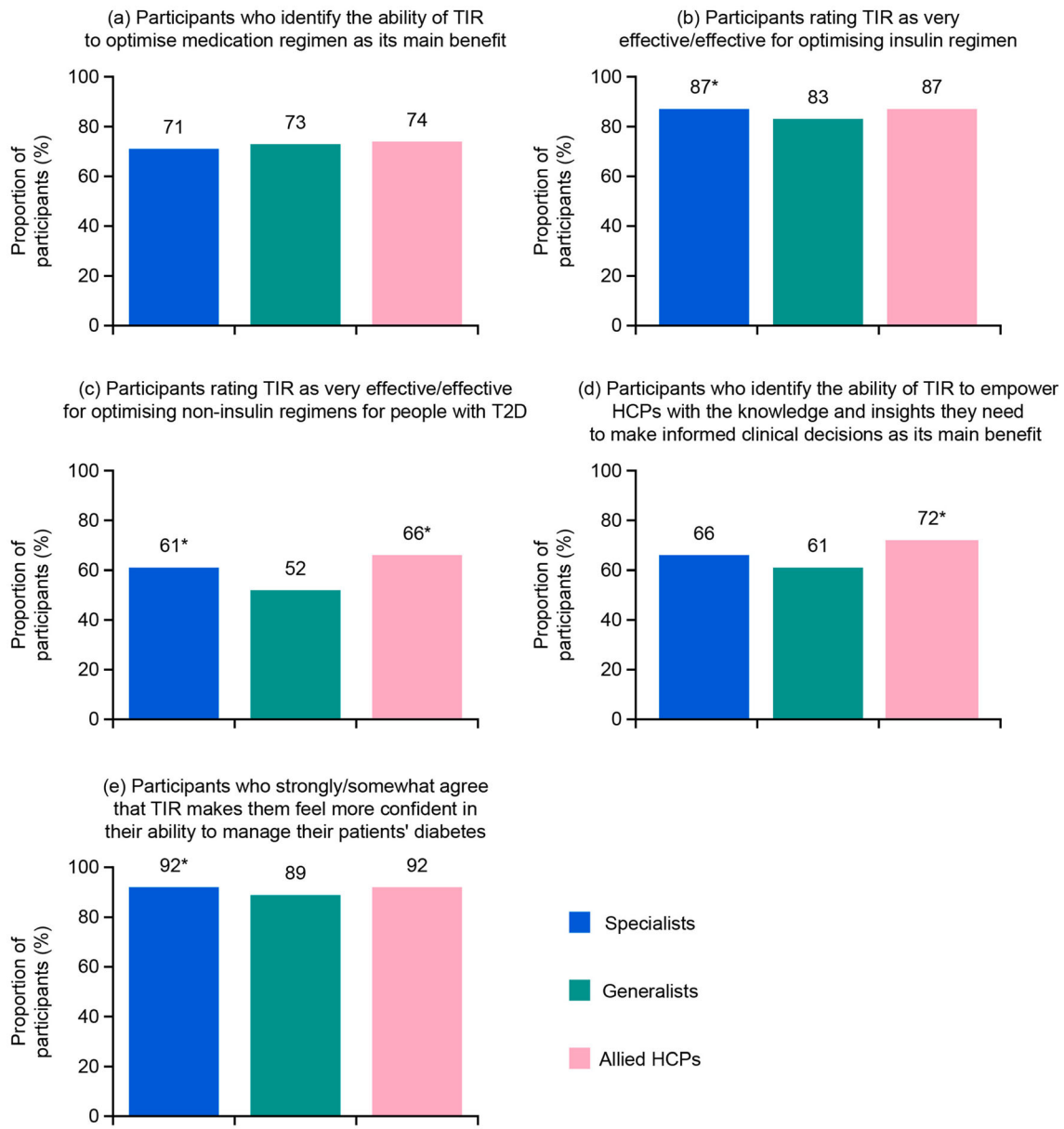


**Fig. 1** Value of TIR for clinical decision-making, as reported by HCPs. *$p < 0.05$ for difference versus generalists. *HCP* healthcare professional, *T2D* type 2 diabetes, *TIR* time in range

reported for specialists (93%; $p < 0.05$ vs. generalists), allied HCPs (96%; $p < 0.05$ vs. specialists and generalists), and generalists (87%).

Participants cited a range of benefits to using TIR for clinical decision-making. The ability to help optimise medication regimens was identified as a main benefit of using TIR by 71–74% of participants (Fig. 1). More than 8/10 participants reported finding the use of TIR very effective or effective for optimising insulin regimens, and at least one in two considered it very effective or effective for optimising non-insulin regimens for people with T2D, which was reported particularly among specialists and allied HCPs, compared with generalists ($p < 0.05$ for both comparisons) (Fig. 1).

At least 60% of participants reported the empowering of HCPs with the knowledge and

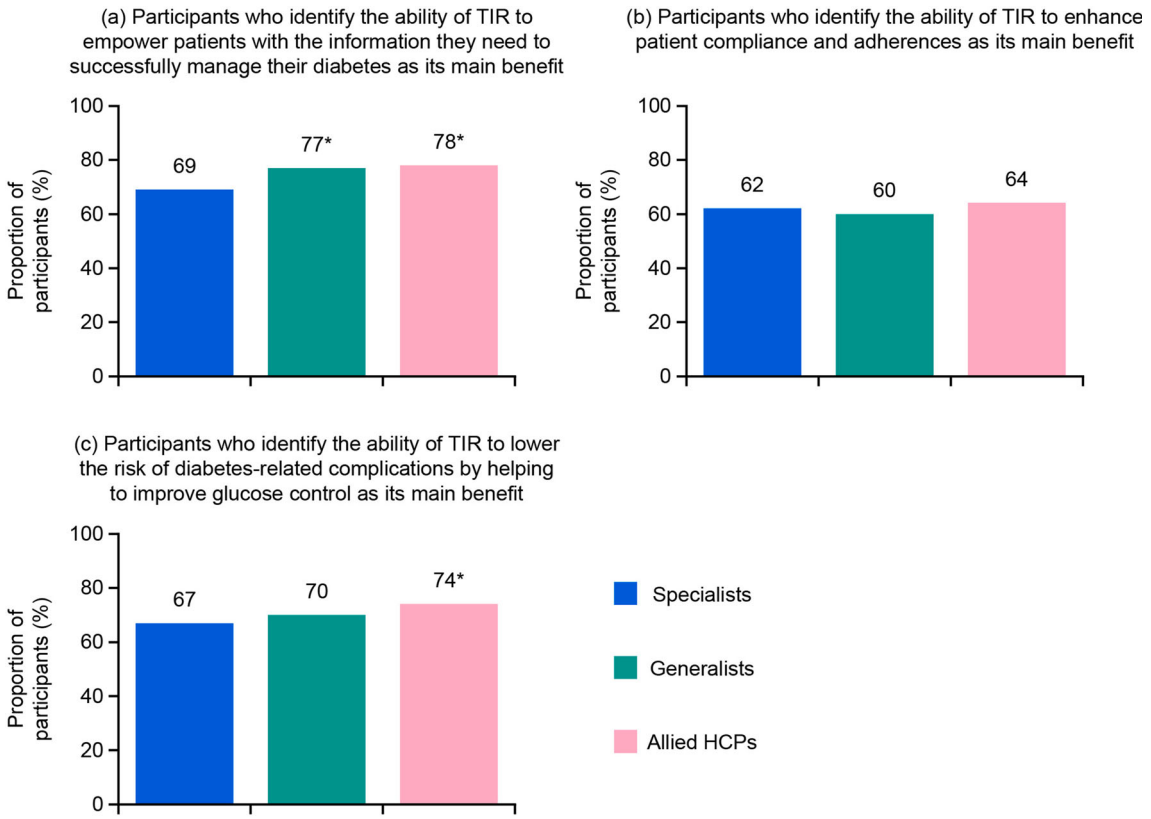


**Fig. 2** Value of TIR for empowering people with diabetes to manage their diabetes, as reported by HCPs. *$p < 0.05$ for difference versus specialists. *HCP* healthcare professional, *TIR* time in range

insights they need to make informed clinical decisions to be a main benefit of TIR, and approximately 90% strongly or somewhat agreed that it makes them feel more confident in managing people with diabetes (Fig. 1).

In addition to empowering HCPs, the majority of participants emphasised that TIR empowers the person with the information they need to successfully manage their diabetes, enhances their self-management, and lowers their risk of complications by helping to improve their blood glucose levels (Fig. 2). Empowering people with diabetes with information and lowering the risk of complications were reported as benefits by a greater proportion of allied HCPs than specialists ($p < 0.05$ vs. specialists) (Fig. 2).

TIR can be used as a tool to inform lifestyle modifications, with 76% of specialists, 73% of generalists, and 82% of allied HCPs ($p < 0.05$ vs. specialists and generalists) considering it to be very effective or effective (Fig. S1a in the electronic supplementary material). Furthermore, the majority of participants agreed that TIR allows people with diabetes to immediately see the direct impact of their actions (Fig. S1b). The majority of participants considered TIR to be very effective or effective in providing accurate information about hypoglycaemia, and strongly or somewhat agreed that TIR helps to reduce patient fear of hypoglycaemia and provides a more accurate and complete picture of glucose fluctuations than HbA1c (Fig. S1c, d).

From the perspective of at least half of the participants, TIR provides a more accurate and complete picture of glucose fluctuations than HbA1c, offers the benefit of facilitating more effective patient–physician dialogue, helps save time for both people with diabetes and physicians, and makes it easier to manage people

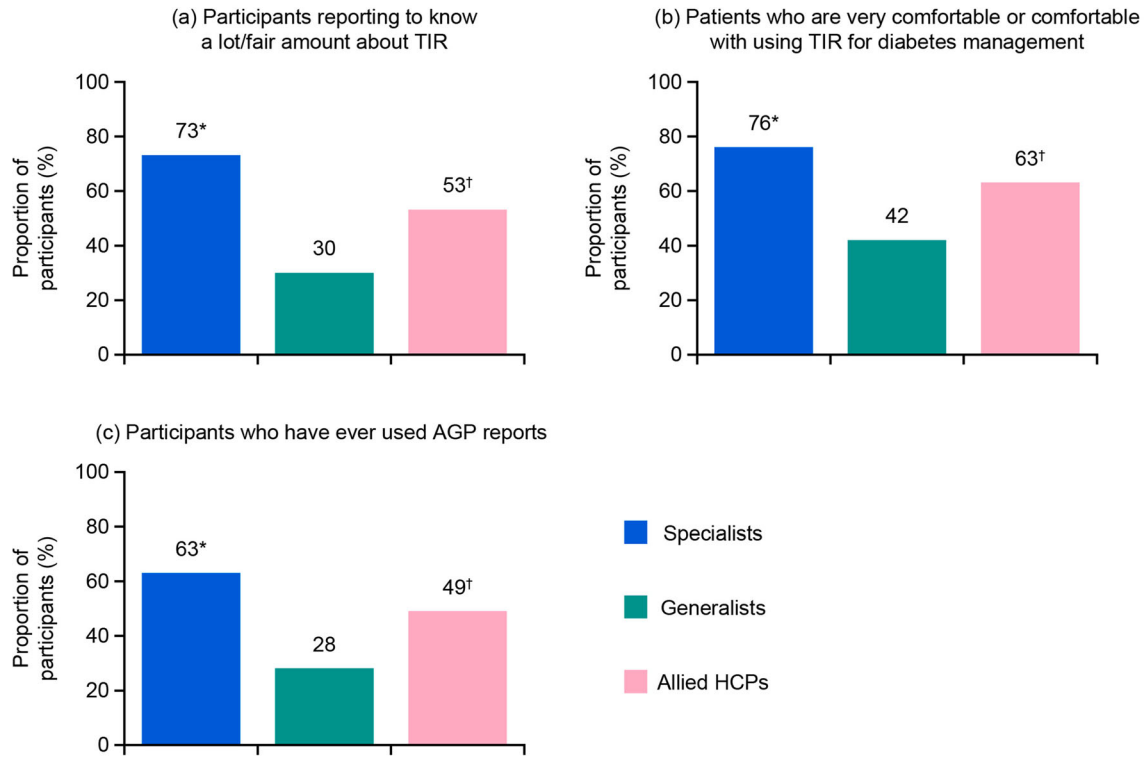


**Fig. 3** **a** Knowledge of and **b** comfort with using TIR, and **c** use of AGP reports, among participants. $^{*}p < 0.05$ for difference versus generalists and allied HCPs. $^{\dagger}p < 0.05$ for difference versus generalists. *AGP* ambulatory glucose profile, *HCP* healthcare professional, *TIR* time in range

with diabetes virtually (Fig. S1e–h). These benefits were reported by a greater proportion of allied HCPs than specialists and generalists.

## Current Knowledge and Use of TIR by HCPs

Knowledge and comfort with using TIR as well as use of ambulatory glucose profile (AGP) reports among participants were limited, particularly among generalists compared with specialists and allied HCPs (Fig. 3). The proportion of participants reporting that they were very comfortable/comfortable using TIR was 76% for specialists ($p < 0.05$ vs. generalists and allied HCPs), 42% for generalists, and 63% for allied HCPs ($p < 0.05$ vs. generalists).

## Training Requirements and Barriers to Adoption of TIR

Overall, 32% of specialists ($p < 0.05$ vs. generalists), 11% of generalists, and 35% of allied HCPs ($p < 0.05$ vs. generalists) reported receiving formal training or instructions on TIR. Lack of TIR training/education for HCPs was considered a main barrier for wider adoption of TIR for diabetes management. The different aspects of training deemed to be required for TIR use by each of the three HCP subgroups are presented in Fig. 4. A greater proportion of generalists and allied HCPs versus specialists reported the need for the majority of training aspects. Training needs reported included clinical guidance about TIR targets for different patient populations, how to use TIR data to make clinical decisions, and how to interpret TIR data (Fig. 4).

Beyond their own training needs, almost all participants agreed that patient education on TIR is also necessary to increase adoption of the

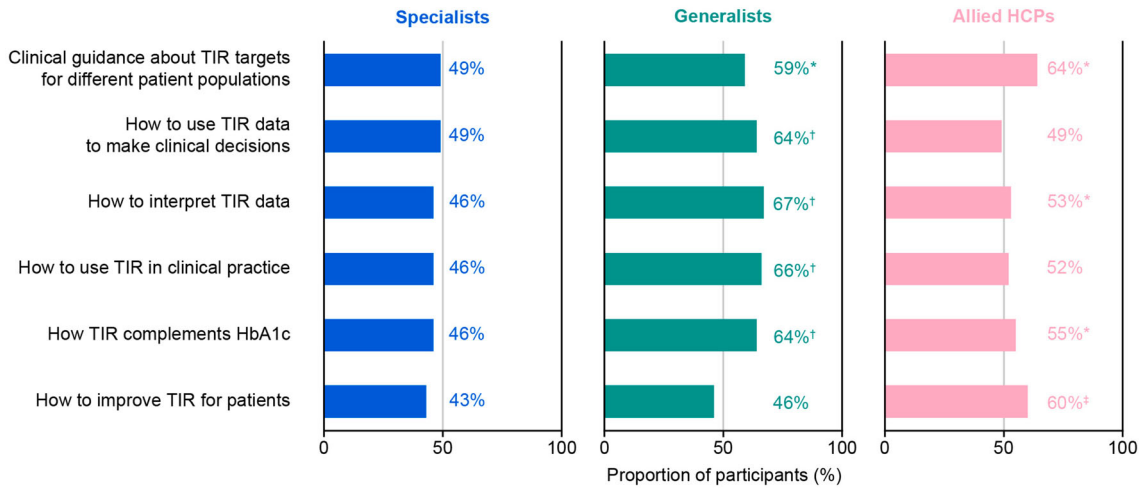


**Fig. 4** Training needs for TIR use, as reported by specialists, generalists, and allied HCPs. *$p < 0.05$ for difference versus specialists. †$p < 0.05$ for difference versus specialists and allied HCPs. ‡$p < 0.05$ for difference versus specialists and generalists. *HbA1c* glycated haemoglobin, *HCP* healthcare professional, *TIR* time in range

metric, with 93% of specialists ($p < 0.05$ vs. generalists), 89% of generalists, and 95% of allied HCPs ($p < 0.05$ vs. generalists) responding that patient education is absolutely essential, very important, or important. Overall, the majority of all participants strongly or somewhat agreed that there is a need for more resources to help educate people with diabetes on TIR. Limited access to CGM was deemed a barrier to wider adoption of TIR by 65% of specialists, 74% of generalists ($p < 0.05$ vs. specialists), and 69% of allied HCPs.

### Factors Necessary for Facilitating the Increased Use of TIR

Most participants considered integration of TIR into clinical guidelines to be a key factor for the increased use of TIR (Fig. 5). Raising awareness of TIR among HCPs and people with diabetes was also cited as important for the increased use of TIR (Fig. 5).

Recognition of TIR by regulators as a primary clinical endpoint was cited as a key factor for the increased use of TIR by 52–59% of participants (Supplementary information: the questionnaire, question 420). Finally, recognition of TIR by payers as a parameter for evaluation of diabetes treatment was cited as a key factor by the majority of participants (60–70%), especially among allied HCPs ($p < 0.05$ for difference vs. specialists) (Fig. 5).

## DISCUSSION

TIR is a recent metric that complements the traditional measure of HbA1c [19]. In this study, the knowledge of and attitudes towards the use of TIR in diabetes management among HCPs with prior awareness of the metric were investigated via an online quantitative survey. Overall, most of the HCPs surveyed agreed that TIR is likely to become the standard metric for diabetes management in the future. TIR was regarded as providing many benefits for HCPs, including helping to optimise a patient's medication regimen and giving HCPs the knowledge and insights they need to make informed clinical decisions. In addition, the majority of participants felt that TIR empowers people with diabetes with the information they need to successfully manage their diabetes. However, the level of comfort with using TIR reported by HCPs was low, particularly for generalists, with lack of education or training for both HCPs and people with diabetes identified as a key barrier to wider adoption of TIR in practice. Additional barriers to implementation of TIR were identified which, if targeted, may increase awareness

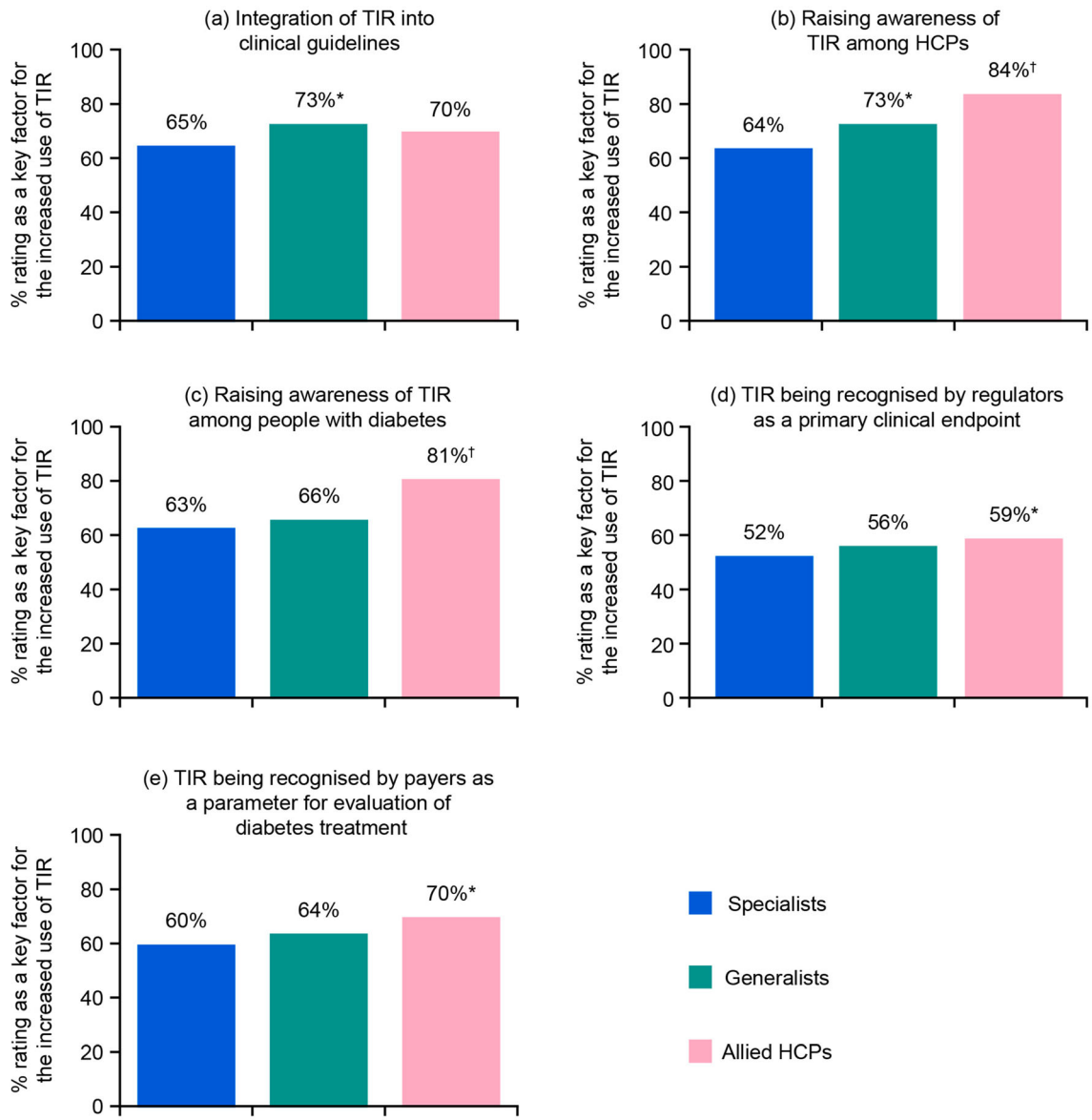


**Fig. 5** Factors necessary for facilitating the increased use of TIR. $^{*}p < 0.05$ for difference versus specialists. $^{\dagger}p < 0.05$ for difference versus specialists and generalists. *HCP* healthcare professional, *TIR* time in range

and use of TIR, and ultimately help improve diabetes management for people with diabetes.

The results of the survey were analysed by HCP subgroup: specialists, generalists, and allied HCPs. The proportion of generalists expressing that TIR is becoming the standard of care in diabetes was slightly smaller than that of specialists and allied HCPs. This is likely to be due to generalists seeing fewer people with diabetes receiving insulin (and therefore possibly using CGM) than the other HCPs. Several benefits of TIR, including use as a tool to inform lifestyle modifications, facilitating more effective patient–physician dialogue, and saving time for both people with diabetes and HCPs, were reported by a significantly greater proportion of allied HCPs than by specialists or generalists. A greater proportion of allied HCPs

than specialists reported empowering people with diabetes with information and lowering the risk of complications as benefits of TIR. This discrepancy may be due to the greater frequency of patient interactions that allied HCPs have compared with specialists. However, another possible explanation is that specialists may be more critical of potential benefits compared with allied HCPs. Despite these benefits, use of TIR and comfort level with using TIR were generally low for all HCPs, and particularly for generalists.

Furthermore, although HCPs' opinion on the need for further training and education on AGP reports was not directly questioned in the survey, the authors feel that education on how to interpret AGP reports (Supplementary information: the questionnaire, question 345), taking into account recommendations of $> 70\%$ TIR and $< 4\%$ TBR, is required. Indeed, a sizeable minority of HCPs were only somewhat comfortable or not comfortable with AGP interpretation and the explanation to people with diabetes; the results from the survey suggest that even HCPs who use AGP reports are not comfortable interpreting them. Interpreting trends (e.g. postprandial highs or nocturnal highs/lows) and how to address them also need to be discussed. All HCP subgroups identified the need for clinical guidance on TIR targets for different patient populations as important. However, the topics directed towards interpretation and use of TIR in clinical practice were emphasised more by generalists, which corresponds with the lower awareness, knowledge, and use of TIR and AGP in this subgroup. In the opinion of the authors, training should include structured interpretation of TIR data and guidance on the actions that should be taken in response to these data. For example, if TIR is $< 70\%$, the HCP should check TBR and indicators of glycaemic variability. If TBR is $> 4\%$, the timings of hypoglycaemic episodes should be assessed. Any TAR should be investigated to see if this occurs either postprandially or overnight. Training should also focus on enabling HCPs to articulate the benefits of TIR to their patient and on how to identify patterns in the data and discuss these with the patient.

In addition to HCP training on TIR, wider adoption of the metric is likely to be facilitated by its integration into clinical guidelines and recognition by regulators and payers. A consensus report published in 2019 by Battelino et al. provides recommendations on targets for TIR, TAR, and TBR [14]. Although this consensus report was endorsed by the European Association for the Study of Diabetes (EASD) and the American Diabetes Association (ADA) (among other bodies), integration of TIR into official clinical practice guidelines is likely to increase confidence of HCPs in its use and enable wider adoption. It will also be important to gain acceptance from regulators of TIR as a primary clinical endpoint for use in future trials. This will require expert HCPs participating in the preparation of consensus papers summarising the current evidence to date from trials using TIR as a clinical endpoint.

As mentioned, use of CGM can be dependent on reimbursement [12]. For more widespread reimbursement of CGM for people with diabetes wishing to use TIR, recognition of TIR as a parameter for evaluation of diabetes management by payers was considered a barrier to using TIR by the majority of participants in this study (60–70%).

The strengths of this study include an international design and assessing HCPs across seven countries on four continents. Alongside geographical range, three different HCP groups were analysed in each country, and so data generated take into account both degree of specialisation and HCP role. Consequently, the level of granular information detailed here should aid the development of tailored TIR training for HCPs.

As with all survey studies, our study has limitations. Reporting bias may have manifested, for example, as a result of HCPs being hesitant to admit not being comfortable with using a particular technique. This may have been the reason for the consistently lower proportion of specialists reporting need for TIR training compared with generalists and allied HCPs. Inclusion in this study required the HCP to be aware of TIR (although not necessarily to have experience in the practical use of TIR) and this requirement would have introduced bias.

This study focused on global data and any future secondary publications could discuss the differences among countries.

## CONCLUSIONS

TIR as a metric is changing the way in which diabetes is managed. The majority of HCPs who took part in this survey recognised the value of TIR in aiding clinical decision-making and empowering people with diabetes in managing their diabetes. However, barriers to wider implementation of TIR exist. Our results identified that education is needed to increase awareness of TIR and to optimise its use in clinical practice. There is a need for considering TIR in clinical guidelines and for recognition by regulators and payers. Physicians and clinical managers should aim to review healthcare services with tailored support and training to help evaluate the use of TIR in clinical practice.

## ACKNOWLEDGEMENTS

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***Data Availability.*** The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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