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Timely testing: who needs to do what differently to improve adherence to guideline-recommended glycaemic monitoring?

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The haemoglobin A1c (HbA1c) level has become the standard of care for monitoring type 2 diabetes as it reflects a person's average blood glucose level over the previous 2–3 months, is correlated with risk of long-term complications and can be measured cheaply and easily. International guidelines recommend testing HbA1c every 6–12 months for those with stable type 2 diabetes, and every 3–6 months in adults with unstable type 2 diabetes until HbA1c is controlled on unchanging therapy.[1–3] However, these guidelines are based on expert consensus rather than robust evidence on whether the frequency of HbA1c measurement impacts patient outcomes. To date, most studies have focused on the association between testing frequency and glycaemic control.[4–6]

In this issue of *BMJ Quality & Safety* Imai and colleagues go further, demonstrating an association between adherence to guideline-recommended testing frequency and health outcomes.[7] Using data from electronic health records (EHRs), they examined adherence to guideline-recommended HbA1c testing frequency over a 5-year period in 6424 people with type 2 diabetes across 250 general practices in Australia. An adherence rate was calculated for each person with type 2 diabetes, dividing the number of tests performed within the recommended intervals by the total number of conducted tests (minus 1). Patients were categorised into low-adherence (<33%), moderate-adherence (34%–66%) and high-adherence groups (>66%). Where there was high adherence to guideline-recommended testing frequency, HbA1c values remained stable or improved over time. In contrast, with low adherence, HbA1c values remained unstable or deteriorated over the 5-year period. The risk of developing chronic kidney disease was lower among those with high adherence compared to those with low adherence (OR 0.42, 95% CI 0.18 to 0.99). There was no evidence of an association between the rate of adherence and the development of ischaemic heart disease. This study provides support for the importance of frequent HbA1c testing as recommended in current clinical guidelines for prevention of complications of diabetes.

The study exploits an abundance of observational data on processes and outcomes of care readily available in EHRs in a real-life setting and among a general population with type two diabetes over a 5 year period. However, the authors highlight methodological challenges. Using EHRs to explore the association between adherence to testing frequency and HbA1c is susceptible to selection bias, given that patients need to have HbA1c measurements recorded to be included in the study. Imai and colleagues include 'active patients' defined as individuals who attended the practices three or more times in the past 2 years at the time of the visit and had two or more HbA1c tests over the study period.[7] While this restriction was necessary to avoid duplication of patients across primary care practices and to study the development of complications over time, it may introduce selection bias and also reduce the generalisability

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of the findings. The authors suggest their findings are conservative estimates of the association between adherence to guideline-recommended testing frequency and outcomes, given the positive association between practice visits and glycaemic control. However, those who do not attend general practice regularly differ in many other ways, which may also affect the association between adherence to guideline-recommended testing frequency and health outcomes. A recent systematic review of non-attendance at outpatient diabetes appointments, including those with a general practitioner or nurse, found that younger adults, smokers and those with financial pressures were less likely to attend.[8] In addition, even among those who attend general practice regularly, differences in other aspects of care such as self-management behaviour are likely to exist between those with high-adherence versus low-adherence rates.[9] In the study by Imai and colleagues, data were not available on potentially important factors, such as patients' body mass index, smoking status and adherence to medication,[7] making it difficult to attribute unstable or deteriorating HbA1c to low-adherence rates. Furthermore, the adherence rate was estimated based on average test numbers over 5 years, so adherence may vary over time. Future research could build on the work of Imai and colleagues to examine the causal relationships between a range of care processes (including testing frequency), HbA1c and health outcomes by assessing the temporality of relationships, accounting for selection bias and confounding, and exploring potential causal mechanisms such as treatment intensification.[9]

Imai and colleagues also found that the median testing frequency in people with type 2 diabetes was less than the recommended two tests per year in Australia (median 1.6 tests per year).[7] Poor adherence to recommended testing frequency is documented in several countries with similar guidelines, including countries in Europe[10 11] and Asia[12] as well as in the USA,[13] thus raising questions about how best to improve this process of care. Diabetes care is the subject of extensive quality improvement and implementation research,[14] and a variety of interventions have been shown to improve processes and outcomes of care for people with diabetes.[15] How and why these interventions work is unclear because of the range of intervention components operating at the patient, professional and system levels. Most interventions focus on a range of guideline-recommended behaviours in both health professionals and patients and are often described more broadly than changing or targeting one specific behaviour.[16] For instance, adherence to HbA1c testing frequency itself is not one specific behaviour; it includes a series of behaviours by the person with diabetes, and potentially their support network, as well as behaviours by health professionals. The person with diabetes must initiate an appointment; the health professional may prompt the person to attend for regular testing; on deciding and making the effort to attend, the person with diabetes must agree to the blood test; and the health professional must carry out the blood test and send it to a lab for analysis. To improve adherence to HbA1c testing frequency, we may have to intervene in multiple places, but first we need to identify where the process breaks down.

There also needs to be a clearer understanding of *why* the process breaks down. To date, there has been no systematic review of the factors associated with adherence to the frequency of HbA1c testing recommended in guidelines. Individual studies, conducted in different health systems, have identified a range of patient-level factors including age, rurality, disease duration, receipt of specialist care, glycaemic control, cardiovascular risk factors and diabetes-related complications.[10–13] Few studies have examined the professional, organisational and system-level determinants of adherence. Yet we have reason to believe that factors at these levels are also important. In a qualitative synthesis of barriers to optimal diabetes management in primary care, perceived professional barriers included limited time and resources, changing professional boundaries leading to uncertainty about clinical responsibility, and a lack of confidence in knowledge of guidelines and skills.[17] A meta-analysis of professional and practice-level factors associated with the quality of diabetes management in primary care identified doctor gender and age, doctor-level diabetes volume, practice deprivation and use of EHRs as significant determinants of quality, typically measured by a collection of individual indicators or a composite measure.[18] Furthermore, evidence from a systematic review and meta-analysis of quality improvement interventions for diabetes suggests that strategies that intervene on the entire system of chronic disease management are associated with the largest effects irrespective of baseline HbA1c.[15] Thus, to improve adherence to the frequency of HbA1c testing frequency, the problem needs to be understood in context, and solutions should incorporate professional and system-facing interventions as well as patient-facing interventions.

Based on their analysis of the content of implementation interventions to support diabetes care, Presseau and colleagues call for better reporting of who needs to do what differently at all levels, including the system level, which is often underspecified.[16] This, they propose, would contribute to the development of an underlying programme theory for improvement interventions linking activities to intended outcomes.[19] Such an approach is relevant to many chronic conditions where disease management involves multiple actors, actions and settings. The development of testable theories and integration of causal reasoning are increasingly advocated in improvement and implementation science as a way to enhance the generalisability of interventions.[20 21] Causal diagram modelling,[20] the action–effect method[19] and the implementation

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research logic model,[22] facilitate the development and communication of intervention programme theory. The action effect method in particular is intended as a facilitated collaborative process to enhance the practicality of programme theory and to provide an actionable guide for quality improvement teams.[19]

The current study by Imai and colleagues underscores the importance of the link between regular HbA1c testing, better glycaemic control and reduced risk of complications.[7] While the causal mechanisms require further investigation, this study provides an important piece of the puzzle. Few interventions target Hba1c testing frequency alone, and this is unlikely to be the sole priority for people with diabetes or their health professionals, given the multiple processes recommended for optimal clinical and self-management. However, given its centrality and profile in diabetes management, targeting HbA1c could be a lever for wider improvement. The foundation for such an intervention should be a better understanding and more precise articulation of who needs to do what differently, as well as how and why this intervention is expected to change specific processes of care and ultimately improve patient outcomes.

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