Digital adherence technologies in tuberculosis

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With great interest, we read the cluster-randomised superiority trial by Xiaoqiu Liu and colleagues[1] published in *The Lancet Global Health*. The authors should be applauded for providing this large and important study investigating the use of digital adherence technology to support tuberculosis treatment. However, although adherence rates were slightly improved in the intervention group, no effect on the primary composite outcome of death, loss to follow-up or stopping treatment, treatment failure, switch to multidrug-resistant tuberculosis treatment, or tuberculosis recurrence by 18 months from treatment start was shown.

Previous research has shown an association between non-adherence to treatment and poor tuberculosis outcomes.[2] As such, the planned adherence interventions in this trial might not have been optimally implemented or adapted to the needs of the patient. First, the shared decision-making approach, one of the adherence-enhancing strategies that has been shown to be effective in other fields (eg, asthma),[3] was not implemented as initially planned; in some regions there was more clinician decision making instead. Second, the authors speculate that "certain patterns of non-adherence are associated with increased risk of poor treatment outcomes or treatment recurrence".[1] Digital adherence technologies could show these patterns in close to real time. However, we would like to note that patterns of digital data do not show everything. Beyond looking at data patterns, much more emphasis is needed on the actual underlying reasons for those suboptimal patterns and on providing personalised support to patients.

WHO distinguishes between five different dimensions of treatment adherence: socioeconomic factors, health-system factors, condition-related factors, therapy-related factors, and patient-related non-adherence factors (figure).[4] Each of these factors requires different adherence-enhancing strategies.[5] For example, digital tools can be used as reminders and for providing motivational messages, but other non-adherence factors (eg, overcoming side-effects or fear of side-effects, financial constraints, or lack of knowledge) still require an intervention provided in person, possibly supported by digital data. Current digital data profiling should not merely be used as an independent solution that is the same for everyone. Instead, it should be used to facilitate shared decision making and support personalised interventions for tuberculosis treatment.

Importantly, in the trial by Liu and colleagues,[1] many doctors did not know how to manage digital adherence data. Therefore, training clinicians on how to interpret digital data decision-support tools is needed. The combination of digital data and behavioural phenotyping requires structured questions and data collection that could be integrated into digital tools. As such, tuberculosis treatment could change from being the same for everyone to being adapted to individual patients.[2]

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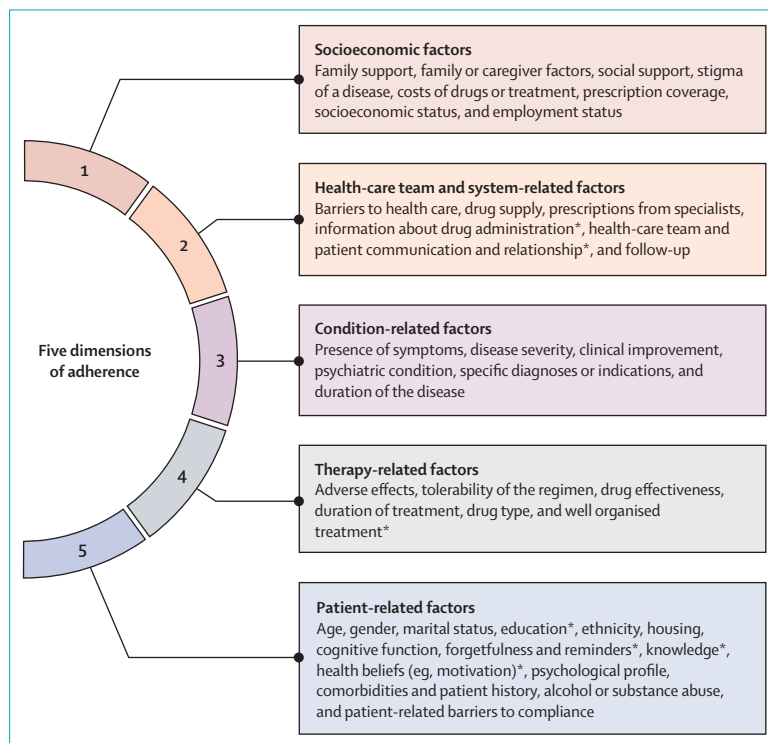
Figure: Five dimensions of treatment adherence and determinants that can be managed digitally
*Can be managed digitally.

Five dimensions of adherence

1. **Socioeconomic factors**
Family support, family or caregiver factors, social support, stigma of a disease, costs of drugs or treatment, prescription coverage, socioeconomic status, and employment status

2. **Health-care team and system-related factors**
Barriers to health care, drug supply, prescriptions from specialists, information about drug administration*, health-care team and patient communication and relationship*, and follow-up

3. **Condition-related factors**
Presence of symptoms, disease severity, clinical improvement, psychiatric condition, specific diagnoses or indications, and duration of the disease

4. **Therapy-related factors**
Adverse effects, tolerability of the regimen, drug effectiveness, duration of treatment, drug type, and well organised treatment*

5. **Patient-related factors**
Age, gender, marital status, education*, ethnicity, housing, cognitive function, forgetfulness and reminders*, knowledge*, health beliefs (eg, motivation)*, psychological profile, comorbidities and patient history, alcohol or substance abuse, and patient-related barriers to compliance

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1   Liu X, Thompson J, Dong H, et al. Digital adherence technologies to improve tuberculosis treatment outcomes in China: a cluster-randomised superiority trial. *Lancet Glob Health* 2023; **11:** e693–703.

2   Chimeh RA, Gafar F, Pradipta IS, et al. Clinical and economic impact of medication non-adherence in drug-susceptible tuberculosis: a systematic review. *Int J Tuberc Lung Dis* 2020; **24:** 811–19.

3   Wilson SR, Strub P, Buist AS, et al. Shared treatment decision making improves adherence and outcomes in poorly controlled asthma. *Am J Respir Crit Care Med* 2010; **181:** 566–77.

4   WHO. Adherence to long-term therapies: evidence for action. 2003. https://apps.who.int/iris/handle/10665/42682 (accessed July 19, 2023).

5   Kardas P, Lewek P, Matyjaszczyk M. Determinants of patient adherence: a review of systematic reviews. *Front Pharmacol* 2013; **4:** 91.