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Assessing Accordance with Test Instructions for Reliable Data Collection in Remote Digital Health Studies*

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***Abstract*— Remote, sensor-based tests show promise in augmenting standard clinical assessments of functional ability in neurological diseases. Ensuring accordance with test instructions remains, however, a challenge for such tests. We present here a novel methodology to assess accordance with test instructions for improving the collection of reliable data with unsupervised, sensor-based tests in digital health studies.**

***Clinical Relevance*—Automatic assessment of accordance with test instructions enables efficient and reliable data collection with remote, sensor-based tests.**

I. INTRODUCTION

Remote, sensor-based tests allow the highly granular and ecologically valid assessment of functional impairment [1]. A challenge that remains with remote, unsupervised testing is the detection of tests that are not performed in accordance with the instructions, as these tests may lead to incorrect conclusions drawn from the collected data.

Context features which are derived from the raw sensor data provide information on how the test was taken and hence on the accordance with the instructions. It is critical that such features do not capture disease-related signals to avoid flagging tests impacted by the disease.

We present here a new methodology that takes advantage of a simple context feature, 'Phone on the Table', to prevent non-accordant tests in digital health studies.

II. METHODS

Seventy-six people with multiple sclerosis and 25 healthy controls were enrolled and performed for 24 weeks a set of daily unsupervised smartphone-based tests with the Floodlight Proof-of-Concept app, including the U-Turn Test (UTT) (NCT02952911) [1, 2]. The UTT instructed the subjects to walk and perform at least five consecutive U-turns while carrying the smartphone on them [2]. We developed 'Phone on the Table' to detect whether the smartphone was left on a fixed surface while the subjects took the UTT. To assess its potential impact on preventing non-accordant UTTs, we simulated interventions in NCT02952911 by triggering alerts based on frequency of non-accordant tests, as detected by this context feature, within a 10-day window (frequency threshold). We assumed that the subjects remained fully accordant to the test's instructions for 30 days after an alert was triggered. Thus, any non-accordant UTT observed during this period was considered as preventable.

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III. RESULTS

'Phone on the Table' flagged 58 (0.6%) UTTs as non-accordant across five subjects. Figure 1 shows the percentage of non-accordant tests that could have been prevented and the number of alerts for ten different threshold values. For a frequency threshold of 0.2, 70% of non-accordant UTTs could have been saved, with 7 alerts or less than 1.5 alerts per non-accordant subject on average.

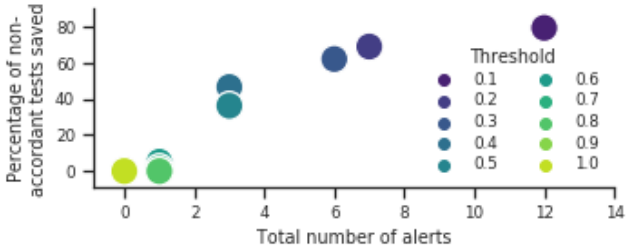

Figure 1. Percentage of non-accordant tests saved vs. total number of alerts.

IV. DISCUSSION & CONCLUSION

Context features enable efficient assessment of accordance with instructions in remote, sensor-based tests and can be used to implement strategies aimed at improving data reliability by preventing non-accordant tests.

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