

# The Effect of a Mobile Health Decision Support System on Diagnosis and Management of Obesity, Tobacco Use, and Depression in Adults and Children

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## ABSTRACT

Research on mobile health decision support systems (mHealth DSS) is limited, and few studies have focused on nurses or nurse practitioners (NPs). This study compared diagnostic rates and care planning by nurses in NP training randomized to mHealth DSS versus a control group for obesity and overweight, tobacco use, and depression. The patient encounter (N = 34,349) was the unit of analysis in the randomized controlled trial. NP students were assigned within specialty to receive mHealth DSS for 1 of 3 conditions. There was a significant effect ( $P < .0001$ ) of mHealth DSS on diagnosis, but the effect on number of care plan items varied.

**Keywords:** advanced practice nurse, decision support system, depression, handheld computer, mobile health, nurse, nurse practitioner advanced practice nurse, obesity, tobacco use

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Mobile health (mHealth) apps are on the rise and are increasingly being integrated into clinical practice and education and used by patients and health care consumers either independently or in collaboration with their health care providers. Several recent systematic reviews and a scoping review of systematic reviews have examined the impact of handheld devices, which have evolved from early personal digital assistants that were synchronized with a database through specialized cradles to today's smartphone apps.<sup>1-5</sup> One of the earliest reviews was a 2008 systematic review of 48 studies from 1996 to 2008 and included 10 studies focused on nurses or nursing students.<sup>1</sup> However, only 1 of the 10 studies reported interventions related to nursing care processes. The 2002 study by Ruland,<sup>6</sup> which showed that nurses' use of the handheld CHOICE (Creating better Health Outcomes by Improving Communication about Patients'

Expectations) system resulted in nursing care that was more consistent with patient preferences and improved patients' preference achievement, is the earliest research indexed in PubMed that includes the keywords of *nurse* and *handheld computer*.

The body of literature specifically focused on mHealth decision support systems (DSSs) for health care professionals and students suggests that such systems improve adherence to clinical practice guidelines (CPGs)<sup>2-4</sup> and access to medical/health information at the point of care,<sup>3,4</sup> increase screening,<sup>2</sup> improve diagnosis, decrease medical errors,<sup>1</sup> increase documentation,<sup>3</sup> increase referrals,<sup>2</sup> and increase efficiency.<sup>3</sup> The majority of studies are focused on physicians or medical students. There is little nursing research cited in these reviews. Moreover, review authors noted that most studies did not address effectiveness and that randomized controlled trials (RCTs) were infrequent in comparison with other less

rigorous designs. A 2014 literature and commercial review by Martínez-Pérez et al<sup>5</sup> identified 192 commercial mHealth DSS apps. This suggests that regardless of the level of evidence for the effectiveness reported in the literature, the supply of such apps is increasing.

In 2002, the Columbia University School of Nursing began integrating mobile devices into the nurse practitioner (NP) curriculum as part of a series of Health Resources and Services Administration grants focused on informatics for evidence-based NP practice including the development of informatics competencies.<sup>7</sup> In the initial implementation, NP students used personal digital assistants to document their clinical encounters using an application built by our project team.<sup>8</sup> Standardized terminologies and a focus on nursing process were a vital foundation of the initial NP student clinical log.<sup>9</sup> Faculty stakeholders found the NP student clinical log and associated reports to be useful for a variety of purposes including monitoring of student performance, benchmarking, and quality of care assessments.<sup>10</sup>

Subsequently, the school received funding from the National Institute of Nursing Research to add decision support features to the existing NP student clinical log and to conduct an RCT of the resulting mHealth DSS. At the time, there was substantial evidence about the effectiveness of DSS in clinical information systems on physicians' adherence to computer-based protocols,<sup>11-14</sup> but little was known about the impact of DSS on nurses or about DSS on handheld platforms.

The focus of the mHealth DSS was the screening and management of obesity and overweight, tobacco use, and depression in adults and children, and the research team undertook a series of activities to develop the mHealth DSS. These included (1) gaining an understanding of the guideline interpretation process of NP students and NPs,<sup>15</sup> (2) developing a set of scenarios to inform system functionality,<sup>9</sup> (3) transforming the CPG recommendations into a format that could be processed by the computer,<sup>16</sup> (4) representing documentation terms using a variety of standardized terminologies,<sup>17</sup> and (5) mapping CPG recommendations into the 5-category NP plan of care (diagnostics, procedures, prescriptions, patient

education and counseling, and referrals).<sup>18</sup> The mHealth DSS was iteratively refined during the development process and subsequently in response to evolving mobile platforms.<sup>19</sup>

The resulting mHealth DSS included a reminder to screen, standardized screening assessment appropriate to each condition, computer-generated diagnosis, ability to select patient goal (eg, desire to quit smoking or lose weight), and ability to create a tailored plan of care that included CPG recommendations organized into the 5 categories.<sup>19</sup> The control application (ie, NP student clinical log) included the ability to document the diagnoses and plan of care items associated with the CPG recommendations, but the diagnosis was not generated based on the standardized screening assessment, there was no opportunity to record patient goal, and the plan of care items were not organized as a tailored plan of care with DSS features.

In previous articles, we have reported screening rates in response to mHealth DSS reminders for obesity and overweight,<sup>20</sup> adult depression,<sup>21</sup> and tobacco use<sup>22</sup> and have shown that screening rates varied by NP specialty, patient race/ethnicity, and payer source.<sup>21,22</sup> The purpose of this study is to compare diagnostic rates and care planning by registered nurses in NP training randomized to mHealth DSS versus the control group for obesity and overweight, tobacco use, and depression.

## METHODS

### Human Subjects Protection

The research protocol was approved by the Columbia Health Sciences Institutional Review Board. Students were considered human subjects but were routinely using the NP student clinical log so its use was not considered a research procedure. The institutional review board approved an opt-out protocol for the mHealth DSS. Students were notified that decision support features were being added to the NP student clinical log and that they would be randomized to receive mHealth DSS for 1 or more of the 3 clinical conditions. They were given the opportunity to opt out of receiving the mHealth DSS by contacting the principal investigator, and several students did so. The students also had the option to choose not to screen in any eligible encounter and to simply select the reason for not screening from a list. In both instances,

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