# Mobile Health Applications to Optimize Chronic Disease Management and Outcomes: Hypertension

**Emily Prince, PharmD; Anna Qinzhe Deng, PharmD; Michael Toscani, PharmD**
Ernest Mario School of Pharmacy, Rutgers, The State University of New Jersey

RUTGERS Institute for Pharmaceutical Industry Fellowships

## Background

Mobile health applications (mHealth apps) are defined by the FDA as 'programs that run on smartphones and other mobile devices that can be used to manage …health and wellness"[1]. According to a 2012 mobile health study, 19% of smartphone owners have downloaded an app specifically to track or manage health[2]. With 48% of American patients with hypertension labeled as uncontrolled[3] there is an evident need for new ways to empower patients to self-manage their hypertension.

MHealth apps represent a growing modality to enable patients to take ownership of tracking and managing their chronic disease states, such as hypertension. With functions such as medication reminders and exportability of readings, mHealth apps for hypertension have the potential to lead to increased clinical outcomes.

## Objective

To identify, evaluate, and rank currently available mobile health applications (mHealth apps) available for use in patients with hypertension, with a focus on patient self-management and potential to improve clinical outcomes.

## Methods

A search of mHealth apps was completed for both iPhone and Android devices in November 2013- February 2014. Search terms "hypertension" and "blood pressure" resulted in n>500 applications in the Apple App store and Google Play. MHealth apps were selected based on star ratings, popularity of reviews, and relevance to search terms. Apps were excluded if not in English or did not track diastolic and systolic blood pressure. Based on the criteria, a total of 7 apps were chosen for inclusion in this research (n=3 Apple, n=3 Android, n=1 Apple/Android).

A qualitative and quantitative ranking tool was developed to evaluate the utility of these apps in helping patients self-manage blood pressure. This ranking tool was developed to assess the mHealth apps' overall usability (1-5 star scale) based on two separate categories of: Useful/Relevant (1-3 scale) and Interface/ Navigation (1-3 scale). The 'Author's Ranking' score gives equal weight to 'useful/relevant' and 'interface/navigation' scores, starting with max score of 5 stars and deducting one star for each point lost in either category.

## Results

**TABLE 1: SUMMARY OF MHEALTH APPS FOR HYPERTENSION**

| General mHealth App Information | | | | | | | |
|---|---|---|---|---|---|---|---|
| App Name/Icon | Blood Pressure Diary | BPMonitor-Family Lite | iBP | Blood Pressure (BP) Watch | Heartwise blood pressure tracking utility | Heart Pal-Blood Pressure Tracker | Blood Pressure (My Heart) |
| Manufacturer | FRUCT | Taconic System LLC | Leading Edge Apps LLC | NumberMatter2Me | SwEng LLC | Deltaworks | Klimazewski Szymon Medical |
| Version | 1.5.1 | 2.9 | 7.1 | 2.1.3 | 3.5.1 | 1.3 | 2.4.00 |
| Price/Device Compatibility | Free Android | Free Apple | $0.99 Apple and Android | Free Android | $0.99 (iPhone) | $0.99 Apple | Free Android |
| Star Rating | 4.3/5 | 4.5/5 | 5/5 | 4.5/5 | 4.5+/5 | 4+/5 | 4/5 |
| Number of Reviews | 578 | 2674 | 6 Apple/ 314 Android | 4,845 | 841 | 251 | 3,710 |
| **Overall Usability** | | | | | | | |
| Authors' Ranking (★ - ★★★★★) | ★ | ★★★ | ★★★★ | ★★★★★ | ★★★★★ | ★★★ | ★★★★ |
| Useful/Relevant(0-3) | 1 | 2 | 3 | 3 | 3 | 2 | 3 |
| Interface/Navigation (0-3) | 1 | 2 | 2 | 3 | 3 | 2 | 2 |
| **Disease Activity Assessment** | | | | | | | |
| Diastolic/Systolic | X | X | X | X | X | X | X |
| BP Time Stamped | X | X | X | X | X | X | X |
| Heart Rate | X | X | X | X | X | X | X |
| Weight | None | X | X | X | X | None | x |
| Height | None | None | None | None | X | None | None |
| BMI calculator | None | None | None | None | X | None | None |
| Mean Arterial Pressure | None | X | X | None | X | X | None |

**FIGURE 1: ADDITIONAL FEATURES**

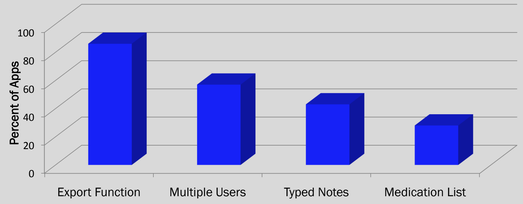
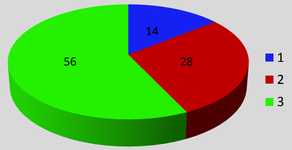


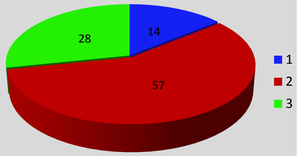

**FIGURE 2: USEFUL/ RELEVANT SCORES**




**Useful/ Relevant Score (1-3)**

1. Tracks less than 50% of listed Disease Activity components OR only tracks diastolic/systolic blood pressure measurements
2. Tracks 50-75% of listed Disease Activity components with no additional features
3. Tracks >75% of listed Disease Activity components OR >50% of listed components with additional features

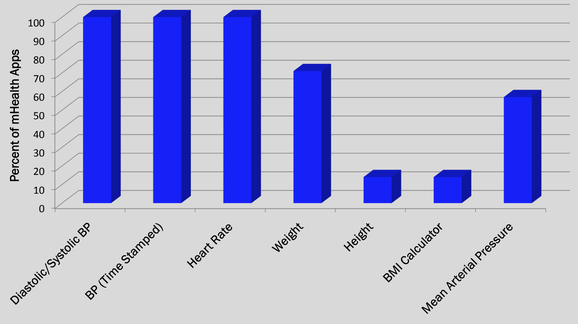
**FIGURE3: INTERFACE/ NAVIGATION SCORES**




**Interface/Navigation Score (1-3)**

1. Confusing/messy/cluttered screen design; intrusive advertisements, complex data input process; information poorly presented or subject to misinterpretation; excessive training required.
2. Average screen design; Average data input process; minimal training required; adequate or expected number of steps/gestures (scrolling or switching between typing and tapping) to complete input of data
3. Clear/clean/uncluttered screen design; no training required; information well presented and easy to understand; no training required; free of advertisements

**FIGURE 4: DISEASE ACTIVITY ASSESMENT**

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## Discussion

- The 7 mHealth apps chosen for inclusion in this research represented a variety of user functionalities available for patients to self-manage their hypertension.
- All apps tracked blood pressure, time stamped BP readings, and heart rate.
- Most of the apps offered additional functions such as typed notes, multiple user accounts, or exportation of readings to email which has the potential to improve patient compliance, facilitate communication of disease activity to health care providers, and may lead to better clinical outcomes.
- Some apps quantified BP readings to stages of hypertension, though there was a variety as to the definition of these stages. One app (My Heart) used ACC/AHA staging, while most just color coded BP readings in green, yellow, or red. Blood Pressure Diary created their own, inaccurate, rating, labeling BP as either "normal", "moderately high", or "optimal". Patients need to be cognizant of their own BP goals and how that compares to the definition used in the specific mHealth app.
- In the research, the authors found other mHealth apps that contained inaccurate information, such as claiming to calculate blood pressure from a photo of a thumbprint. It is important to educate patients on what constitutes a medically accurate and useful mHealth app when looking to use a mHealth app to track and manage hypertension.

## Limitations

The ranking tool created has not been validated. The research only represents a small number of the available hypertension apps in the Android and Apple smartphone market. 'Authors' Ranking' was calculated giving equal weight to 'Useful/Relevant" and 'Interface/Navigation' scores, in actuality clinicians and patients may prefer to give more weight to certain aspects of an mHealth app over others.

## Conclusion

Preliminary results show a multitude of applications representing a variety of user functions available for patients to self-manage blood pressure and related cardiovascular risk factors. This demonstrates the potential for mobile health (mHealth) smartphone applications to increase patient involvement in the management of, and improve the quality of care for, hypertension.

## References

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3. Go AS, et al. Heart disease and stroke statistics—2014 update: a report from the American heart association. *Circulation.* 2014 Jan 21;129(3):e28-e292.