Use of a Mobile Application to Increase Patient Compliance to a Prescribed Home Exercise Program and Improve Outcomes

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USE OF A MOBILE APPLICATION TO INCREASE PATIENT COMPLIANCE TO A
PRESCRIBED HOME EXERCISE PROGRAM AND IMPROVE OUTCOMES

By

Ellie M. Cobb
Jed B. Hurst
Ethan J. Konshuk

A doctoral project submitted in partial
fulfillment of the requirements for the

Doctor of Physical Therapy

Department of Physical Therapy
School of Allied Health Sciences
Division of Health Sciences
The Graduate College

University of Nevada, Las Vegas
May 2016
This doctoral project prepared by

Ellie Cobb

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entitled

Use of a Mobile Application to Increase Patient Compliance to a Prescribed Home Exercise Program and Improve Outcomes

is approved in partial fulfillment of the requirements for the degree of

Doctor of Physical Therapy
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ABSTRACT

**Purpose/Hypothesis:** The purpose of this research study was to examine the efficacy of a mobile application (app) as a telehealth solution for improving patient home exercise program (HEP) compliance and outcomes. It was hypothesized that use of this app would improve physical therapy (PT) HEP compliance among patients using it. It was also hypothesized that increased PT HEP compliance would improve patient outcomes.

**Subjects:** The study sample consisted of patients (n=41) who received treatment at a general outpatient PT clinic between May 2014 through March 2015. The app group consisted of 27 subjects and the non-app group consisted of 14 subjects.

**Methods:** The creator of the app offered free use of their app to a physical therapy clinic. As the app is only compatible with Apple products, the clinic used the app with any patient that had an iPhone. Retrospective review was conducted to determine if differences in patient outcomes were observed. Patients who had access to an iPad or iPhone were considered part of the “app group” and used the mobile app to reference and report PT HEP compliance. Patients without access to an iPad or iPhone were considered part of the “non-app group” and received traditional PT HEP prescription and monitoring. Patient data was extracted from patient medical records, de-identified, and sent to University researchers. An independent t-test was used to analyze age and compliance of the app group and the non-app group. Mann-Whitney U tests were used to analyze number of exercises assigned, global rating of change, functional index score, and pain rating.
Results: It was found that PT HEP compliance, age, and the number of exercises assigned were significantly higher in the non-app group compared to the app group, with PT HEP compliance and number of exercises having $p$ values < 0.001, and age having a $p$ value = 0.045. A trend towards significance was found in the Global Rating of Change ($p = 0.067$), with the app group exhibiting higher scores. No statistically significant difference was found for change in functional index score ($p = 0.566$), or for change in pain rating ($p = 0.483$) between the app and non-app group.

Discussion: The results were inconsistent with the hypotheses. Use of a mobile application did not improve patient compliance nor treatment outcomes. There are several possible explanations for these results. Compliance to a PT HEP may not significantly influence a patient’s change in function or pain during an episode of care. Inaccurate reporting may also explain the findings of the study. Additionally, it is not uncommon for people to have difficulty when using new technologies, therefore novelty of the app for the patients may have affected the results. Further research should be conducted to confirm findings and establish the influence of these limitations.

Conclusion: Based on the data, use of the application did not increase patient PT HEP compliance when compared to verbal self-reporting nor did it improve patient outcomes.
ACKNOWLEDGEMENTS

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INTRODUCTION

One purpose of physical therapy (PT) is to improve the functional mobility of patients. This is done by evaluating, diagnosing, and treating disorders of the movement system. As part of patient treatment, physical therapists often assign a home exercise program (HEP) to improve patient outcomes, independence in functional activities, and continued health. In order to maximize the positive effects of PT, compliance to such programs seems necessary. It was reported that among patients receiving PT, non-compliance to a prescribed PT HEP was as high as 65\%. A World Health Organization article stated that increased patient compliance to a medical plan of care, such as diet modification, increased physical activity, and smoking cessation, was implicated in better treatment outcomes and lower cost of health care. Studies have shown that improved compliance to a PT HEP improves patient outcomes including decreased pain and increased function. However, various barriers to PT HEP compliance exist. Multiple studies have shown that these barriers include anxiety, helplessness, the number of obstacles to exercise perceived by the patient, forgetting exercises, lack of positive feedback from the therapist, and poor communication between the therapist and patient.

There have been different strategies employed, without success, to mitigate some of the barriers that patients encounter in PT HEP compliance. Some studies looked at the efficacy of reminders; one of which examined the use of instructional exercise handouts to supplement verbal instruction and found no improvement in PT HEP recall and performance after 2 days. Another study examined the use of printed handouts and telephone reminders to increase compliance to a walking program. No improvements in
compliance were seen, with 60% of study participants reporting they walked about the same as before the study.\textsuperscript{8}

Other studies described and measured the effect of exercise instruction delivery on compliance. Various forms of instruction were employed: verbal, brochure, audiotape, videotape, and multiple combinations. No increase in compliance was seen among any of the groups; however, the group that received combined verbal instruction, a brochure, and an audio or videotape improved in their ability to perform their prescribed exercises correctly.\textsuperscript{9}

More recently, health care professionals have begun to integrate telehealth into the care of patients. Telehealth is the delivery of healthcare related services and information, with physical distance separating the patient and provider, via real time technology.\textsuperscript{10} To support increased interest in use of telehealth, companies have designed software to assist health care providers in an attempt to improve patient care and efficiency.

Physical therapists have increasing options to integrate telehealth into their practice. Mobile applications (apps) are one method of integrating telehealth into a physical therapy plan of care. Many apps contain videos that serve as a reference for prescribed exercises.\textsuperscript{11,12,13,14} Some apps allow users to track their home exercises by logging dates and times performed. Some apps are designed for therapist use, aiming to aid in creating goals and provide common post op protocols and evaluation forms, as well as exercises that can be printed or emailed to patients.
PURPOSE

The purpose of this research study was to examine the ability of an iPhone™ app (was only available on the iOS platform at the time data was gathered) to improve patient PT HEP compliance and outcomes. It was hypothesized that use of the app would increase PT HEP adherence, and in turn improve patient outcomes. The app allows a patient’s iPhone and therapist’s iPad™ to be as tools for home exercise prescription, monitoring, and communication. The app reminds patients of exercises and helps track exercise completion. The app is also designed to help the patient remember components of their exercise program and decrease related perceived barriers to compliance.\(^\text{15}\)

\(^{*}\) iPhone and iPad are registered trademarks of Apple Inc.
METHODS

Subjects

The app developer partnered with a therapist working in an outpatient clinic in Washington State who received free access to the app for use with his patients. Patients who received outpatient treatment from the participating physical therapist at the outpatient clinic between May 2014 and March 2015 were included in the study. The patient population at this clinic was primarily treated for orthopedic pathologies, although the clinic offered services in several other areas including: ergonomics, golf, orthopedics, orthotics, spine, sport, vestibular, and women’s health.

Procedures

Patients who had access to an iPhone had the option to use the app to assist with completion of their HEP; those who used the app were considered part of the “app group”. Those patients who did not have access to an iPhone were considered part of the “non-app group”.

The app uses two interfaces, one for patients and one for therapists. The patient interface features PT HEP exercises that were assigned in the clinic by the therapist. The exercises are compiled into a list for patient reference at home and features written exercise explanations, video of the patient performing the exercise, frequency and repetition information. Additionally, a reporting system for the patient to mark when exercises are completed can be utilized. This information is updated in real time using a cloud service for the therapist to view. The therapist interface of the app is available on the iPad and contains a dashboard that lists all current patients (Figure 1). When the therapist accesses each patient profile, they are able to view the client overview. Client
overviews include individual patient profiles featuring the patient’s name, date of birth, email, injury, and goals for physical therapy (Figure 2). Results can be viewed by the therapist as weekly reports or as a full plan of care report. Reports consist of categories for patient perceived general health rating, patient perceived exercise difficulty rating, and adherence to exercise percentage [total number of exercises completed divided by the total number of exercises assigned]. Additionally, the therapist can view the patient’s assigned exercise program with frequency, duration, number of set and repetition data. In this screen the therapist has the option to edit or delete exercises. (Figure 3). In this screen the therapist can view patient feedback regarding exercises (Figure 4). The app also features a messaging system that allows patients and therapists to communicate with each other within the app.
Figure 1: In app screenshot depicting the therapist interface dashboard. The dashboard displays current patients listed alphabetically. Each patient profile includes the patient’s name, injury, goals, and patient photo. The dashboard can be filtered based on all patients, new patients, or pending patients. The dashboard has features allowing therapists to invite new patients to join the app as well as a messaging system between therapist and patient.

Figure 2: In app screenshot of the therapist interface showing a client overview with exercise feedback data. The client overview includes patient’s name, date of birth, email, injury, and goal for physical therapy. Results can be viewed by the therapist as weekly reports or as full plan of care reports. Reports consist of categories for patient perceived general health rating, patient perceived exercise difficulty rating, and adherence to exercise percentage. Additionally, the therapist can view the patient’s assigned exercise program with frequency, duration, set and repetition data. In this screen the therapist can also add more exercises.
Figure 3: Exercise Prescription

**Figure 3:** In app screen shot showing the therapist interface when editing an exercise. In this screen the therapist can name the exercise as well as make any comments for the patient to review when performing at home. The therapist has the option of recording a new video of the exercise or selecting from previous recordings. The therapist has the option of selecting exercise frequency and task increments, including sets, reps, and holds.

Figure 4: Exercise Review

**Figure 4:** In app screen shot of the therapist interface showing the exercise view. In this screen patient exercise compliance is broken down into daily compliance as a percentage out of 100%, patient reported difficulty with the exercises on a 0-10 scale, patient reported pain during the exercise on a 0-10 scale, as well as any notations patients may have made regarding the exercise.
The app was used as a self-reporting tool for the patients to report their daily adherence to the prescribed PT HEP. The app recorded the exercises that were prescribed and completed (patients had to check them off in the app) and stored this information in the cloud for easy syncing between therapist and patient devices. Data was extracted from the app database and patient medical records. Data from patient medical records was extracted by the clinic personnel in exchange for monetary compensation for their time. Data was then de-identified and sent to the research team for analysis. The therapist was able to produce useable data for 41 patients, 27 of which used the app, while the remaining 14 did not. Upon receiving the data, the research team calculated number of exercises completed and assigned into a percentage of compliance for each patient.

Patients in the non-app group were asked by their therapist, “What percentage of your exercises have you completed each day since your last appointment?” Patients verbally reported a percentage completed. Therapists documented patient compliance percentages in the daily note. Clinic staff extracted the compliance data from the patient medical record, de-identified it, and sent it to the research team for analysis (Figure 5).

**Figure 5:** Data Flow Chart
Upon initiation of care and again at discharge, all participants completed a CareConnections® form. CareConnections is a web-based suite of rehabilitation medical management services. The functional portion of the CareConnections Outcomes System was used to obtain outcome data on patient subjects (Appendix). During the initial visit the patient completed a “patient worksheet” to measure the patient’s current functional level. Three measures from the CareConnections Outcomes System were used in this research: change in pain, change in function, and global rating of change (GROC). The change in pain score was collected using an analogue scale from 0-10. Change in function was calculated as a percentage using a functional index composed of 8 categories. These 8 categories record subjective patient responses to their functionality during daily activities such as walking, dressing, or eating (Appendix). GROC is a way to measure a patient’s self-perceived change of health status during an episode of care. GROC was marked on a scale from -7 (Very Much Worse) to 7 ( Completely Recovered). At the onset of treatment, pain and function were reported; upon discharge, pain, function, and GROC were recorded.

**Statistical Analysis**

All statistical analyses were performed using SPSS®. To determine level of significance the $\alpha$ value was set *a priori* at 0.05. Descriptive statistics were analyzed for change in pain, change in function and GROC values, participant age, number of cancellations, and the HEP compliance data for the non-app and app patients. Percent
compliance was calculated for patients in the app group by taking the total number of exercises completed divided by the number of exercises assigned.

The normality of this data was established using a Kolmogorov-Smirnov test, following which either an independent t-test or a Mann-Whitney U test was performed to compare groups, depending on the Kolmogorov-Smirnov test results. All variables, other than percent of exercise compliance and age, were not normally distributed. Because of this, the non-parametric Mann-Whitney U test was performed on these variables to compare the groups. A two tailed independent t-test was performed to compare percent compliance and age between the two groups.
RESULTS

Descriptive Statistics

The sample was composed of 41 patients, 27 patients in the app group and 14 in the non-app group. The mean age of the non-app group was 53.4±18.6, with the minimum age being 20 and the maximum being 81. The mean age of the app group was 41.4±17.0 years old, with the minimum age being 16 and the maximum age being 79. The non-app group consisted of 5 females and 9 males, while the app group consisted of 19 females and 8 males. The most common diagnoses in the non-app group were “pain in joint involving shoulder region” and “pain in joint involving foot and ankle” (n=2 for both). The most frequent diagnosis in the app group was “Pain in joint involving lower leg” (n=11). The mean number of visits for patients in the non-app group was 6.4 while patients in the app group had an average of 6.0 visits. The mean number of cancellations per patient in the non-app group was 0.3 while the patients in the app had a mean of 1.1 cancelled visits. The mean number of no show events per patient in the non-app group was 0.6 and 0.3 for the app group. The most used primary insurance of the non-app group was Medicare (28.6%), while Group Health (18.5%) was the most common insurance provider for the app group. The majority of the patients in the non-app group were discharged by the clinic (93.0%), while the remainder were self-discharged (7.1%) and one patient who had not discharged at the time of data collection. The majority of patients in the app group were self-discharged (77.8%), while the remainder were discharged by the clinic (22.2%). The non-app group had a mean initial function score of 65.5% based on the CareConnections patient worksheet, while the app group had a mean initial
functional score of 73.6%. The mean initial pain score of the non-app group was 3.3/10 and 3.4/10 for the app group (Table 1).

**Table 1**: Descriptive Statistics of the Non App and App Groups

<table>
<thead>
<tr>
<th></th>
<th>Non-App Group</th>
<th>App Group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of Subjects</strong></td>
<td>14</td>
<td>27</td>
</tr>
<tr>
<td><strong>Subject Gender</strong></td>
<td>5 females, 9 males</td>
<td>19 females, 8 males</td>
</tr>
<tr>
<td><strong>Mean Age</strong></td>
<td>53.4±18.6</td>
<td>41.4±17.0</td>
</tr>
<tr>
<td><strong>Mean Number of Visits</strong></td>
<td>6.4±3.3</td>
<td>6.0±7.4</td>
</tr>
<tr>
<td><strong>Mean Number of Cancelled Visits</strong></td>
<td>0.3±0.5</td>
<td>1.1±1.4</td>
</tr>
<tr>
<td><strong>Mean Number “No Show” Visits</strong></td>
<td>0.6±1.4</td>
<td>0.3±0.9</td>
</tr>
<tr>
<td><strong>Clinic Discharge</strong></td>
<td>93.0%</td>
<td>22.2%</td>
</tr>
<tr>
<td><strong>Self Discharge</strong></td>
<td>7.1%</td>
<td>77.8%</td>
</tr>
<tr>
<td><strong>Mean Initial Function Score</strong></td>
<td>65.5%±15.0</td>
<td>73.6%±19.5</td>
</tr>
<tr>
<td><strong>Mean Initial Pain Score (10 scale)</strong></td>
<td>3.3±1.7</td>
<td>3.4±2.6</td>
</tr>
<tr>
<td><strong>Most Common Insurance Provider</strong></td>
<td>Medicare (28.6%)</td>
<td>Group Health (18.5%)</td>
</tr>
</tbody>
</table>

**Independent T-test comparisons**

There was a statistically significant difference ($p < 0.001$) between the app and non-app group in the mean percent of exercise compliance (app = 37.6%±25.6, non-app = 78.3%±13.8) (Table 2). It was found that there was a statistically significant difference ($p = 0.045$) between the app and non-app group in age of participant (app = 41.4±17.0, non-app = 53.4±18.6). The degrees of freedom for was equal to 32.
Mann-Whitney U test comparisons

There was a statistically significant difference \((p < 0.001)\) between the app and non-app group in number of exercises assigned \((\text{app} = 5.0\pm2.7, \text{non-app} = 10.7\pm5.0)\) (Table 2). A trend towards significance \((p = 0.067)\) was observed in GROC \((\text{app} = 6.1\pm0.2, \text{non-app} = 5.4\pm0.3)\) (Table 2). No statistically significant difference \((p = 0.566)\) was found for change in functional index score \((\text{app} = 16.2\%\pm13.6, \text{non-app} = 21.0\%\pm9.3)\). (Table 2). A statistically significant difference \((p= 0.030)\) in number of appointment cancellations between the app and non-app group was found \((\text{app} = 1.1\pm1.4, \text{non-app} = 0.3\pm0.5)\) (Table 2). No statistically significant difference \((p = 0.483)\) was found for change in pain rating between the app and non-app group \((\text{app} = -2.6\pm2.1, \text{non-app} = -2.4\pm1.4)\) (Table 2).

Table 2: Results of statistical analysis depicting comparisons of outcome measures between the app and non-app group with (*) indicating statistically significant difference.

<table>
<thead>
<tr>
<th></th>
<th>Non-App Group</th>
<th>App-Group</th>
<th>p value</th>
<th>T value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Percent of Exercise Compliance*</td>
<td>78.3%±13.8</td>
<td>37.6%±25.6</td>
<td>&lt; 0.001</td>
<td>-6.585</td>
</tr>
<tr>
<td>Mean Age*</td>
<td>53.4±18.6</td>
<td>41.4±17.0</td>
<td>0.045</td>
<td>-2.073</td>
</tr>
<tr>
<td>Mean Change in Functional Index Score</td>
<td>21.0±9.3</td>
<td>16.2±13.6</td>
<td>0.566</td>
<td>114.500</td>
</tr>
<tr>
<td>Mean Change in Pain Rating (10 Scale)</td>
<td>-2.4±1.4</td>
<td>-2.6±2.1</td>
<td>0.483</td>
<td>111.000</td>
</tr>
<tr>
<td>Mean Number of Exercises Assigned*</td>
<td>10.7±5.0</td>
<td>5.0±2.7</td>
<td>&lt; 0.001</td>
<td>45.500</td>
</tr>
<tr>
<td>Mean Number of Cancelled Appointments*</td>
<td>0.3±0.5</td>
<td>1.1±1.4</td>
<td>0.03</td>
<td>117.000</td>
</tr>
<tr>
<td>Mean Global Rating of Change</td>
<td>5.4±0.3</td>
<td>6.1±0.2</td>
<td>0.067</td>
<td>85.500</td>
</tr>
</tbody>
</table>
DISCUSSION

The primary purpose of this retrospective study was to determine whether use of the app improved patient compliance to a PT HEP. The results of this study do not support the hypothesis that app users had better exercise compliance than the patients not using the app. Patients solely receiving instruction during therapy sessions and using verbal self-report methods were given significantly more exercises and had significantly higher exercise compliance than the app users. Based on the results of this study, telehealth may be ineffective or even decrease compliance to a PT HEP.

The study relied on accuracy of patients’ self-reported compliance. This was true for both the non-app and app groups, despite different reporting methods between the 2 groups. Inaccurate self-reporting may explain the findings of the study. The app was designed to capture exercise compliance in real time, as the patient completes each exercise. The non-app group exercise compliance was measured via verbal self-report upon their next visit to the physical therapist. Studies have shown that self-reporting of exercise is often inaccurate, with both over and under estimation of physical activity observed. Reliance on self-reported data may lead to inaccurate conclusions due to the inability to adjust for these errors. A systematic review included 74 studies that, on average, reported 60% of study participants over-estimated their activity when comparing self-reported activity levels to actual measured activity. It has also been observed that patients may alter self-reporting based on what they perceive the researcher wants to hear. This indicates that subjects included in the non-app group may have been prone to inaccurately reporting their PT HEP compliance to the therapist due to the nature of the self-reporting method. The results for the compliance of the app group may be more
accurate, as the data is collected at the time of exercise completion, rather than recalled at a later time when verbally asked.

Another plausible explanation for the decreased PT HEP compliance of the app group may be the reporting procedure when using the app. A unique barrier for the app group may have been the novelty of the PT HEP self-reporting feature of the app. Patients may have had difficulty accurately recording exercises, may have forgotten to use the app as they were not accustomed to using a reporting system, or may have preferred to not use the app to record their compliance based on personal preference. Furthermore, self-reporting with the app required subjects to record PT HEP completion for each exercise, adding an additional step to traditional PT HEP. Multiple steps were required of the app users to report PT HEP compliance. Patients may have completed their exercises without recording them in the app. Future research requesting patient feedback regarding exercise recording procedure and perceived barriers unique to app use may provide valuable insight into this potential problem.

App users had significantly fewer exercises assigned to them compared to non-app users as part of their PT HEP. The physical therapist may have given the app users fewer exercises or may have not recorded the exercises in the app because of the time and effort it takes to input exercises. Lack of randomized assignment of patients, as well as inherent differences in impairments or diagnoses between the two groups, may also account for the discrepancy in number of exercises assigned.

A secondary purpose of this study was to determine whether improved compliance to a PT HEP improves patient outcomes. No statistically significant differences were seen in GROC, change in pain, or change in functional index score
between the two groups; however, a trend towards higher GROC for the app group was observed. Although not statistically significant, the app group did have a higher GROC score despite having a decreased rate of PT HEP compliance. Based on these results, it can be concluded that the PT HEP compliance may not significantly influence a patient’s change in function or pain during an episode of care. However, previous studies have established the effectiveness of PT HEP compliance in improving patient outcomes indicating that confounding factors and limitations of research design may have played a role in the results of this study.³,⁴
LIMITATIONS

Of the 41 study participants, 8 patients self-discharged without completing the discharge outcome paperwork. For these patients, change in pain, change in functional index score, and GROC scores were not collected. Of these 8 self-discharged patients, 7 were part of the app group. The therapist did not document the patients’ reason for self-discharge, therefore the data is unavailable for inclusion in the study.

The small sample size increases the risk for type two error, which is indicative of a false negative. Therefore, it is unknown if the same results would be seen in other populations or if there had been a larger sample size. When considering the results of this study in comparison to that of previous research, aforementioned confounding factors, such as app novelty and accurate, consistent app use, may have influenced the effect of the app on PT HEP compliance.7,8,9 Future studies designs should include several changes to decrease confounding factors. An exit interview with the physical therapist would have been beneficial to determine therapist and patient perception and satisfaction with app use. This could have yielded information about the discrepancies observed in the number of exercises assigned. Additionally, the therapist was not given a specific protocol for teaching the patients their PT HEP, adding another possible source of variation. A controlled protocol for PT HEP education would decrease variation between patients. Further patient education for the non-app group, detailing how to calculate percent compliance, would improve research reliability. As the study stands, each patient in the non-app group may have calculated their compliance percentage in different ways. Individual variation in percent compliance calculations may include counting not only repetitions and sets of completion, but also including effort invested, whether or not the
exercises were performed correctly, and other details. Use of the app has the potential to be a more accurate depiction of PT HEP compliance than other self-reporting methods due to real time reporting and readily available accurate exercise instruction, but further research is needed to support this hypothesis.

Differences between subjects in the app group and the non-app group may help explain our results. One statistically significant difference between groups was that of average age. The mean age of the non-app group was 53.4 years old compared the app group which was 41.4 years old. Sluijs et al. found that compliance to PT HEP increased with age. This may explain part of the difference in compliance between the groups as the non-app group had both higher compliance and an older average age.

Another difference observed between groups was insurance coverage. The most used primary insurance of the non-app group was Medicare while Group Health was most common for the app group. This difference is not unexpected as the non-app group also has a higher average age, making it more likely that more of those participants were covered by Medicare. The age difference in groups may explain the difference in insurance provider; however, insurance provider could be indicative of other unknown distinguishing factors. Although there has not been any research to tie insurance provider to PT HEP compliance it is possible that there is an effect.

The groups did have a difference in the ratio between men and women. The non-app group consisted of 5 females and 9 males while the app group consisted of 19 females and 8 males; however, Sluijs et al. found that there was no significant difference in PT HEP compliance between men and women therefore, this did not likely influence the results. A final factor that may have affected the results is that of number of
cancellations between the groups. The mean number of cancellations per patient in the non-app group was 0.3, which is significantly lower than the patients in the app group with a mean of 1.1 cancelled visits. Further research may show that patients who cancel more often are less committed to therapy and therefore less compliant to PT HEP; however, such a claim is beyond the scope of the current work.
CONCLUSION

Use of an app for PT HEP prescription may have limited benefit based on the results of this study. The app was found to be less effective than exclusive, in session education methods at fostering PT HEP compliance. Furthermore, the app users did not have a statistically significant difference when compared to non-app patients on outcomes such as GROC, change in pain, or change in functional index score. Further research is needed to measure the effects of app use for PT HEP. In addition, further research is needed to identify effective methods of overcoming barriers to PT HEP compliance to promote improved outcomes.
APPENDIX

CareConnections Collection Data
Physical Therapy

Patient: John Doe
DOB: 10/20/1980
Gender: Male

Insurance Type & Insurance Company Name: Regence Blueshield

Initial Evaluation Date: 10/1/2013
Referring Provider: Robert Smith, MD
Therapist: Jessica Pare, PT

Primary ICD-9: 719.41 Shoulder
Secondary ICD-9: 728.1 Cervical/Thoracic

Patient D/C'd by clinic (Rx completed)? Date: 1/15/2014 Visits: 12
OR Patient Self-Discharged? Date:

Problem Area

- Upper Extremity
- Lower Extremity
- Cervical/Thoracic
- Lumbar
- TMJ/TMD
- Hand
- Neuromuscular
- Pelvic Floor

Initial Function:
Initial Pain: 75/10

Final Function:
Final Pain: 0/10

Global Rating of Change: 7

Acuity Days:
Acute (less than/equal to 90 days): 30
Chronic (91-120 days):
Chronic (>120 Days):

Work Status & Activity

Work days lost due to condition: 0

- No lost work time
- Return to work without restriction
- Return to work with modification
- Not employed outside the home
- Have not returned to work

Therapist Signature

Please verify that the form is completely filled out, then initial here: __________

Submit this form to ABO when completed and file one copy in patient's chart.
PROBLEM AREA (Please check one):
☐ Upper Extremity (A,D)  ☐ Lower Extremity (B,F)  ☐ Cervical/Thoracic (C,D)  ☐ Lumbar (D,F)  ☐ TMJ (C,E)

FUNCTIONAL INDEX

PART I: Answer all five sections in Part 1. Choose the one answer in each section that best describes your condition.

WALKING
☐ Symptoms do not prevent me walking any distance.
☐ Symptoms prevent me walking more than 1 mile.
☐ Symptoms prevent me walking more than 1/2 mile.
☐ Symptoms prevent me walking more than 1/4 mile.
☐ I can only walk using a stick or crutches.
☐ I am in bed most of the time and have to crawl to the toilet.

WORK
(Appplies to work in home and outside)
☐ I can do as much work as I want to.
☐ I can only do my usual work, but no more.
☐ I can do most of my usual work, but no more.
☐ I cannot do my usual work.
☐ I can hardly do any work at all (only light duty).
☐ I cannot do any work at all.

PERSONAL CARE
(Washing, Dressing, etc.)
☐ I can manage all personal care without symptoms.
☐ I can manage all personal care with some increased symptoms.
☐ Personal care requires slow, concise movements due to increased symptoms.
☐ I need help to manage some personal care.
☐ I need help to manage all personal care.
☐ I cannot manage any personal care.

SLEEPING
☐ I have no trouble sleeping.
☐ My sleep is mildly disturbed (less than 1 hr, sleepless).
☐ My sleep is mildly disturbed (1–2 hrs, sleepless).
☐ My sleep is moderately disturbed (2–3 hrs, sleepless).
☐ My sleep is greatly disturbed (3–5 hrs, sleepless).
☐ My sleep is completely disturbed (5–7 hrs, sleepless).

RECREATION/SPORTS
(Indicate Sport if Appropriate _______________________
☐ I am able to engage in all my recreational/sports activities without increased symptoms.
☐ I am able to engage in all my recreational/sports activities with some increased symptoms.
☐ I am able to engage in most, but not all of my usual recreational/sports activities because of increased symptoms.
☐ I am able to engage in a few of my usual recreational/sports activities because of my increased symptoms.
☐ I can hardly do any recreational/sports activities because of increased symptoms.
☐ I cannot do any recreational/sports activities at all.

ACUITY (Answer on initial visit.)
How many days ago did onset/injury occur? ________ days

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## C. CERVICAL/TMJ

**CONCENTRATION**
- I can concentrate fully when I want to with no difficulty.
- I can concentrate fully when I want to with slight difficulty.
- I have a fair degree of difficulty in concentrating when I want to.
- I have a great deal of difficulty in concentrating when I want to.
- I cannot concentrate at all.

**HEADACHES**
- I have no headaches at all.
- I have slight headaches which come less than 3 per week.
- I have moderate headaches which come infrequently.
- I have moderate headaches which come 4 or more per week.
- I have severe headaches which come frequently.
- I have headaches almost all of the time.

**READING**
- I can read as much as I want without increased symptoms.
- I can read as much as I want with slight symptoms.
- I can read as much as I want with moderate symptoms.
- I cannot read as much as I want because of moderate symptoms.
- I cannot read at all because of severe symptoms.
- I cannot read at all.

## D. LUMBAR*/CERVICAL/UPPER EXTREMITY

**DRIVING**
- I can drive my car or travel without any extra symptoms.
- I can drive my car or travel as long as I want with slight symptoms.
- I can drive my car or travel as long as I want with moderate symptoms.
- I cannot drive my car or travel as long as I want because of moderate symptoms.
- I cannot drive at all or travel because of severe symptoms.
- I cannot drive my car or travel at all.

**LIFTING**
- I can lift heavy weights without extra symptoms.
- I can lift heavy weights but it gives extra symptoms.
- My symptoms prevent me from lifting heavy weights but I manage
  if they are conveniently positioned. (e.g. on a table)
- My symptoms prevent me from lifting light to medium weights if they are conveniently positioned.
- I can lift only very light weights.
- I cannot lift or carry anything at all.

## E. TMJ

**TALKING**
- I can talk without any increased symptoms.
- I can talk as long as I want with slight symptoms in my jaws.
- I can talk as long as I want with moderate symptoms in my jaws.
- I cannot talk as long as I want because of moderate symptoms in my jaws.
- I can hardly talk at all because of severe symptoms in my jaws.
- I cannot talk at all.

**EATING**
- I can eat whatever I want without symptoms.
- I can eat whatever I want but it gives extra symptoms.
- Symptoms prevent me from eating regular food, but I can manage
  if I avoid hard foods.
- Symptoms prevent me from eating anything other than soft foods.
- I can chew soft foods occasionally, but primarily adhere to a liquid diet.
- I cannot chew at all and maintain a liquid diet.

## F. LUMBAR*/LOWER EXTREMITY

**STANDING**
- I can stand as long as I want without increased symptoms.
- I can stand as long as I want, but it gives me extra symptoms.
- Symptoms prevent me from standing for more than 1 hour.
- Symptoms prevent me from standing for more than 30 minutes.
- Symptoms prevent me from standing for more than 10 minutes.
- Symptoms prevent me from standing at all.

**SQUATTING**
- I can squat fully without the use of my arms for support.
- I can squat fully, but with symptoms or using my arms for support.
- I can squat 3/4 of my normal depth, but less than fully.
- I can squat 1/2 of my normal depth, but less than 3/4.
- I can squat 1/4 of my normal depth, but less than 1/2.
- I am unable to squat any distance due to symptoms.

**SITTING**
- I can sit in any chair as long as I like.
- I can only sit in my favorite chair as long as I like.
- My symptoms prevent me sitting more than 1 hour.
- My symptoms prevent me sitting more than 1/2 hour.
- My symptoms prevent me sitting more than 10 minutes.
- My symptoms prevent me from sitting at all.

* Lumbar questions adapted from Oswestry.

## PAIN INDEX

Please indicate the worst your pain has been in the last 24 hours on the scale below

![Pain Index Scale]

**PLEASE DO NOT COMPLETE THE FOLLOWING SECTIONS ON FIRST VISIT**

**GLOBAL RATING OF CHANGE**

With respect to the reason you sought treatment, how would you describe yourself now compared to your first treatment at our clinic? (Circle one)

![Rating Scale]

**WORK STATUS** (check most appropriate)

1. ☐ No lost work time
2. ☐ Return to work without restriction
3. ☐ Return to work with modification
4. ☐ Have not returned to work
5. ☐ Not employed outside the home

Work days lost due to condition: ___________ days

I am aware that the information gathered on this form may be used anonymously for research or publication. Please initial: ___________
REFERENCES


CURRICULUM VITAE

Ellie Cobb, SPT, BS

EDUCATION
- University of Nevada, Las Vegas - Las Vegas, NV
  - Doctorate of Physical Therapy. Expected degree: May 2016
- Northern Arizona University
  - B.S. in Exercise Physiology: May 2012

CLINICAL EXPERIENCE
- Sunrise Children’s Hospital - Las Vegas, NV- April 2016
  - Pediatric Acute Care Hospital, Hem/Onc, PICU, Outpatient Clinic
- Spooner Physical Therapy Ahwatukee – Phoenix, AZ- December 2015
  - Outpatient Orthopedic Physical Therapy
- Hillcrest Health and Rehab – Bellevue, NE - September 2015
  - Skilled Nursing Facility
- Physiotherapy Associates – Omaha, NE - August 2014
  - Outpatient Orthopedic and Sports Physical Therapy

RESEARCH
- D. Young, E. Cobb, J. Hurst, E. Konshuk. Use of a mobile application to increase patient compliance to a prescribed home exercise program and improve outcomes.

PROFESSIONAL PRESENTATIONS
- D. Young, E. Cobb, J. Hurst, E. Konshuk. Use of a mobile application to increase patient compliance to a prescribed home exercise program and improve outcomes. Poster presentation CSM Anaheim, CA. February 17-20, 2016.

CONTINUING/SUPPLEMENTAL EDUCATION
- APTA Combined Sections Meeting: Anaheim, California. February 2016
- Therapeutic Neuroscience Education: Dr. Adriaan Louw. April 2015
• UNLVPT Distinguished Lecture Series: Dr. Timothy W. Flynn. Nov 2014
• UNLV Physical Therapy Research Presentations. May 2014
• Therapeutic Neuroscience Education: Dr. Adriaan Louw. April 2014
• Biomechanical risk factors related to ACL injury: Implications for rehabilitation and return to sport decisions post ACL reconstruction: Dr. Christopher Powers. April 2014
• HIPAA Training. March 2014
• Collaborate Institutional Training Initiative (CITI) Human Research Curriculum Completion. March 2014
• APTA Combined Sections Meeting: Las Vegas, Nevada. February 2014
• UNLVPT Distinguished Lecture Series: Dr. Gail Jensen. June 2013

**PROFESSIONAL MEMBERSHIPS/CERTIFICATIONS**

- American Heart Association Healthcare Provider (2014-Present)
  - CPR and AED Certification

- Member of American Physical Therapy Association (2013-Present)
Jed Hurst, SPT, BS

EDUCATION

- University of Nevada, Las Vegas: Las Vegas, Nevada.
  - Doctor of Physical Therapy. Expected degree: May 2016

- Utah Valley University: Orem, Utah
  - Bachelor of Exercise Science. April 2013

CLINICAL EXPERIENCE

- The Orthopedic Specialty Hospital: Murray, Utah - April 2016
  - Inpatient orthopedic physical therapy

- Aspen Ridge Transitional Rehabilitation: Midvale - December 2015
  - Inpatient rehabilitation

- Meier and Marsh Physical Therapy: Toole, Utah - September 2015
  - Outpatient physical therapy

- Jordan Valley Medical Center: West Jordan, Utah - August 2014
  - Outpatient physical therapy

RESEARCH

- D. Young, E. Cobb, J. Hurst, E. Konshuk. Use of a mobile application to increase patient compliance to a prescribed home exercise program and improve outcomes.

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  o CPR and AED Certification
• Member of American Physical Therapy Association (2013-Present)
Ethan Konshuk, SPT, BS

EDUCATION
- University of Nevada, Las Vegas - Las Vegas, NV
  - Doctorate of Physical Therapy. Expected degree: May 2016
- Brigham Young University Idaho - Rexburg, ID
  - B.S. in Exercise Physiology: December 2012
  - Minor: Fitness and Exercise
- Eastern Washington University - Cheney, WA
  - No degree earned
  - 50 college credits earned during junior and senior years of high school

CLINICAL EXPERIENCE
- HealthSouth Desert Canyon - Las Vegas, NV - April 2016
  - Inpatient rehabilitation hospital
- Providence - St Peters - Olympia, WA - December 2015
  - Acute Care Hospital, oncology, renal, general med/surg floors
- Proactive Orthopedic and Sports Physical Therapy - Vancouver, WA - Sept 2015
  - Outpatient Orthopedic and Sports Physical Therapy
- Total Rehab Center - Somerset, KY - August 2014
  - Outpatient Orthopedic Physical Therapy

RESEARCH
- D. Young, E. Cobb, J. Hurst, E. Konshuk. Use of a mobile application to increase patient compliance to a prescribed home exercise program and improve outcomes.

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  ○ Neurology Section
  ○ Orthopedic Section