USE OF A BLUETOOTH TABLET-BASED TECHNOLOGY TO IMPROVE OUTCOMES IN LUNG TRANSPLANTATION

A Pilot Study

Am J Transplant. 2020;20:3649–3657.

INTRODUCTION

- Non-compliance is a chronic problem in lung transplant recipients
- Home spirometry initiated in 1995 at Keck Medical Center
- Pocket PATH program at University of Pittsburgh
- Early detection of issues results in early interventions, decreased visits and admissions
- Increased education and knowledge of post transplant care
- Empowers the patient to be active in their own care
- Increased quality of life

REMOTE MONITORING SOLUTION

- System deployed (ActiCare Health, Livermore, CA) uses Bluetooth to transmit patient information, symptoms and activity level to transplant coordinators in real time
- Platform allows for face-to-face communication between patients and providers, including an educational library complete with video content, tutorials, and self-assessments
- To encourage patient compliance with daily reporting, humorous memes, inspirational messages, and incentive badges are transmitted
- Weekly compliance reports are generated to transplant center to reinforce need for compliance

Pulmonary Function Testing and Oxygen Sats

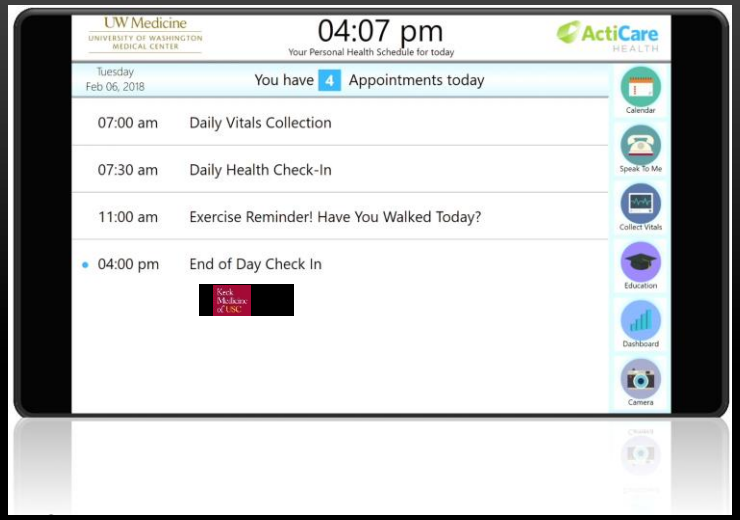
Blood Glucose Monitoring

Comprehensive Blood Pressure Monitoring

Weight Monitoring

Temperature Monitoring

Activity Monitoring (Pedometer)



Microsoft Surface Tablet Patient Service Hub

- Fully connected
- Education Center
- Tutorials & Self Assessments
- Daily Care Calendar
- Live Telehealth
- Photo capabilities

ActiCare HEALTH

MORE ABOUT THE PLATFORM

- Arrives ready to use from box
- Ability to have face to face interactions via secure videoconference
- Live person provides 1:1 training, interprets results, contacts patient, and notifies program of results
- Provides reminders
- Ability to trend reports
- Monitor usage of video tutorials
- Congratulatory messages and memes

ALERT CAPABILITIES

- Alert parameters set by transplant program: glucose, PFTs, blood pressure, oxygen saturation, patient symptoms
- Non – critical alerts
- Critical alerts

REPORTING FREQUENCY

- Customizable to program needs
- Report daily for 3 months at our center
- Report 3 times a week for remainder of first year, though many keep reporting daily
- Discontinuation at one year at discretion of center

CASE STUDY

Use of a Bluetooth tablet-based technology to improve outcomes in lung transplantation: A pilot study

Felicia A. Schenkel[1] | Mark L. Barr[2] | Chris C. McCloskey[3] | Tammie Possemato[1] | Jeremy O'Conner[1] | Roya Sadeghi[1] | Maria Bembi[1] | Marian Duong[1] | Jaynita Patel[1] | Amy E. Hackmann[2] | Sivagini Ganesh[4]

[1]Keck Medical Center, University of Southern California, Los Angeles, California

[2]Division of Cardiothoracic Surgery, Department of Surgery, University of Southern California, Los Angeles, California

[3]ActiCare Health, Livermore, California

[4]Division of Pulmonary and Critical Care Medicine, Department of Medicine, University of Southern California, Los Angeles, California

Correspondence
Felicia A. Schenkel
Email: fschenkel@med.usc.edu

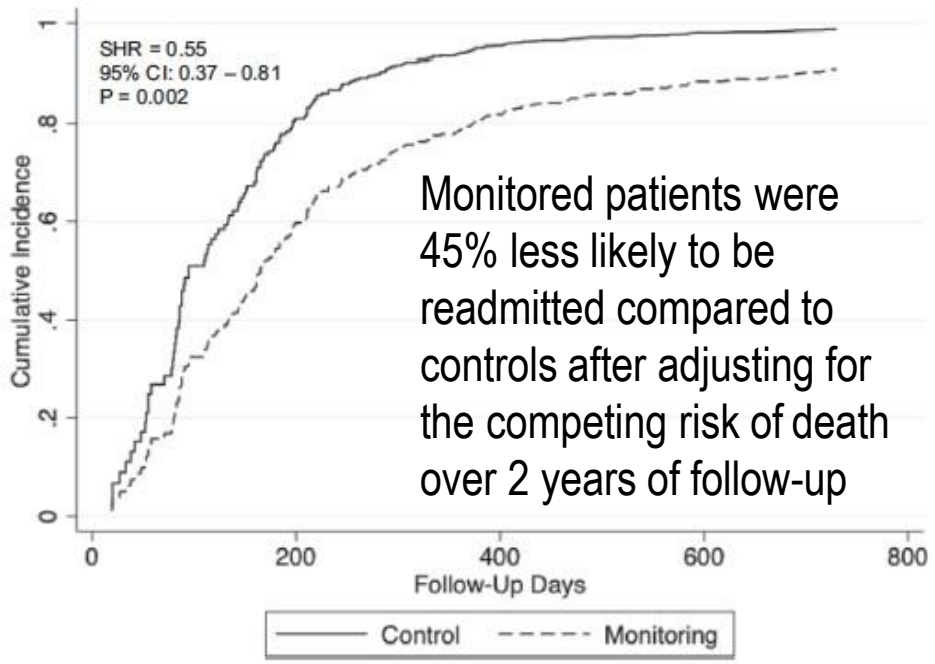
Funding information
USC Transplant Institute at the Keck Hospital of University of Southern California

The impact of remote patient monitoring platforms to support the postoperative care of solid organ transplant recipients is evolving. In an observational pilot study, 28 lung transplant recipients were enrolled in a novel postdischarge home monitoring program and compared to 28 matched controls during a 2-year period. Primary endpoints included hospital readmissions and total days readmitted. Secondary endpoints were survival and inflation-adjusted hospital readmission charges. In univariate analyses, monitoring was associated with reduced readmissions (incidence rate ratio [IRR]: 0.56; 95% confidence interval [CI]: 0.41-0.76; $P < .001$), days readmitted (IRR: 0.46; 95% CI: 0.42-0.51; $P < .001$), and hospital charges (IRR: 0.52; 95% CI: 0.51-0.54; $P < .001$). Multivariate analyses also showed that remote monitoring was associated with lower incidence of readmission (IRR: 0.38; 95% CI: 0.23-0.63; $P < .001$), days readmitted (IRR: 0.14; 95% CI: 0.05-0.37; $P < .001$), and readmission charges (IRR: 0.11; 95% CI: 0.03-0.46; $P = .002$). There were 2 deaths among monitored patients compared to 6 for controls; however, this difference was not significant. This pilot study in lung transplant recipients suggests that supplementing postdischarge care with remote monitoring may be useful in preventing readmissions, reducing subsequent inpatient days, and controlling hospital charges. A multicenter, randomized control trial should be conducted to validate these findings.

KEYWORDS
business/management, clinical research/practice, economics, health services and outcomes research, hospital readmission, lung transplantation/pulmonology, monitoring: physiologic, organ transplantation in general, outpatient care, quality of care/care delivery

CUMULATIVE INCIDENCE OF READMISSION

FIGURE 1 Cumulative incidence of readmission estimated by the Fine-Gray Model with death as the competing risk. CI, confidence interval; SHR, subdistribution hazard ratio



Monitored patients were 45% less likely to be readmitted compared to controls after adjusting for the competing risk of death over 2 years of follow-up

EVENT-FREE PATIENT SURVIVAL

93% of monitored patients survived to 2 years compared to 79% of controls

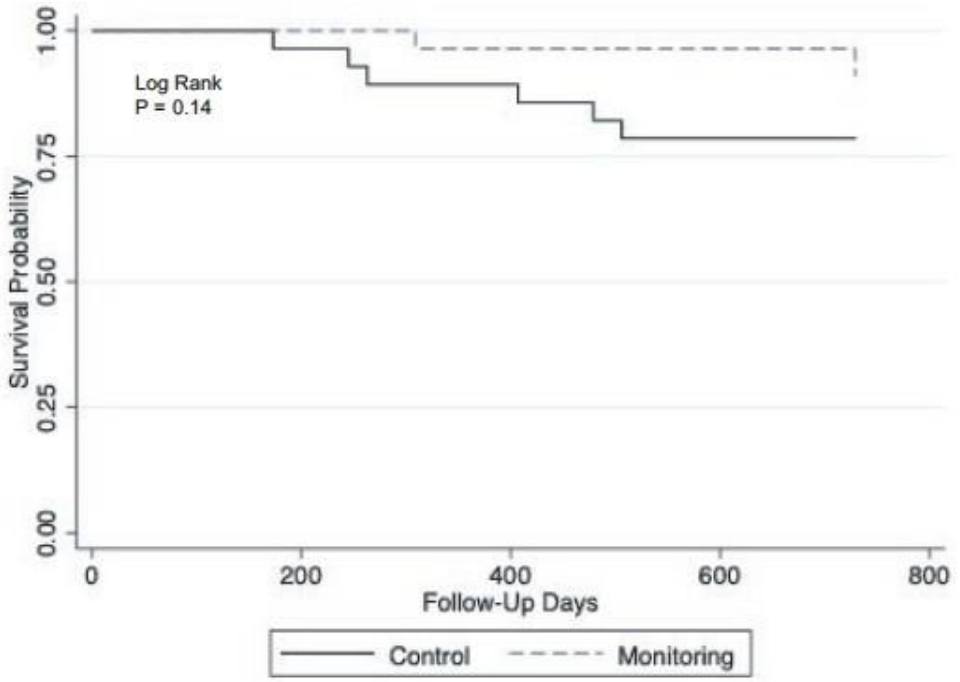


FIGURE 2 Kaplan-Meier curves comparing survival probabilities for remote monitoring and controls

STUDY LIMITATIONS

- Small sample size
- Single center study
- Unmeasured confounding
- No quality of life metric evaluated
- Minimal reimbursement on the part of insurers
- Long-term patient dependency on system, security

ActiCare HEALTH

Transplant Monitoring Program
Patient Weekly Activity Report

6111 Southfront Rd., Suite M
Livermore, CA 94551
1-844-303-2284

WEEKLY ACTIVITIES THROUGH Mar 25, 2018

PATIENT INFORMATION

Patient Name	Demo Patient
Patient MRN	00246897531

VITALS, DAILY, & NIGHTLY CHECK-IN COMPLIANCE

COMMENTS:

Patient exhibits moderate to high compliance, reporting vitals and completing health check-ins most days or the week. Patient attended scheduled weekly call on 03/23.

Date	Vital Signs	Daily Health Check-In	Nightly Check-In
March 19, 2018	Completed		
March 20, 2018	Completed	Completed	
March 21, 2018	Completed	Completed	
March 22, 2018	Completed	Completed	
March 23, 2018	Completed	Completed	
March 24, 2018	Completed	Completed	
March 25, 2018	Completed	Completed	
COMPLIANCE	100%	86%	0%

PATIENT ALERTS (PAST 7 DAYS & ALL OUTSTANDING)

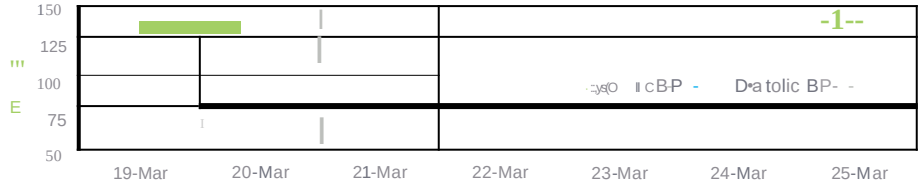
COMMENTS:

There are 11 open alerts from the past week. The patient's systolic BP fluctuated this week ranging from a low of 123 to a high of 143. The patient's heart rate ranged from 81 to 94. The patient's FEV1 fluctuated from a low of 151 to a high of 164. The patient's FEF25-75 ranged from 82 to 93. The patient's blood glucose was between 97 and 131. All other parameters traveled within a consistent range. Trend charts can be found on the pages that follow.

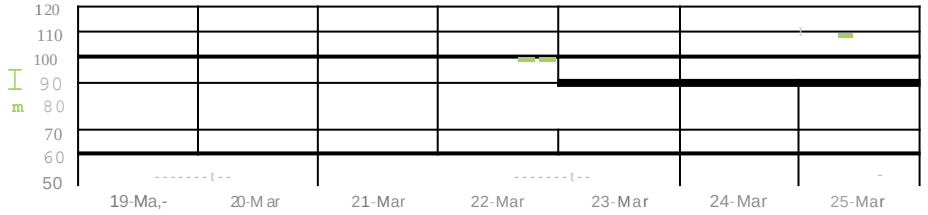
Alert	Date Reported	Status	Days Outstanding
Cough	25-Mar-18	Open	0
Thick phlegm	25-Mar-18	Open	0
Shortness of breath	25-Mar-18	Open	0
Cough	23-Mar-18	Open	2
Chest congestion	23-Mar-18	Open	2
Fever	23-Mar-18	Open	2
Chills	23-Mar-18	Open	2
FEF 25-75 - low (0.82)	22-Mar-18	Open	3
Cough	22-Mar-18	Open	3
Unable to cough up phlegm	22-Mar-18	Open	3
Chest congestion	22-Mar-18	Open	3

PATIENT 7-DAY VITAL SIGN TRENDS

BLOOD PRESSURE

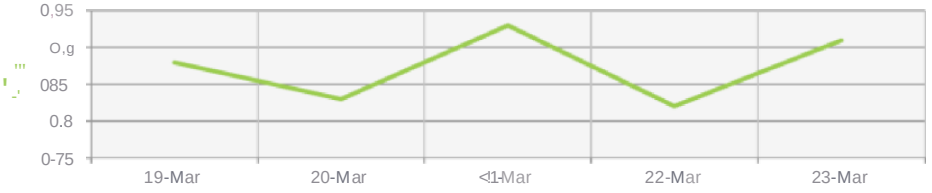


HEART RATE



LUNG FUNCTION (FEV1)

LUNG FUNCTION (FEF25-75)



CASE STUDIES

- 3 patients: decreased spirometry…documented allograft rejection (2 - A1 and 1 A2)
- 1 patient: persistent HTN…managed at home
- 1 patient: desaturation…DVT / PE
- 1 patient: bradycardia…due to amiodarone toxicity
- 1 patient: decreased spirometry…URI secondary to influenza
- 1 patient: reported abdominal pain…SBO requiring emergent surgery