# ATOM-HP: Analytical Technologies to Objectively Measure Human Performance

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Integrated Media Systems Center[1], Department of Biological Sciences[2], Keck School of Medicine of USC[3]
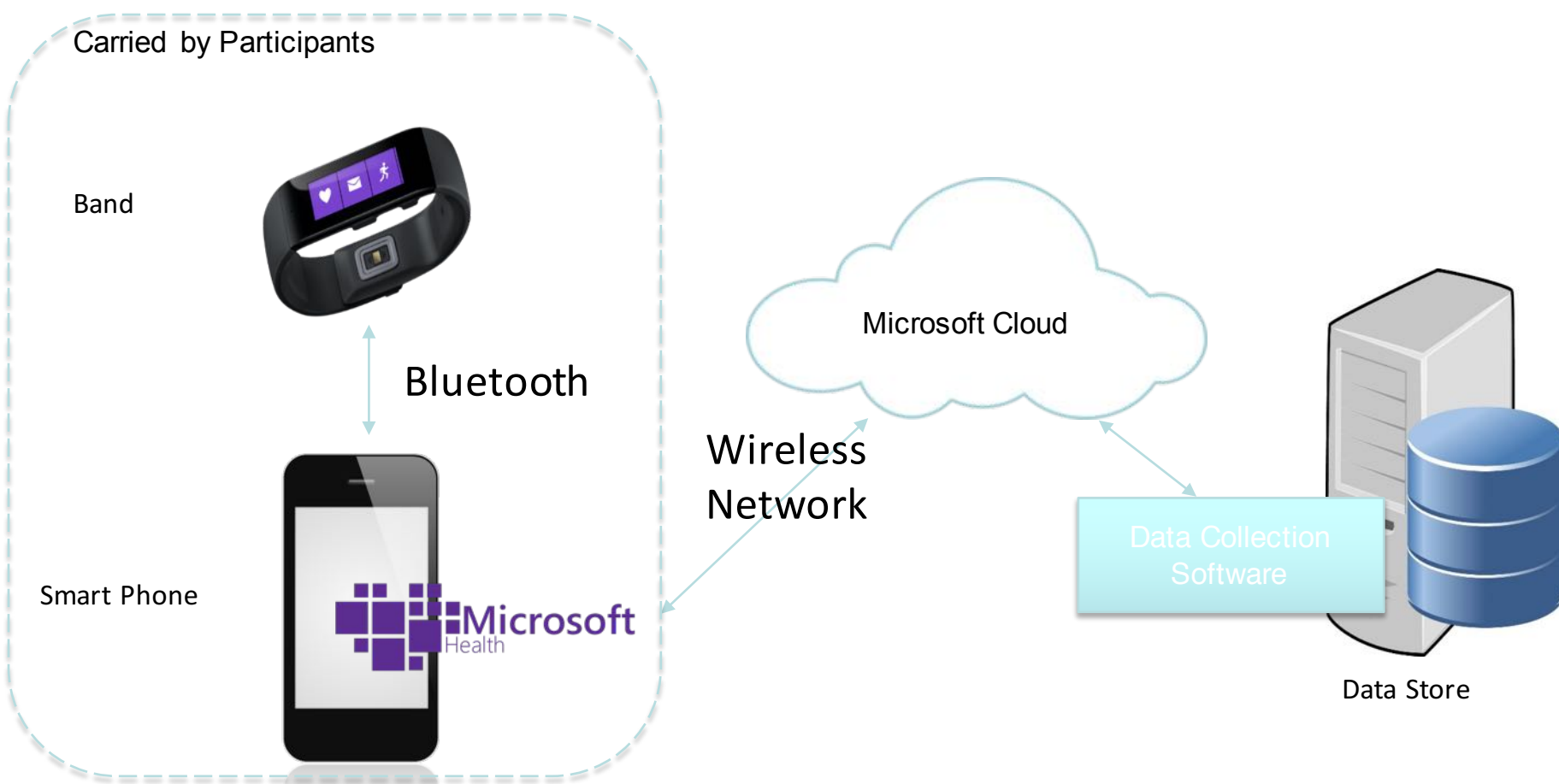University of Southern California, Los Angeles, CA    **BigData in Health**

## Introduction

- **Cancer patients undergoing treatment**
- The successful mission completion/survival of warfighters
- Technology to measure performance
- **Exceptional development of sensors**
- 3D Camera sensor (Depth, Infrared, RGB,…)
- Wearable sensor



## Motivation

### Previous Work

- Mobility Assessment using a Single 3D Sensor [1]



Eigenvector 1   Eigenvector 2   Eigenvector 3   Eigenvector 4
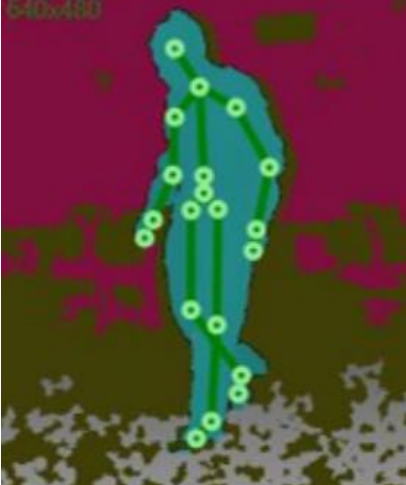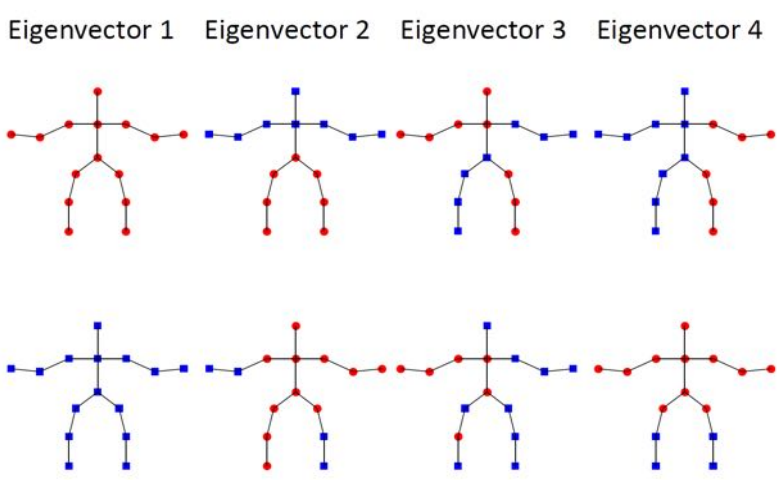
- Activity Recognition Using Wrist-Worn Sensors for Human Performance Evaluation [2]
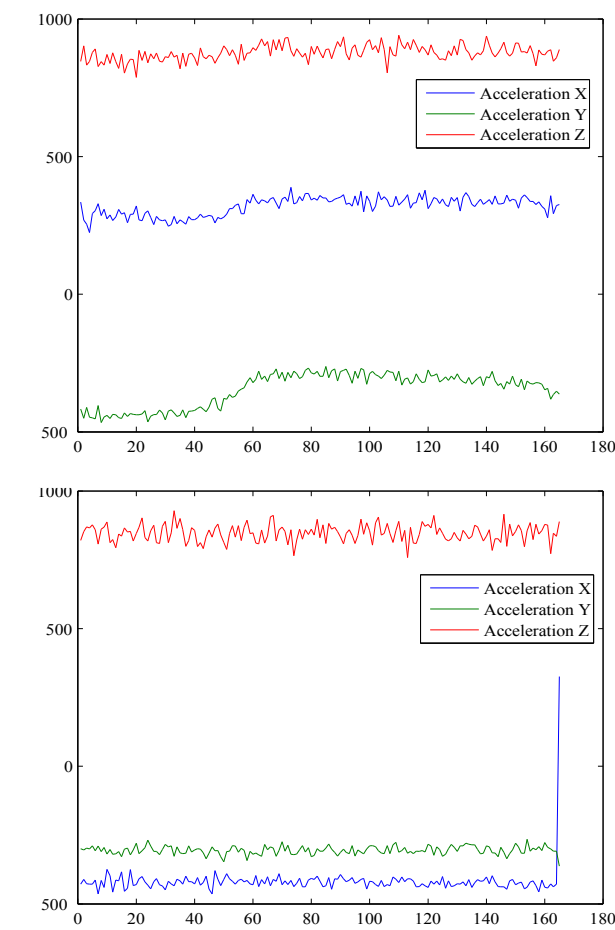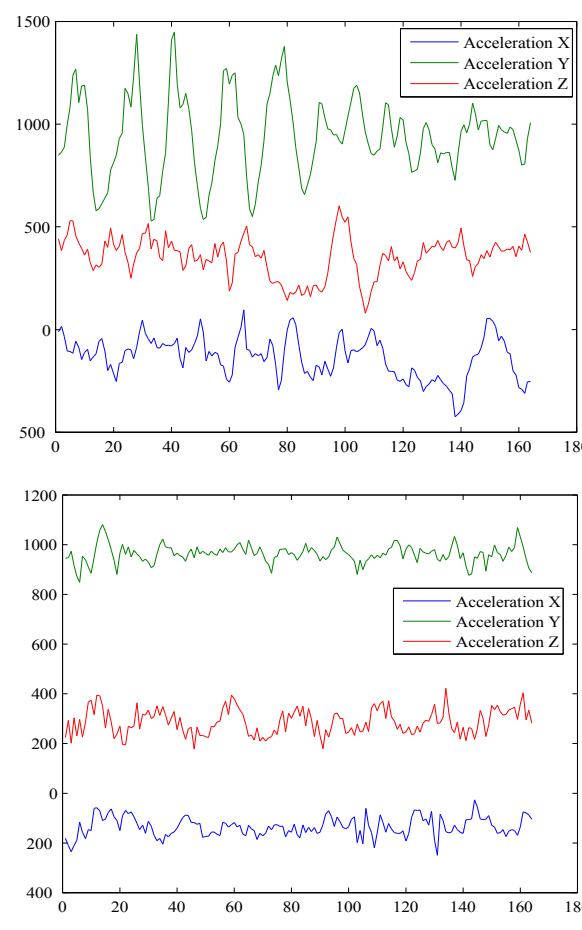


Sitting    Walking    Lying    Standing

### Condition

- PS [3] remains best predictor of patient survival in patients with metastatic cancer: better than genomics, blood based biomarkers, imaging
- Evaluation limited to observations during visits

| ECOG Performance Status Scale | |
|---|---|
| Grade | Description |
| 0 | Normal activity.  Fully active, able to carry on all pre-disease performance without restriction. |
| 1 | Symptoms but ambulatory.  Restricted in physically strenuous activity, but ambulatory and able to carry out work of a light or sedentary nature (*e.g.*, light housework, office work). |
| 2 | In bed <50% of the time.  Ambulatory and capable of all self-care, but unable to carry out any work activities.  Up and about more than 50% of waking hours. |
| 3 | In bed >50% of the time.  Capable of only limited self-care, confined to bed or chair more than 50% of waking hours. |
| 4 | 100% bedridden.  Completely disabled.  Cannot carry on any self-care.  Totally confined to bed or chair. |
| 5 | Dead. |

## System

### Home Remote Patient Monitoring



Carried by Participants

Band

Bluetooth

Smart Phone

Microsoft Health

Wireless Network

Microsoft Cloud
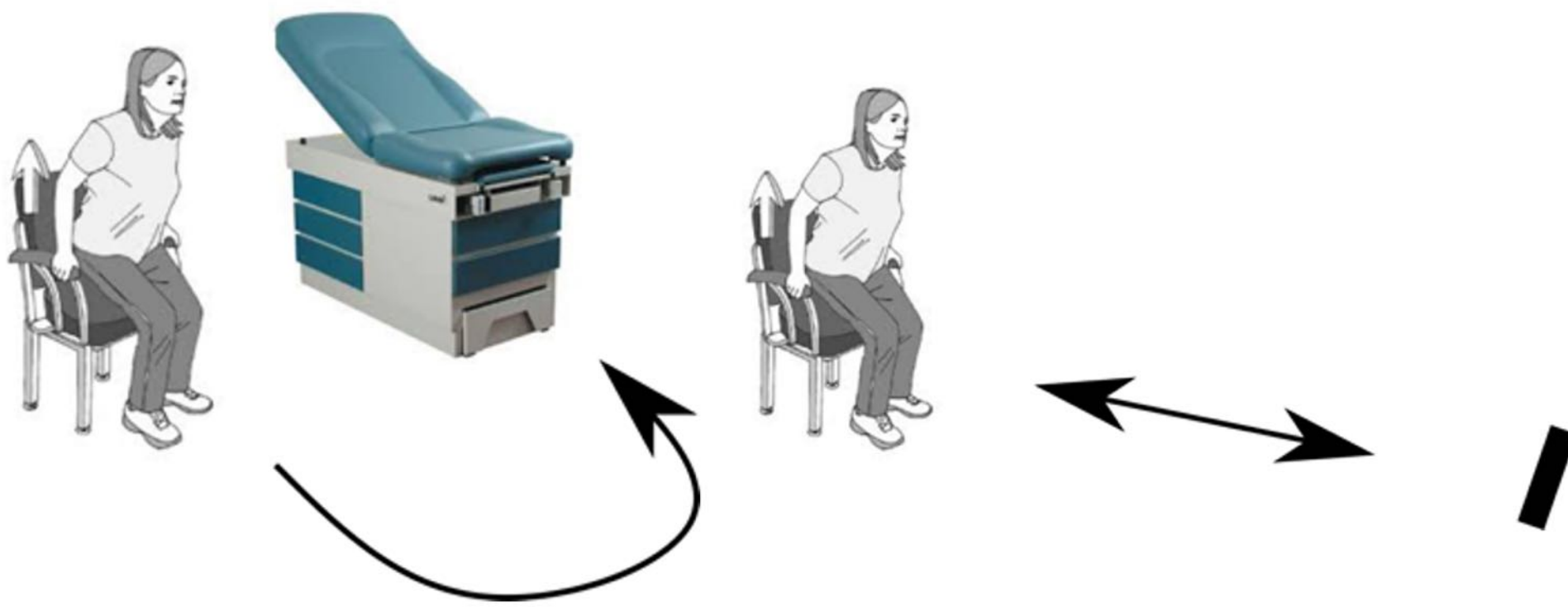
Data Collection Software

Data Store

### In the Clinic
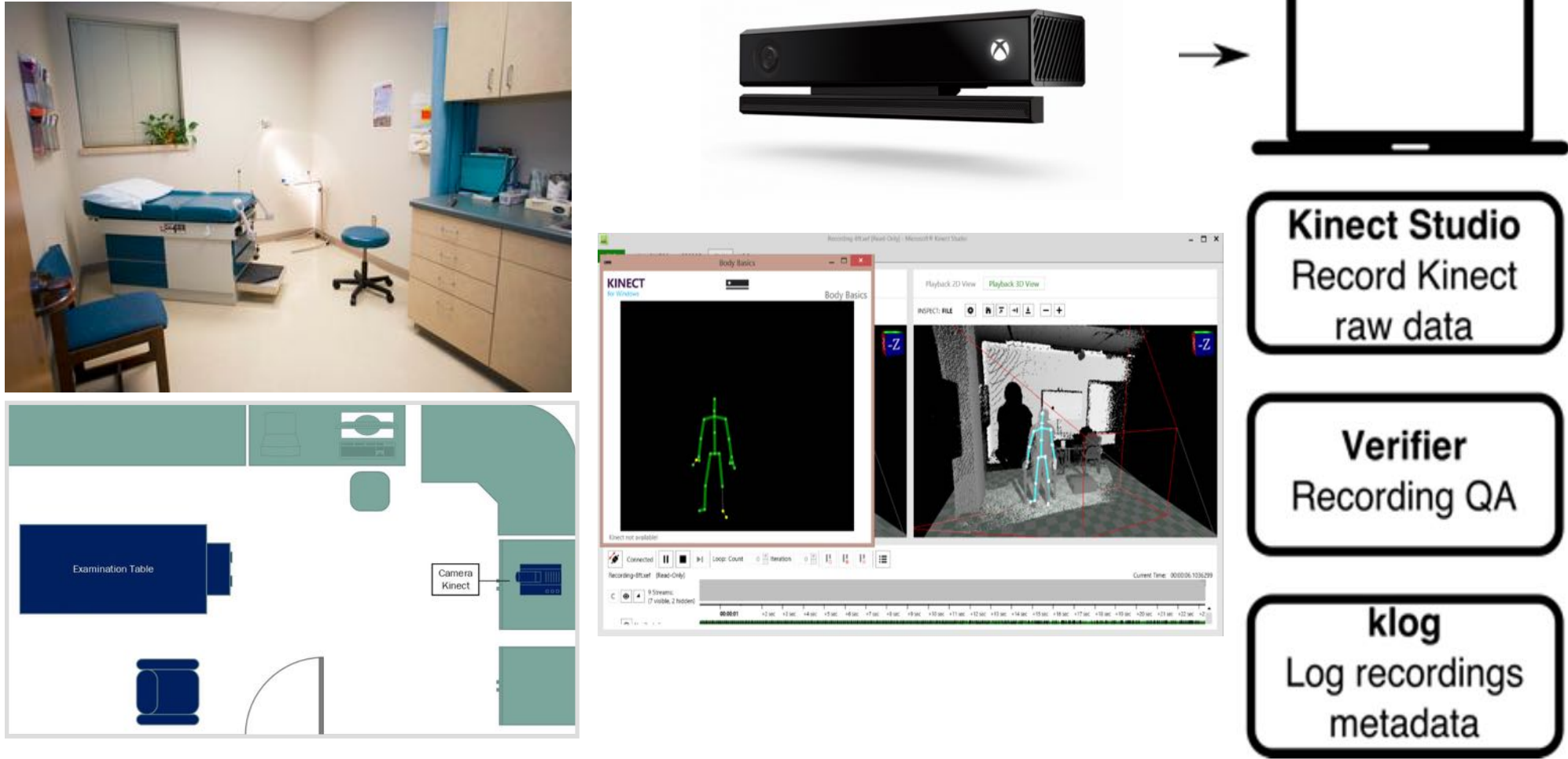
- Tasks for Clinical Study

Chair to Exam-Table          Get-Up and Go



- Mobility Recording / Process



**Kinect Studio** — Record Kinect raw data

**Verifier** — Recording QA

**klog** — Log recordings metadata

- Mobility Data Analysis



## Related Research

[1] L. Nocera et al. "Towards Assessing Mobility in Parkinson's Disease Patients Using a Single 3D Sensor" to appear in Journal of Neurorehabilitation & Neural Repair, Oct.15.
[2] M. Nguyen, et al. "Activity Recognition Using Wrist-Worn Sensors for Human Performance Evaluation", IEEE International Conference on Data Mining (ICDM 2015), Nov.15.
[3] M.M.Oken, et al. "Toxicity and response criteria of the Eastern Cooperative Oncology Group." *American journal of clinical oncology* 5.6 (1982): 649-656.