INTEGRATING DIGITAL INTERVENTIONS WITH THE CLINICAL ENTERPRISE

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Overview

Digital Health

o What it is and where it fits within Biomedical Informatics

o Examples

o Quality and effectiveness

The Clinical Enterprise

o Electronic health record systems

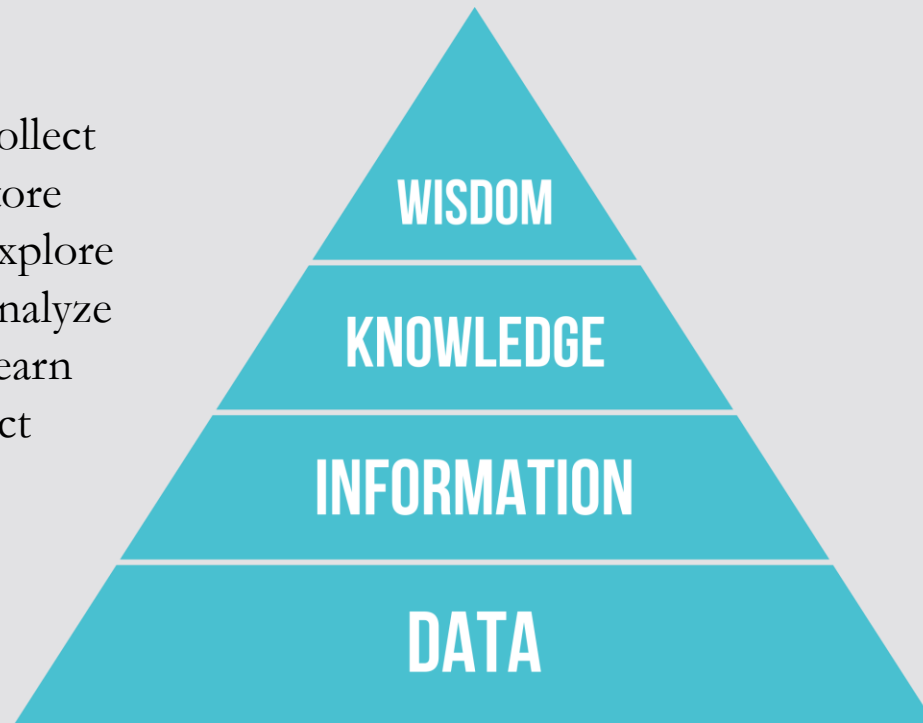o Other informatics systems

Steps Towards Successful Integration

o Case-studies

o Lessons Learned

Biomedical Informatics

Informatics

o Biomedical informatics is the field devoted to improving biomedical research, human health care, heath outcomes through the **optimal use of information**, with the aid of informatics and data-centric sciences (adapted from AMIA)

- Collect
- Store
- Explore
- Analyze
- Learn
- Act

What is Digital Health?

Digital Health

o (Electronic health, or eHealth) is the use of electronic/informatics systems to improve care, and more generally, to improve health

Informatics systems

o Hardware

o Software

o Data and Information

Examples

Telehealth

o The use of electronic information and telecommunication technologies to support remote clinical health care, patient and professional health-related education, health administration, and public health (adapted from HRSA)

o Well integrated into the clinical enterprise

Mobile health (mHealth)

o The use of mobile technologies (e.g. smartphones, tablets, Bluetooth glucosemeter, etc.) and other wearable devices to improve care and health

Digital Health in Numbers

o 85% Americans have a smartphone (uptake lower primarily in older rural populations)

o 60% Americans use the Internet to find health-related information

o 45% Americans use the Internet specifically to find weight loss-relevant information

o There are over 350,000 mobile apps available for android and iPhone…JUST for health

o There are over 400 wearable devices available from 266 companies (2016) and related to health monitoring

Pew Research Center. Mobile Technology Fact Sheet. 2021
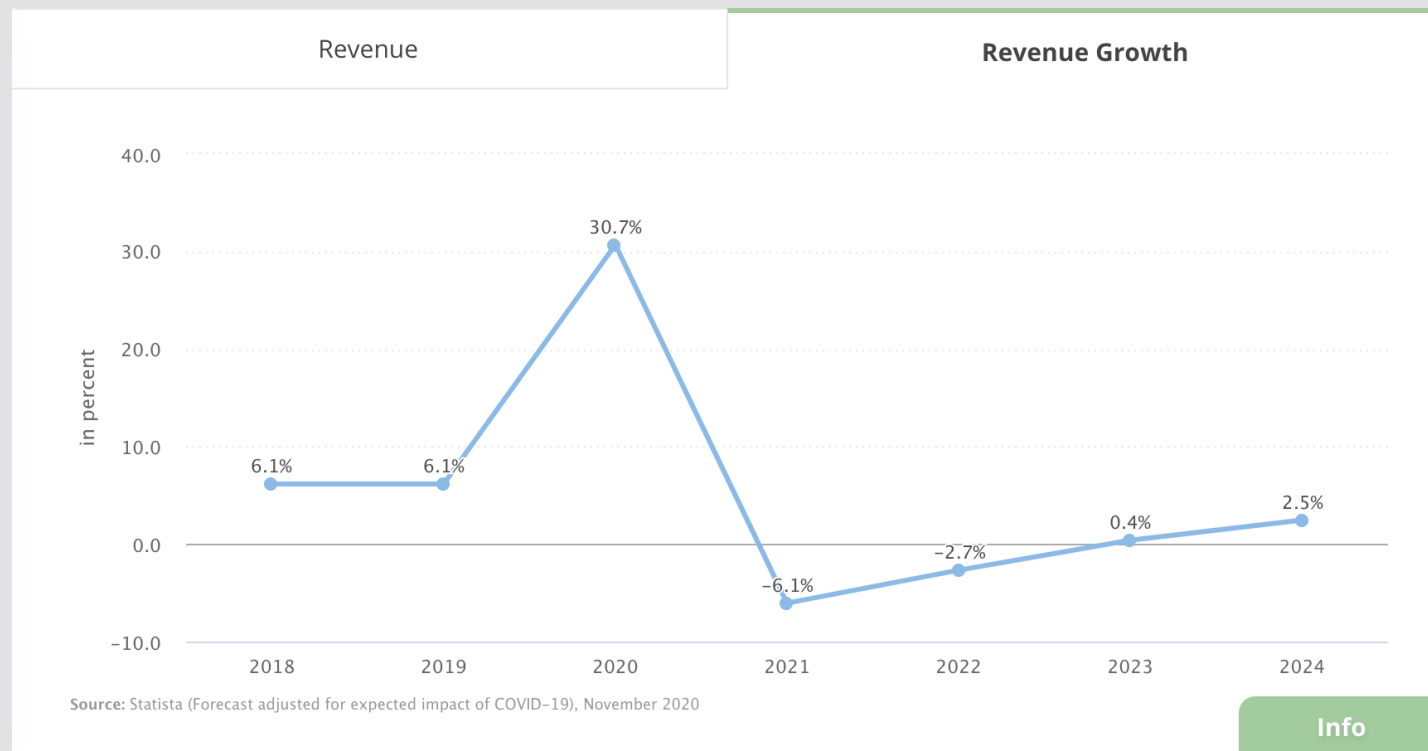Vandrico. The Wearable Technology Database. 2017
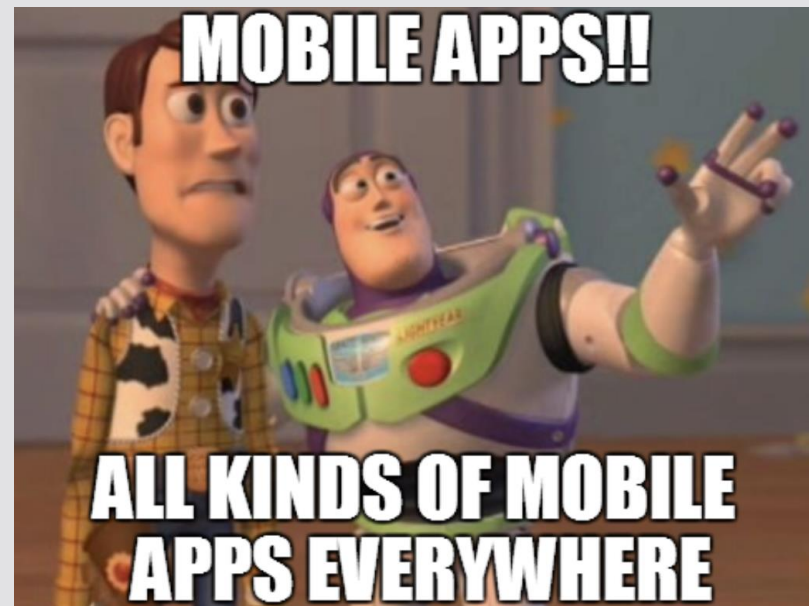
The Impact of COVID-19

Telehealth

o Locked down led to canceling of elective procedures and care delivery via telehealth

Wearables

Revenue	Revenue Growth

Source: Statista (Forecast adjusted for expected impact of COVID-19), November 2020

Info

Apps: Quality & Effectiveness

Yes, they work!

o Emerging body of literature indicating that Internet-based strategies and mobile apps could be effective ways to improve clinical care, and to deliver customized, preference-sensitive, culturally-sensitive health behavior interventions

o Advances in informatics <u>allow</u> the seamless integration of digital health with Electronic Health Record systems (EHRs) e.g. FHIR, SMART-on-FHIR

Apps: Quality & Effectiveness

Or maybe not

- Emerging body of literature indicating that many online resources and apps are not evidence-based and/or poorly informed
    - Inaccurate information (Modave et al., "Analysis of the accuracy of weight loss information search engine results on the internet", *American Journal of Public Health,* 2014, etc.)
    - Incomplete (Eng et al. "The promise and peril for mobile health applications for diabetes and endocrinology". *Pediatr Diabetes*, 2013, etc.)
    - Not designed with the user in mind (Chavez et al. "Mobile apps for the management of diabetes". *Diabetes Care*, 2017, etc.)

- But in practice…they are not integrated (since …MYCIN!)

- This is a big issue in clinical settings!

Electronic Health Records

EHR

o A clinical information system that supports the daily work of healthcare providers who interact directly with the patient to improve her/his health

o Different subtypes: inpatient, outpatient/ambulatory, ED, Group practice, Hospital

Key Players

o Windows based: Epic and Cerner, both running on Citrix

o Web-based: Vista (VA), running as an intranet web application

EHR and care

Benefits:

o Things do not get lost

o Legibility improved

o Searchable (somewhat)

Negatives

o Expensive

o Difficult to deploy

o Weak evidence that they improve care (Brenner SK et al. Effects of health information technology on patient outcomes: a systematic review. JAMIA. 2016;23(5):1016-36.)

o Don't play well with others → Interoperability and integration (business model) are subpar, which leads to data gaps and discontinuity of care

The Clinical Enterprise

396   C.J. McDonald et al.
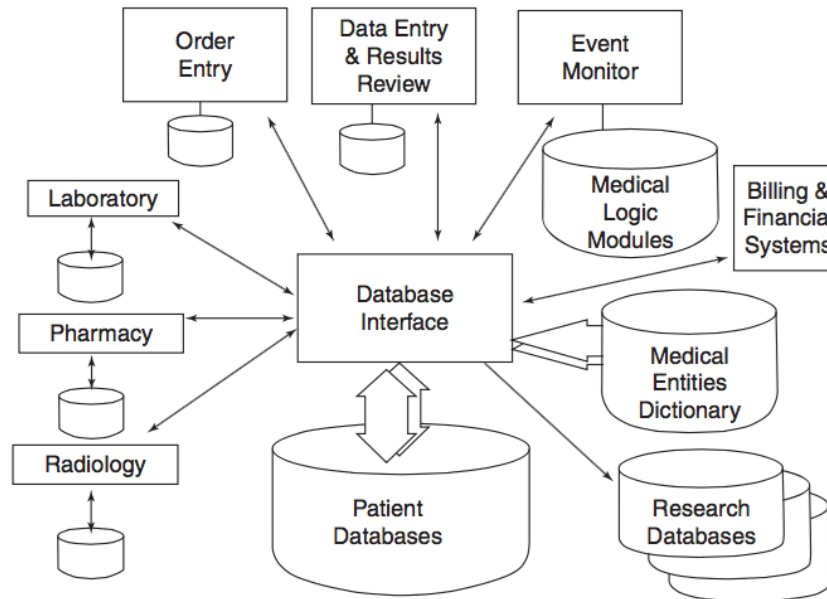
Fig. 12.2 A block diagram of multiple-source-data systems that contribute patient data, which ultimately reside in a computerized patient record (CPR). The database interface, commonly called an interface engine, may perform a number of functions. It may simply be a router of information to the central database. Alternatively, it may provide more intelligent filtering, translating, and alerting functions, as it does at Columbia University Medical Center (Source: Courtesy of Columbia University Medical Center, New York)

More broadly, includes personnel, patients, patient advocates, etc.

Data Types
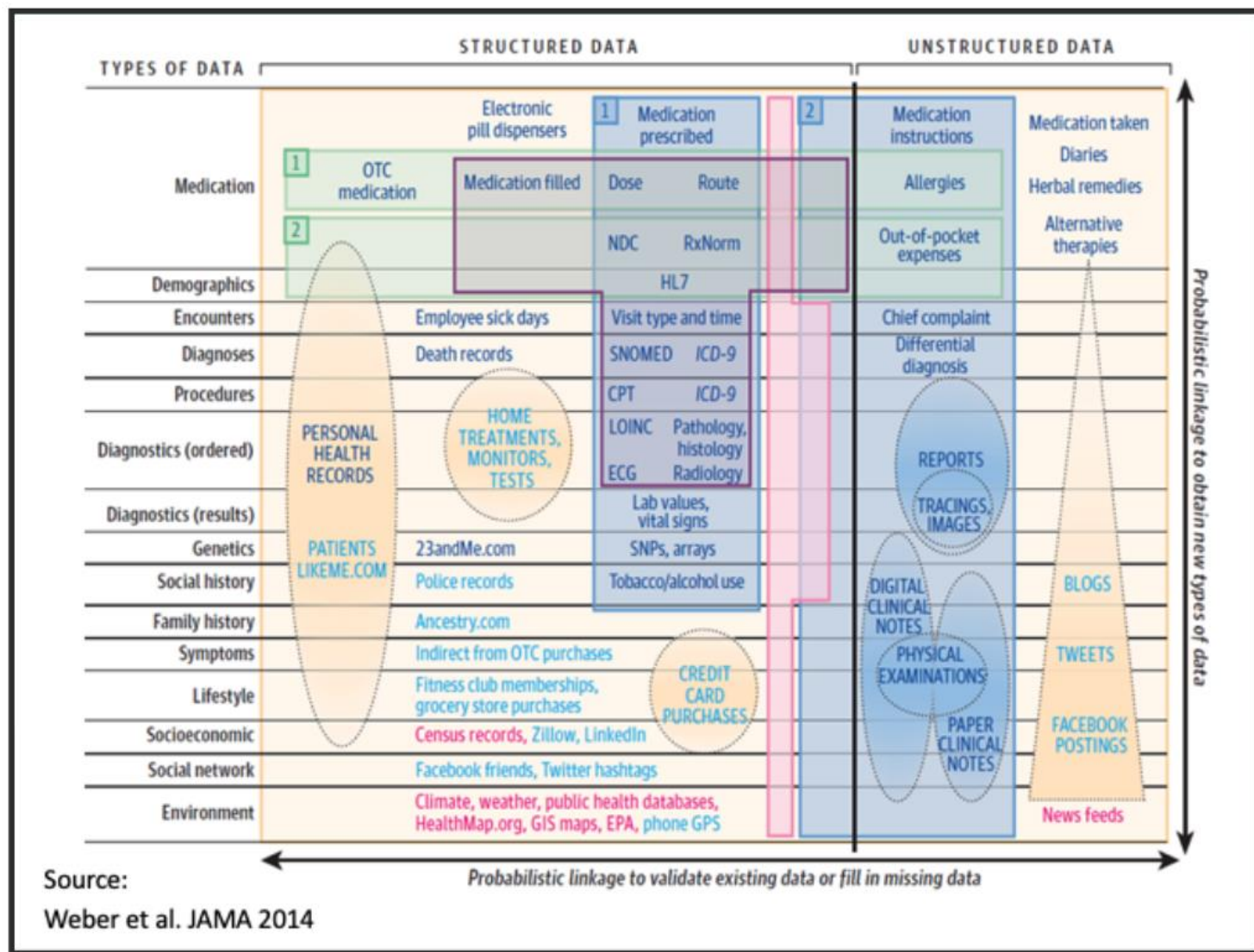
Source: Weber et al. JAMA 2014

Integration

Elements of integration

o Personal: who are the users

o Technical: hardware, software, data components

o Legal: dealing with EHR data, HIPAA and connectivity with other tools

Digital Health Done Right

User integration (personal)

o User-centered design and development

- Patients → focus groups
- Providers → in-depth, semi-structured, structured interviews

System (technical)

o Verification & Validation

o Security & Privacy

o Integration

User-Centered Design

What is UCD

o An iterative process where designers and users work together in phases to ensure that what is designed meets the needs of the user

UCD in an Agile framework

o Agile is (initially) a software process to ensure software is developed to meet the needs of the users, while performing correctly and reliably

Case-study: DiaFit

Complementing the standard of care with mHealth

o DiaFit: a mobile app for the management of diabetes and obesity for patients and providers
o Integrates all components of diabetes management (ADA)
o Automated messaging based on user data
o Open source
o Integrates with Epic

Team and stakeholders

o Chief of Internal Medicine, endocrinologist, nurse scientist, registered dietitian, software engineers, IT specialists, Epic team
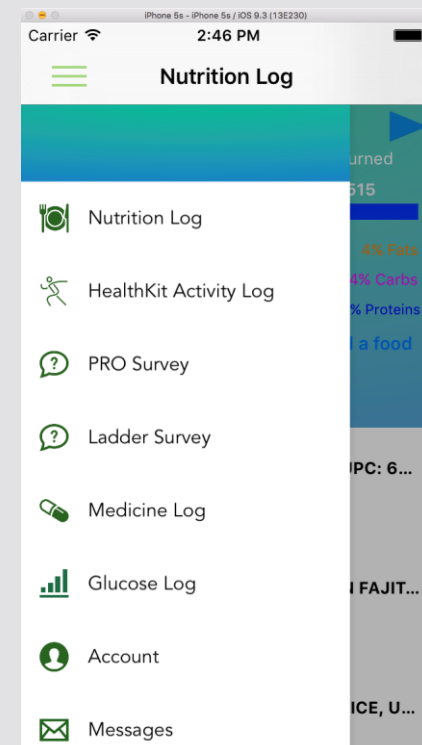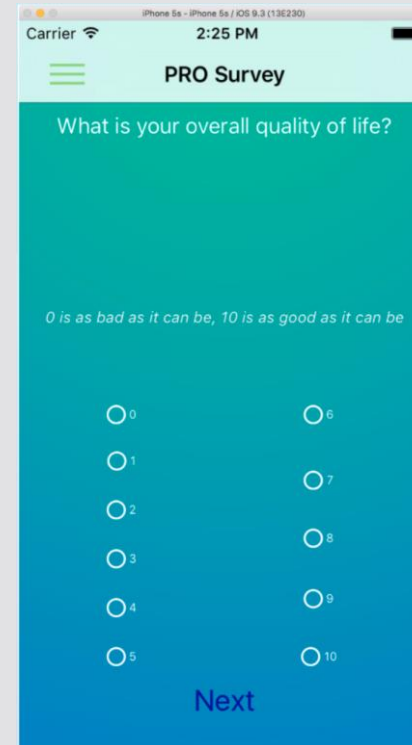o And…Patients/Community Advocates

DiaFit

Physicians

o In-depth interviews

o Semi-structured interviews

Patients (citizen scientists)

o Focus groups

Everyone

o Brainstorming sessions

o Co-authors

Modave F, et al. DiaFit: The Development of a Smart App for Patients with Type 2 Diabetes and Obesity. JMIR Diabetes. 2016 Jul-Dec;1(2):e5. doi: 10.2196/diabetes.6662. PMID: 29388609; PMCID: PMC5788459

Case-study: ALEX

Increasing CRC screening among low to medium risk patients

o Shift the time burden from primary care practice to technology

o Virtual humans

o Integrate with EHR → messaging though MyChart

Focusing on racial and ethnic minorities

o Use the flexibility of virtual humans: preliminary data suggest that racial and ethnic minorities may be more comfortable discussing screening with a provider they can relate to

o UCD to create ALEX, a "Virtual Doctor"

Griffin L, et al. Creating an mHealth App for Colorectal Cancer Screening: User-Centered Design Approach JMIR Hum Factors 2019;6(2):e12700

ALEX

Team and stakeholders

o   Health communication experts, computer scientists, BMI, IDR team

EHR Integration

o FHIR not an option early on

o Worked with EHR team to use MyChart for ALEX

3 arm-RCT (N=1,363, B/W adults 50-73)

o Animated VH

o Static VH

o Attention control (text info)

o Primary outcome: intention to discuss CRC with provider

ALEX

Variables	B (SE)	p-value
Intervention conditions		
Animated VHA (ref) versus control	**0.32 (0.1)**	**0.003**
Static VHA (ref) versus control	0.08 (0.11)	0.74
Animated VHA (ref) versus static VHA	**0.24 (0.10)**	**0.041**
Interaction		
Static VHA X race concordance	**0.22 (0.11)**	**0.043**
Animated VHA X race concordance	−0.04 (0.08)	0.633

Research Question 1 asked whether exposure to an animated VHA intervention would result in higher intentions to talk to a doctor about CRC screening.

FHIR

What is FHIR?

o Fast Health Interoperability Resources (http://fhir.org)

o Set of specifications to allow healthcare interoperability

o Interoperability is defined as the ability to exchange information AND use is effectively

o This assumes information is formatted correctly and also interpreted correctly (e.g., with semantics attached to the exchange)

SMART on FHIR

o Substitutable Medical Applications and Reusable Technology (http://smarthealthit.org)

o A universal application program interface (API) to allow the connection between EHRs and smartphone apps

FHIR Example

```json
"resourceType": "Observation",
"id": "heart-rate",
"meta": {
  "profile": [
    "http://hl7.org/fhir/StructureDefinition/vitalsigns"
  ]
}
```

Case-study: PROMIS

Objective

o The seamless integration of patient-reported outcome from PROMIS (PRO Measurement Information System http://promishealth.org) into the EHR (http://easipro.org)

o Epic, Cerner, OpenEMR, others

Team

o Initially: NU, UofC, UIC, UAB, UK, UF, UU, Harvard Catalyst, USC CTSI, UTH added later

o Clinical team (UF): Hematology-Oncology, Endocrinology

o Epic team, legal team at UF

PROMIS

Tools developed

o PRO Planning Guide → empirical knowledge and guidance to implement PRO in clinics

o Decision log → decision tracking

o Implementation Plan Template

On the technical side

o Lot of information available through the various open-source communities

o FHIR and SMART are not complex

On the legal side

o Be prepared!

Lessons Learned

The Key Elements:

o Planning is an iterative process – follow an Agile approach

o Find your clinical champion

o Clearly identify the needs and intended use from stakeholders

o Expect barriers and embrace the problem solving

o Be cognizant of clinical workflows

o Allow sufficient time for planning and decision-making (and add to your estimate!)

o Continuously engage institutional leaders

Questions and Maybe Some Answers