



PHARMonious

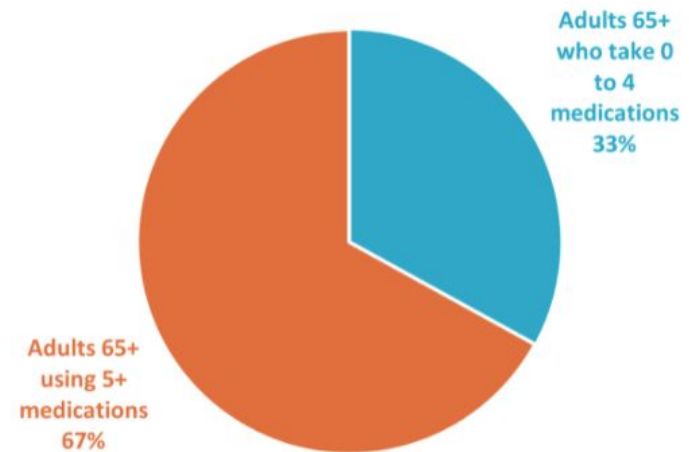
AN OPTIMIZED SOLUTION TO POLYPHARMACY MANAGEMENT
THROUGH DATA INTEGRATION AND PATIENT EMPOWERMENT

The Polypharmacy problem

Polypharmacy is most commonly defined as the use of 5+ medications at the same time by a single patient.

Who is at risk?

- Adults aged 65 and older
- Younger patients with chronic pain
- Patients with diabetes
- Patients with mental health conditions



According to a study from 2019, 67% (approximately 54.7 million) adults aged 65 and older fell under the criteria of polypharmacy

Harmful Outcomes



Adverse Drug Effects

- In 2018 there were 280,000 hospitalizations for ADE's, costing approximately \$3.8 billion
- Polypharmacy is present in 90% of ADE's



Delirium

- Older patients are more than two times as likely to experience delirium than those taking fewer than five drugs



Falling

- Older adults taking 4+ drugs is associated with an 18% increase in the risk of falling
- Falling can lead to more harmful outcomes, for example broken bones



Mortality

- In older adults polypharmacy is associated with a 59% greater chance of death compared to taking no medications

Deprescribing

Deprescribing is the process of lowering dosages or stopping medications which may be causing harm, or which are no longer serving their purpose.

Top 4 Drug Classes to Deprescribe

Proton Pump Inhibitors (PPIs) ↻

In 2019 more than 22 million patients were prescribed PPIs

Benzodiazapine & Z-drugs

In 2019 more than 12 million patients were prescribed drugs in this class

Antihyperglycemics

In 2019 insulin based medications alone accounted for over 11 million patients.

In total antihyperglycemics were prescribed to over 37 million patients.

Antipsychotics

In 2019 antipsychotics accounted for over 4 million patients.

Medication management

- Stores information about prescribed and over-the-counter medications in a centralized location
 - Ability for patients to input over-the-counter medications using barcode scan
 - Physicians, pharmacists, and other providers can access the entire list and contribute
 - Interfaces with existing drug databases to provide medication information including appearance, interactions, and side effect information
 - Has the ability to permit access to patient caretakers



Static UI prototype showing the medication list feature

Medication management

- Scheduled medication reminders to increase medication adherence
 - Requires confirmation input to ensure notifications don't get ignored or forgotten
 - Images and medication specific barcodes decrease confusion over which medications are which
 - Optimizes deprescribing by allowing providers to schedule specific tapering schedules
 - Integrating with smart watches can prevent missing a notification when not near phone



Static UI prototype showing medication reminder workflow

EHR Integration

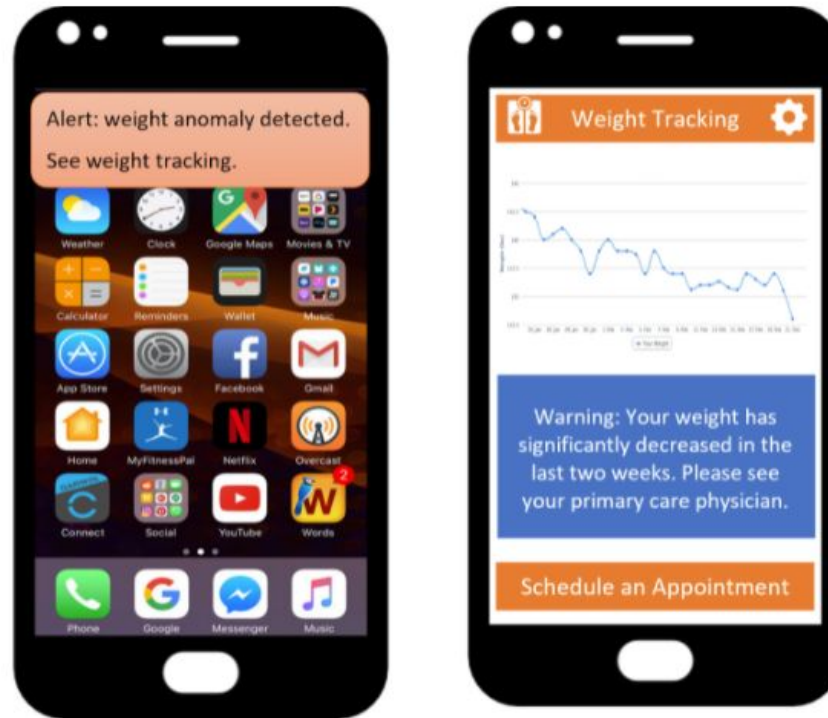
- Integrates medical and prescription history from all providers, prescribers, and pharmacies.
 - This will mitigate therapeutic duplication by providing an exhaustive list of current and past medications
- Integration of prescription criteria can alert users if there are medications which might conflict (PIMs)
 - Integration of Beer's criteria and the STOPP/START Criteria into the product itself for automated oversight of prescriptions



Static UI prototype showing prescriber PIM alert

Integration of sensor technology

- Allows tracking of critical health data to generate reports, and alert users if there are health anomalies detected



Static UI prototype showing health anomaly alert

Integration of sensor technology

- Smart watch sensor integration could be used to track:
 - blood pressure, blood oxygen level, heart rate, falls, sleep tracking, and steps/activity levels
- Connecting to other devices could provide even more valuable data
 - Integration of insulin pump data to track blood glucose levels
 - Integration with bluetooth scales for weight tracking
- Large scale data accumulation could allow for the correlation of yet unknown trends between specific medications and health outcomes



Static UI prototype showing wearable data reporting function

Application to a case study



Karen Smith, 64 years old, female

- Karen went to the doctor because she was having difficulty breathing.
- Her health history also included: chronic renal disease, cognitive impairment, six falls in the past several months, anxiety, pupil dilation, sweating episodes, nausea, occasional tremors, fatigue, anemia, and gaining 20 lbs over the past year

Application to a case study



| Medication | Health Concern | Prescriber |
|-----------------------------|--------------------------|------------------------|
| Diclofenac | Pain Relief | Chronic Pain Physician |
| Cyclobenzaprine | Pain Relief | Chronic Pain Physician |
| Hydrocodone / acetaminophen | Pain Relief | Chronic Pain Physician |
| Clonazepam | Panic Attacks | Psychiatrist |
| Nortriptyline | Pain Relief / Depression | Psychiatrist |
| Duloxetine | Depression | Psychiatrist |
| Topiramate | Pain Relief (Migraines) | Primary Care Physician |
| Gabapentin | Pain Relief (Nerve Pain) | Primary Care Physician |
| Cetirizine | Allergies | Primary Care Physician |

How could PHARMonious help the situation?

Preventative Intervention

- Karen's medication list shows significant duplication of therapies and PIM interactions caused by lack of communication between her various prescribers
 - PHARMonious integrates EHR data and could potentially have prevented this
 - Health data tracking could have alerted adverse reactions to this combination of medications before the side effects were this severe

Facilitating the reduction of medications

- Recommendation: Taper off of regular clonazepam to mitigate fall risk and respiratory depression
 - Relevant features: medication scheduling will simplify the tapering process, PHARMonious will move medication out of current list and prevent automatic refills from confusing patient, can monitor fall data and blood oxygen during and after removing the medication, monitor weight trends as a result of deprescribing
- Recommendation: Decrease dose of gabapentin and topiramate to mitigate cognitive issues and additive effects
 - Relevant features: medication scheduling for the tapering process
- Recommendation: Minimize serotonergic medications as patient shows signs of serotonin toxicity
 - Relevant features: medication scheduling for the tapering process, monitor heart rate to see if it regulates afterwards
- Recommendation: Consider mitigating sleep therapy without medication
 - Relevant feature: sleep tracking reports

Every patient has an existing database containing their current prescriptions and prescription information

| | generic_name | description | openfda.pharm_class_epc | how_supplied | drug_interactions | indications_and_usage | reason_for_prescription | prescriber |
|---|--------------|---|------------------------------|---|---|--|-------------------------|------------------------|
| 0 | DICLOFENAC | ND | ND | ND | ND | [Use(s) <input type="checkbox"/> for the temporary relief of arthriti... | pain relief | chronic pain physician |
| 1 | GABAPENTIN | [DESCRIPTION SECTION Gabapentin tablets, USP a... | [Anti-epileptic Agent [EPC]] | [HOW SUPPLIED SECTION Gabapentin Tablets, USP ... | ND | [INDICATIONS & USAGE SECTION Postherpetic Neur... | nerve pain | primary care physician |
| 2 | DULOXETINE | [1] DESCRIPTION Duloxetine hydrochloride, USP ... | ND | [16 HOW SUPPLIED/STORAGE AND HANDLING Product:... | [7 DRUG INTERACTIONS Both CYP1A2 and CYP2D6 ar... | [1] INDICATIONS & USAGE Duloxetine delayed-rele... | antidepressant | psychiatrist |

Prescription information is obtained from the openFDA API



Allows for addition of new medication and checks for interactions with existing medications

Also runs a deprescribing algorithm if the medication is in the top 5 classes for deprescribing.

Proof of concept code

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| 0 | DICLOFENAC | ND | ND | ND | [Use(s)] for the temporary relief of arthriti... | pain relief | chronic pain physician |
| 1 | GABAPENTIN | [DESCRIPTION SECTION Gabapentin tablets, USP a... | [Anti-epileptic Agent [EPC]] | [HOW SUPPLIED SECTION Gabapentin Tablets, USP ... | ND | [INDICATIONS & USAGE SECTION Postherpetic Neur... | nerve pain primary care physician |
| 2 | DULOXETINE | [11 DESCRIPTION Duloxetine hydrochloride, USP ... | ND | [16 HOW SUPPLIED/STORAGE AND HANDLING Product... | [7 DRUG INTERACTIONS Both CYP1A2 and CYP2D6 ar... | [1 INDICATIONS & USAGE Duloxetine delayed-rele... | antidepressant psychiatrist |

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Link to interactive prototype:

If time allows:

<https://xd.adobe.com/view/03c8cad8-60e6-4d19-8a8d-b84dacf69d2c-569b/?fullscreen>

Meet the team: HackPack

Meet the team behind PHARMonious



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