Multiple Pharmacy Database

IEOR 115 Team 3

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Retail Pharmacy Business

- Founded in 1962 by Dan Bertelli in Morgan Hill, CA
- 2 Current Locations in Central California
  - Atwater and Sonora
- Approximately 40 Employees company wide
- Up to 300 scripts per location on peak days
- Focuses on Patient Care and Customer Service
  - Speedy service at levels chains cannot maintain
  - Focus on patient welfare and quality of care
Current Services

- Prescription Compliance
- Sync MyRx
- Delivery Program

Manually Tracked Services
Initial Project Proposal

**Prescription Compliance**
- Track pickup dates to determine if patients are taking medication properly
- Pharmacist interventions if required

**Sync MyRx**
- Reduce patient trips by synchronizing medication refills
- Prepare patients medication in advance of sync date

**Delivery Program**
- Coordinate deliveries to households
- Reduce number of trips needed
Multiple Pharmacy Database

A Comprehensive Pharmacy Solution
Less Time Waiting
• Quote an expected fill time for each new RX
• Prioritize RXs based on Desired Return Time

Better Pharmacist Interaction
• Measure efficacy of different interventions
• Take action to preempt possible health complications

Fewer Pharmacy Trips
• Synchronize patient prescriptions through Sync MyRx
• Combine with delivery program to minimize trips
Improving Pharmacy Operations

**Prescription Inventory**
- Efficient placement of drugs on shelf
- Track medication from vendor to patient

**Advertisement ROI**
- Measure ROI in terms of new patients
- Evaluate different forms of advertising

**Medicine Interactions**
- Track patient’s conditions and medications
- Flag potential harmful interactions
Normalization Analysis

Selected Relations
Patient

Patient

<table>
<thead>
<tr>
<th>PID</th>
<th>DOB</th>
<th>HouseholdID</th>
<th>Home Phone</th>
<th>Cell Phone</th>
<th>Email Address</th>
<th>Preferred Contact Method</th>
<th>Join Date</th>
<th>Is Delivery</th>
<th>Is SyncRx</th>
<th>Sync Date</th>
<th>Sync Day</th>
</tr>
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<tbody>
<tr>
<td>FD1</td>
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<td></td>
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<tr>
<td>FD2</td>
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<tr>
<td>FD3</td>
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</table>

3NF Normalization

P1

<table>
<thead>
<tr>
<th>PID</th>
<th>DOB</th>
<th>HouseholdID</th>
<th>Cell Phone</th>
<th>Email Address</th>
<th>Preferred Contact Method</th>
<th>Join Date</th>
<th>Is Delivery</th>
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<th>Sync Day</th>
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<tbody>
<tr>
<td>P1</td>
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</table>

P2

<table>
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<tr>
<th>HouseholdID</th>
<th>Home Phone</th>
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P3

<table>
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<tr>
<th>PID</th>
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<th>Sync Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>P3</td>
<td></td>
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<td></td>
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</table>
### Rx_Instance

<table>
<thead>
<tr>
<th>RxID</th>
<th>Refill_Number</th>
<th>Pharmacist_ID</th>
<th>Store_ID</th>
<th>Delivery_ID</th>
<th>Order_Date</th>
<th>Fill_Date</th>
<th>Pick_up_Date</th>
<th>Days_Supply</th>
<th>Quantity</th>
<th>Insurance_ID</th>
<th>Reimbursement_ID</th>
<th>Bill_to_Insurance</th>
<th>Desired_Pickup_Time</th>
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</thead>
</table>

**FD1**

**FD2**

**FD3**

**3NF Normalization**

**RI1**

<table>
<thead>
<tr>
<th>RxID</th>
<th>Refill_Number</th>
<th>Pharmacist_ID</th>
<th>Store_ID</th>
<th>Delivery_ID</th>
<th>Order_Date</th>
<th>Fill_Date</th>
<th>Pick_up_Date</th>
<th>Quantity</th>
<th>Insurance_ID</th>
<th>Reimbursement_ID</th>
<th>Bill_to_Insurance</th>
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</thead>
</table>

**RI2**

<table>
<thead>
<tr>
<th>InsuranceID</th>
<th>ReimbursementID</th>
<th>Bill_to_Insurance</th>
</tr>
</thead>
</table>

**RI3**

<table>
<thead>
<tr>
<th>Fill_Date</th>
<th>Quantity</th>
<th>Days_Supply</th>
</tr>
</thead>
</table>

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FD1 is a functional dependency from RxID to Refill_Number.

FD2 is a functional dependency from ReflectionID to InsuranceID.

FD3 is a functional dependency from Fill_Date to Quantity, Days_Supply.
Queries

Getting at the data we want
Query I: Intervention Efficacy

- **Purpose**: Measures the change in patient compliance after holding an intervention with them by comparing medication lapses before and after an intervention.

- **Business Justification**: Tells the pharmacy which interventions are most effective at reducing the patient’s delay in picking up prescriptions. This helps the pharmacists choose what types of interventions to hold, and base their decision on data rather than their own subjective observations.
Query I: Intervention Efficacy

- **Mathematical Model**

  For this query, we use a regression model to correlate the “gap times” (number of days of delay in pickup) before and after the intervention.

  The slope of the best-fit line tells us, on average, the ratio of the new gap time to the old gap time. We call this the “intervention effectiveness ratio,” or IER.

  An IER of 0.5, for example, means that, on average, a patient that undergoes that type of intervention has their gap time halved.
Query I: Intervention Efficacy

**SQL Implementation**

```
SELECT x.itype, 
     (((count(*) * sum(x.beforegap * x.aftergap)) - (sum(x.beforegap)*sum(x.aftergap)))) / ((count(*) * sum(x.beforegap^2)) - sum(x.beforegap)^2)) AS ier
FROM (SELECT before.itype, before.gap, after.gap
     FROM (SELECT a.itype, a.pid, (a.pickupdate - a.expecteddate) AS gap
     FROM (SELECT i.type AS itype, i.pid, rxi1.pickupdate, (rxi2.pickupdate + rxi2.dayssupply) AS expecteddate
     FROM intervention i, rx_instance rxi1, rx_instance rxi2
     WHERE rxi1.pickupdate < i.date AND i.rxid = rxi1.rxid AND i.refillnumber = rxi1.refillnumber AND
     rxi2.rxid = rxi1.rxid AND rxi2.refillnumber = rxi1.refillnumber - 1) AS a
     HAVING a.pickupdate = max(a.pickupdate)) AS before,
     (SELECT b.itype, b.pid, (b.pickupdate - b.expecteddate) AS gap
     FROM (SELECT i.type AS itype
     FROM intervention i, rx_instance rxi1, rx_instance rxi2
     WHERE rxi1.pickupdate < i.date AND i.rxid = rxi1.rxid AND i.refillnumber = rxi1.refillnumber AND
     rxi2.rxid = rxi1.rxid AND rxi2.refillnumber = rxi1.refillnumber - 1) AS a
     HAVING a.pickupdate = max(a.pickupdate)) AS before, 
     (SELECT b.itype, b.pid, (b.pickupdate - b.expecteddate) AS gap
     FROM (SELECT i.type AS itype, i.pid, rxi1.pickupdate, (rxi2.pickupdate + rxi2.dayssupply) AS expecteddate
     FROM intervention i, rx_instance rxi1, rx_instance rxi2
     WHERE rxi1.pickupdate < i.date AND i.rxid = rxi1.rxid AND i.refillnumber = rxi1.refillnumber AND
     rxi2.rxid = rxi1.rxid AND rxi2.refillnumber = rxi1.refillnumber - 1) AS b
     HAVING b.pickupdate = max(b.pickupdate)) AS after
     WHERE before.pid = after.pid AND before.itype = after.itype) AS x
GROUP BY itype;
```
Query I: Intervention Efficacy

- Intervention Efficacy - Call to Family
  - Number of Gap Days After Intervention vs. Number of Gap Days Before Intervention

- Intervention Efficacy - Call to Doctor
  - Number of Gap Days After Intervention vs. Number of Gap Days Before Intervention

- Intervention Efficacy - 1-on-1 Conversation
  - Number of Gap Days After Intervention vs. Number of Gap Days Before Intervention

---

<table>
<thead>
<tr>
<th>itype</th>
<th>ier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Call a Family Member</td>
<td>0.809630690090265</td>
</tr>
<tr>
<td>Call their Doctor</td>
<td>0.782400494310283</td>
</tr>
<tr>
<td>One-on-One Conversation</td>
<td>0.769375995809416</td>
</tr>
</tbody>
</table>
Query II: Expected Fill Time

**Purpose**
Provide patient with an expected RX fill time, taking into account pharmacist average fill time and RXs in queue

**Business Justification**
Allows patient to better decide whether to wait or come back
Allows Pharmacy to prioritize prescriptions in queue by giving them more information on the current state of the pharmacy

**Mathematical Model**
Find late prescriptions that still needed to be filled
Quoted Fill Time = \(\text{SUM(Pharmacist Fill Time} \times \text{Queue})\)
Returns time that current patient's prescription would be next
**Query II: Expected Fill Time**

**SQL Implementation**

```sql
SELECT DateAdd("n",Sum(queue.num_in_queue*avg_times.AvgTime),Now()) AS ReadyTime
FROM (SELECT rxi.pharmacistID, COUNT(*) as num_in_queue
    FROM rx_instance rxi
    WHERE rxi.Desired_Pickup_Time <= NOW() AND rxi.Fill_date IS NULL
    GROUP BY rxi.pharmacistID) AS queue,
    (SELECT p.PID, AVG(DATEDIFF("n", rxi.Order_date, rxi.Fill_date)) as AvgTime
    FROM Employee p, Rx_Instance rxi
    WHERE p.PID = rxi.pharmacistID AND rxi.Fill_date IS NOT NULL
    GROUP BY p.pID) AS avg_times
WHERE (((queue.pharmacistID)=[avg_times].[PID]));
```
Query II: Expected Fill Time

New RX Instance Data Entry Form

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RxID</td>
<td>10211</td>
</tr>
<tr>
<td>Refill_Number</td>
<td>7</td>
</tr>
<tr>
<td>PharmacistID</td>
<td>11285</td>
</tr>
<tr>
<td>StoreID</td>
<td>3</td>
</tr>
<tr>
<td>Order_Date</td>
<td>5/2/2013 12:32:43 PM</td>
</tr>
<tr>
<td>Desired_Pickup_Time</td>
<td>5/2/2013 5:04:19 PM</td>
</tr>
<tr>
<td>Days_Supply</td>
<td>30</td>
</tr>
<tr>
<td>Quantity</td>
<td>60</td>
</tr>
<tr>
<td>InsuranceID</td>
<td>85</td>
</tr>
<tr>
<td>ReimbursementID</td>
<td>1269</td>
</tr>
<tr>
<td>Amount_Billed_to_Insurance</td>
<td>$159.00</td>
</tr>
</tbody>
</table>
Consider a 66 year old customer, Mr. Jones, who currently takes six separate medications for arthritis, high blood pressure, and emphysema.

However, he struggles with picking up his medication on time, often going days without necessary medication.

A prime candidate for a one-on-one pharmacist consult intervention.
Any Questions?

Thank you for your attention.