Healthy Operations, Healthy Patients:
Navigating the Intersection of Operations and Cost Control in Dental Practices

Mary Papandreas
DMD Candidate, LDI Summer Fellow

Christian Terwiesch
Wharton Professor, LDI Summer Mentor
Thank You!

Christian Terwiesch
PhD
- Wharton Operations & Information Management Professor
- Co-director of Mack Institute for Innovation Management
- Perelman School of Medicine Faculty
- LDI Mentor

Gursher Harika
MBA Candidate
- Director of Analytics & Strategy for Advanced Dental Brands
- Wharton MBA Candidate

Joanne Levy
MBA, MCP
- Founding Director, SUMR; Director, Student Initiatives, LDI
- Associate Director, Health Care Management and Economics PhD Program
- Healthcare Management Concentration Faculty Advisor

Margaret Yang
MS Ed.
- Director of Student Affairs and Engagement at Penn Dental Medicine

Dr. Uri Hangorsky
DDS, MS
- Penn Dental Medicine Clinical Professor of Periodontics
- Penn Dental Medicine Associate Dean for Student Affairs

Acknowledgements
The cost to both receive and provide dental care is rising, and there is a growing labor shortage in the dental workforce.

**Labor shortages have led to decreased access to dental care across the country**

- **72M** People in US living in DHPSA
- **12,288** dental professionals needed to alleviate shortage

**Dental costs have seen historic year over year increases**

- **$125** Average cost of basic dental cleaning without insurance
- **45%** Percent of dentists worry about the financial viability of their practice

**Key Term**

**DHPSA**: Dental Health Professional Shortage Area

**Sources:** data.HRSA.gov, ADA HPI, Dentaly

Significance

Healthy Operations, Healthy Patients
This case study models the operations of a dental practice and identifies key drivers that impact patient flow and practice finances.

**Study Design**

- Both quantitative and qualitative data was collected from a single dental practice that is part of a broader Dental Services Organization.
- Historical CDT codes billed by the practice were used to model static demand by procedure at the dental practice.
- Operational capacity was calculated using self-reported productivity metrics regarding both dentist and hygienist time per procedure per patient.
- The model determines how many procedures can be done per day based on both demand and resource availability and then translates operational capacity into financial metrics using real P&L data from the practice.

A **sensitivity analysis** was performed to demonstrate how changing various **operational metrics** impacted the number of patients able to be treated by the practice and ultimately the financial performance of the practice.

### Practice Overview

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Boston, MA</td>
</tr>
<tr>
<td># of Dentists</td>
<td>3</td>
</tr>
<tr>
<td># of Hygienists</td>
<td>3</td>
</tr>
<tr>
<td>Revenue</td>
<td>$3.9M</td>
</tr>
<tr>
<td>EBITDA</td>
<td>$1.5M</td>
</tr>
</tbody>
</table>

**Key Term**

**EBITDA**: Earnings Before Interest, Taxes, Depreciation, & Amortization.
Identification of operational constraints and their financial impact empowers dental offices to make meaningful workflow changes.

<table>
<thead>
<tr>
<th>Description</th>
<th>Base Model</th>
<th>Sensitivity Analysis</th>
<th>Future Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operations</strong></td>
<td>Current practice demand was compared to resource capacity to define the number of procedures able to be completed per day</td>
<td>Different operational levers were changed to see how they impacted the number of procedures completed</td>
<td>Influence policy regarding Medicaid dental coverage and provider reimbursement</td>
</tr>
<tr>
<td><strong>Finances</strong></td>
<td>The number of procedures completed per day was linked to revenue and EBITDA</td>
<td>Validation: All variables were changed within reason to ensure viable future recommendations</td>
<td>Prove the viability of a Medicaid dental practice</td>
</tr>
<tr>
<td><strong>Variables</strong></td>
<td></td>
<td></td>
<td>Continuing Education: Show dentists how to better run their offices to accommodate more patients</td>
</tr>
<tr>
<td><strong>Validation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Tools**

Base Model: Stakeholder Interviews, Market Research, Excel Business Model

Sensitivity Analysis: Industry Research, Excel Analysis, Data Visualization, Data Validation

Future Applications: Health Policy Advocacy, Dental Medicaid Model, Continuing Education Courses

Aims

Healthy Operations, Healthy Patients
An operational model quantifies the current capacity of the dental office and identifies existing constraints to delivering additional care.

**Model Design**

Data sources included historic billing codes, P&L statements, and staff anecdotes.

**Key Inputs**
- Active Patient Panel
- Annual Procedures by Type
- Office Days and Hours
- Reimbursement Rates
- Costs

**Key Assumptions**
- Hygienist Time per Procedure
- Dentist Time per Procedure
- Productivity vs Downtime Percentage

All procedures were categorized into the following types:

- Diagnostics
- Preventative
- Restorative
- Periodontics
- Orthodontics
- Oral Surgery
- Endodontics
- Prosthodontics
- Adjunct
An operational model quantifies the current capacity of the dental office and identifies existing constraints to delivering additional care.

**Demand Calculations**

*Static demand was calculated based on historic CDT codes for completed procedures*

1. Visits per year ÷ Active Patient Panel = Procedures per patient per year

   **Procedure Type / Patient / Year**

2. Visits per year ÷ Open Days per Year = Procedures per day

   **Procedure Type / Day**

Calculating current demand by procedure type allows the model to assess if demand is being met at a more granular level. For example, the practice could be meeting restorative demand but underperforming for oral surgery demand.
An operational model quantifies the current capacity of the dental office and identifies existing constraints to delivering additional care.

**Operations Calculations**

Operational calculations are based off of self-reported productivity metrics from the dental practice being studied.

1. Working Minutes per Day $\times$ Daily % of Procedures = Available Minutes per Procedure Type

2. Available Procedure Minutes per Day $\div$ Dentist Minutes per Procedure = Capacity for Procedures per Day

**Example**

If a dentist averages **60 minutes** per procedure, they can see 8 patients per day, which is **1,696 patients per year**.

If a dentist averages **45 minutes** per procedure, they can see 10-11 patients per day, which is **2,120-2,332 patients per year**.

**Resource Constraints:**
- Number of dentists and hygienists
- Office hours
- Productivity vs downtime

Methods

Healthy Operations, Healthy Patients
Operational inefficiencies are linked to financial impacts and the impactfullness is further quantified through a sensitivity analysis.

The **financial viability** of a dental practice is measured by EBITDA.

The financial viability of a dental practice is measured by EBITDA. The baseline EBITDA is $1.52M. An increase in financial viability by improving one operational variable is estimated to be 8-10%.

The graph shows the increase in financial viability after making operational changes:
- Add a Dentist: $200,000 increase
- Improve to 15% Downtime
- Increase Hours of Operation by 30 minutes
- Work Half Day Every Friday (vs Every Other)
- Decrease Procedure Times by 5%

Increase in Financial Viability after Making Operational Change

**Methods**

**Healthy Operations, Healthy Patients**

*Wharton*

*University of Pennsylvania*
Capacity constraints hinder dental offices from seeing more patients while demand soars

Key Finding:
The model proved that the dental office is capacity constrained. The key resource in every dental office is the dentist’s available time.

<table>
<thead>
<tr>
<th>Example Variable: Downtime</th>
<th>Base Case</th>
<th>Better Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downtime %</td>
<td>20%</td>
<td>15%</td>
</tr>
<tr>
<td>Available Dentist Minutes / Day</td>
<td>384</td>
<td>408</td>
</tr>
<tr>
<td># of Procedures / Day</td>
<td>31</td>
<td>32</td>
</tr>
<tr>
<td># of Procedures / Year</td>
<td>6,572</td>
<td>6,784</td>
</tr>
</tbody>
</table>

Productivity vs downtime*: The practice reported staff is performing clinical work for 80% of the available 8 working hours per day; the other 20% is downtime

*Includes administrative work, EHR time, waiting time, etc

“Higher labor productivity in capacity-constrained operations has a direct effect on service level, revenue, and growth.” - Christian Terwiesch

212 more procedures annually

Sources: knowledge.wharton.upenn.edu
Dentists are highly productive when actively seeing patients, however downtime inefficiencies drive capacity constraints.

Findings

<table>
<thead>
<tr>
<th>Operational Variables</th>
<th>Ethical Concerns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage Downtime</td>
<td>● Many of the current ways to improve productivity put both the doctor and patient at potential risk</td>
</tr>
<tr>
<td>Hours of Operation</td>
<td>● Incentivized compensation plans for dentists to complete procedures faster in order to see more patients can lead to decreased quality of care</td>
</tr>
<tr>
<td>Friday Hours</td>
<td>● Adding new technology often increases the cost of procedures to patients</td>
</tr>
<tr>
<td>Procedure Times</td>
<td></td>
</tr>
</tbody>
</table>

“Companies track and record every dollar… that goes through their operation… The same level of rigor is often lacking when it comes to the measurement and analysis of labor productivity, even though one could argue that the time of our employees is one of the most valuable resources that exist in an organization.”

- Christian Terwiesch

Sources: knowledge.wharton.upenn.edu
This study proves that small operational improvements lead to large scale gains in number of patients treated

Future research can explore both how to best achieve increased productivity and the impact of being able to treat more patients from a health policy, health equity, and access to care perspective.

**Medicaid Dental Practice Viability**
This model can influence policy by showing the minimum Medicaid reimbursement required for financial viability of dental practices. Dental offices are also able to compensate for low Medicaid reimbursement rates by increasing the volume of patients they see.

**Serving DHPSA in Rural Areas**
Increasing the number of patients able to be seen in rural practices can help improve the patient to provider ratio in DHPSA.

**Mid-Level Dental Provider Criticality**
Scope of practice for mid-level providers varies by state. The model can show how these differences impact the number of patients able to be treated.

**Implementation of Productivity Increasing Strategies**
Productivity initiatives can be quantitatively tracked through this model. This empowers dental practice owners to see which strategies improve patient flow the most. To track productivity, practices can time procedures, track outputs, or use visual tracking.

**Increased Productivity**  
**Increased Number of Patients Treated**  
**Increased Access to Care**

**Sources:** knowledge.wharton.upenn.edu
The next generation of dentists must recognize the importance of operational efficiency to best treat growing numbers of patients.

**Lessons Learned**

1. **Small productivity changes matter**  
   Incremental increases to available clinic time translate to more patients treated.

2. **Health services research is critical**  
   Operations research can greatly impact access to care and health policy.

3. **Find your why in research**  
   Health services research combined my passion for clinical dentistry and business.

4. **Patients rely on strong operations**  
   There is a huge number of untreated patients with current dental productivity.
Thank You
## Data Sources

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Model Use</th>
<th>Associated Tabs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wharton ACDG Services 20, 21, 22</td>
<td>Procedure Mix, Staffing Ratios, Revenue per Procedure</td>
<td>Demand Pivot &amp; Forecast, Revenue by Procedure, Staffing Summary, Demand, Operations, Capacity Constraints</td>
</tr>
<tr>
<td>ACDG P&amp;L</td>
<td>Revenue, Costs</td>
<td>Revenue by Procedure</td>
</tr>
<tr>
<td>Stakeholder Interviews</td>
<td>Time per Procedure</td>
<td>Operations</td>
</tr>
</tbody>
</table>
Dentists’ Confidence in Economy

Confidence in the Economy

Looking ahead to the next six months, how confident are you in the recovery of the following? (Percentages indicating “very” or “somewhat” confident.)

Dentists’ confidence in their dental practice and the dental care sector declined slightly in July 2023. Confidence levels remain below a high point in 2021.

Sources: ADA HPI

Healthy Operations, Healthy Patients