SYSTEMS ENGINEERING AND OPHTHALMOLOGIC TELEMEDICINE: PREVENTING BLINDNESS

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VA HEALTH CARE Defining EXCELLENCE in the 21st Century

FINANCIAL DISCLOSURES

The authors have no financial disclosures related to this talk

GOALS

- Understand eye disease and telemedicine principles
- Understand eye care at the VA and eye care delivery methods
- Understand how systems engineering can help prevent blindness

LEARNING OBJECTIVES

- Discuss eye disease, telemedicine, and tele-ophthalmology
- Discuss Technology-based Eye Care Services (TECS) program
- Discuss impact and eye care delivery with TECS
- Discuss systems engineering principles and how they apply to TECS

VISION IS…

- Critically important to quality of life
- Keeps people independent and healthy
- High priority for patients

TEST!

- **Why did Mr. C not get his eye care sooner?**
- **What barriers are there?**

FACTS

- **Eye disease is more common as people age**

- **People over age 65 should have an eye exam every 1-2 years.**

- **As people age, less likely to seek out eye care**

WHY?

FACTS

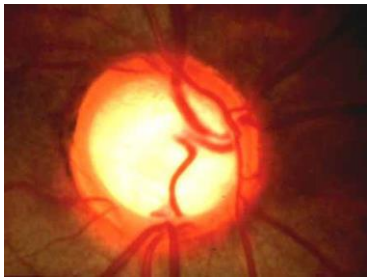
Older people are more likely to:

1. Live in rural places and be medically underserved.
2. Be dependent on others for transportation.
3. Limited income and cannot afford cost to travel.
4. Doctor visit fatigue.

TEST!

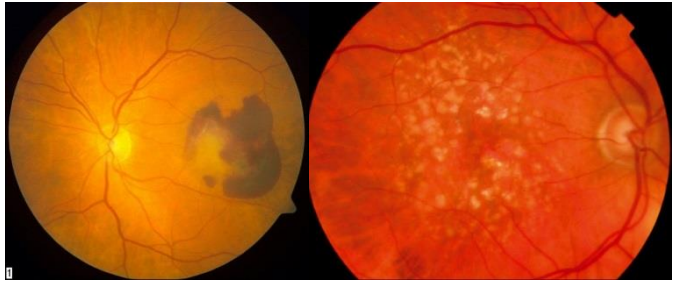
- What is the leading cause of curable blindness in the world?
- What is the leading cause of incurable blindness?
- What is the leading cause of blindness in working age adults?

FACTS



Top 4 most prevalent eye diseases:

1. Cataract
2. Glaucoma
3. Macular Degeneration
4. Diabetic Retinopathy



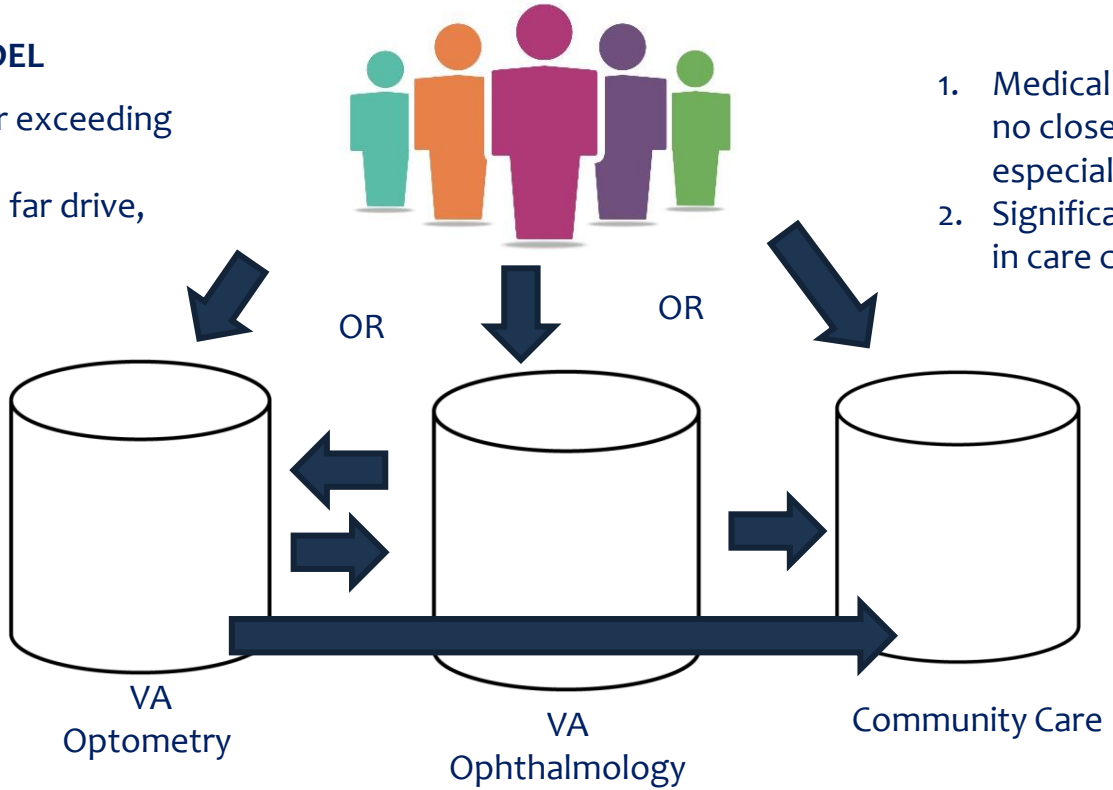
EYE DISEASE IN THE VA

1. Veteran population older than general population
2. Also higher rates of minorities
3. Higher percentage of diabetics

EYE CARE DELIVERY PRE-TECS

CLINIC VISIT MODEL

1. Rapid growth far exceeding growth capacity
2. Patient barriers: far drive, travel cost



1. Medically underserved have no close private providers, especially ophthalmology
2. Significant cost to the system in care coordination

TELEMEDICINE PRINCIPLES

Defined as care delivered where the patient and the provider are separated by distance.

Two major types:

1. Synchronous/Video – direct visual connection between provider and patient
2. Asynchronous/Store & Forward – gather data in one place at one time, store data, reviewed by provider in a different place at a different time

EXAMPLES OF TELEMEDICINE IN MEDICINE

Tele Primary Care

Tele Dermatology

Tele Psychiatry

Tele Rheumatology

Tele Geriatrics

Tele ICU

Tele Rehabilitation

- On the patient end, there is a "presenter" that facilitates the patient encounter. In many of these programs providers use video to actively manage or view the exam results
- Consultative services
- Store and Forward (e.g. dermatology)

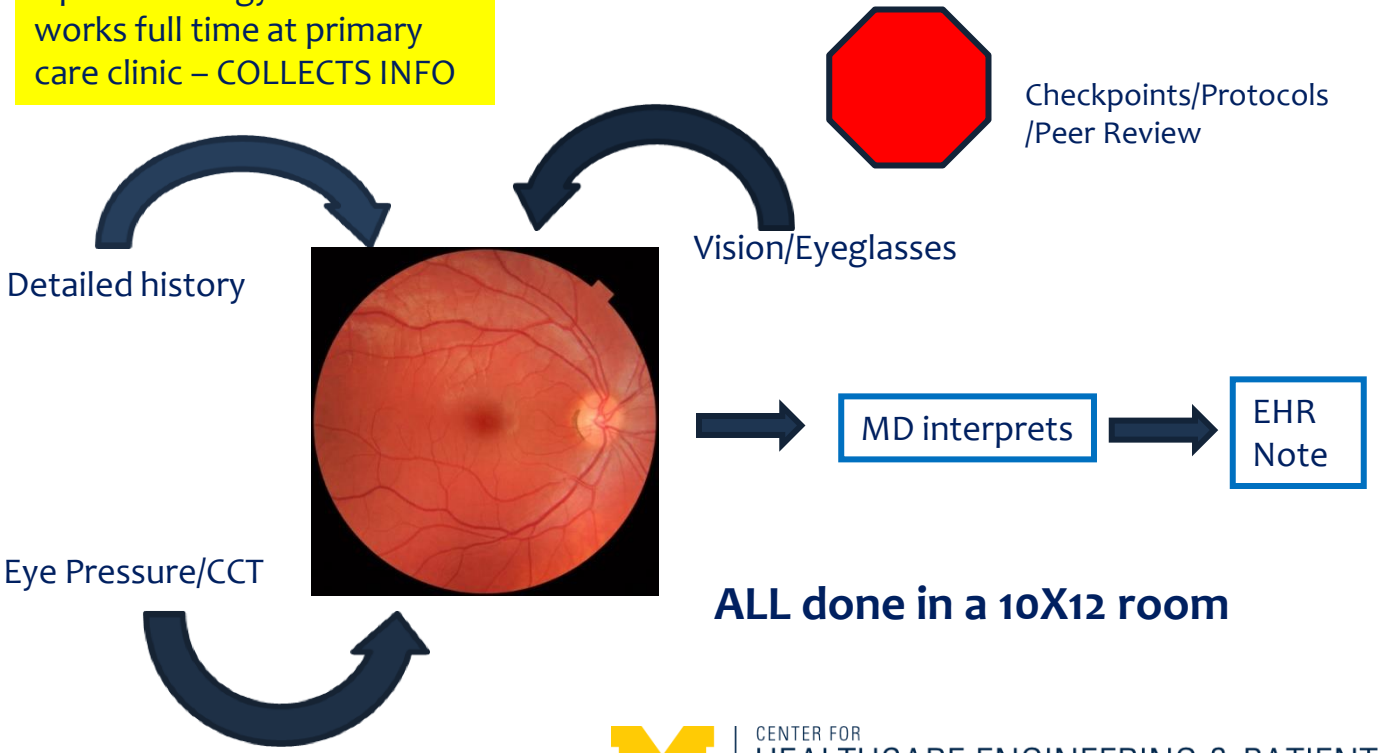
WHAT IS TECS?

Prevent blindness

Use technology to provide routine or follow up eye care to improve access.

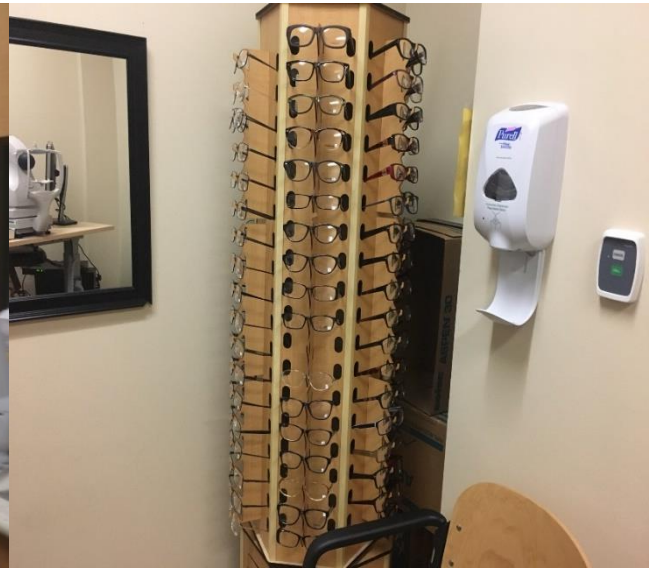
TECS

Ophthalmology Technician works full time at primary care clinic – COLLECTS INFO



ALL done in a 10X12 room

TECS SET UP

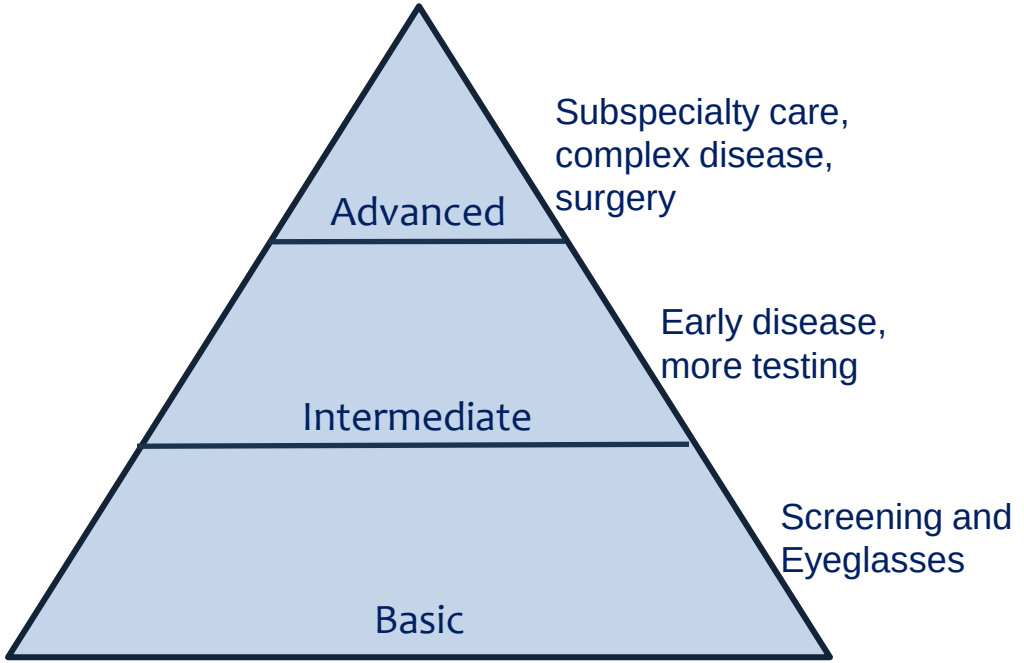


WORK SMARTER

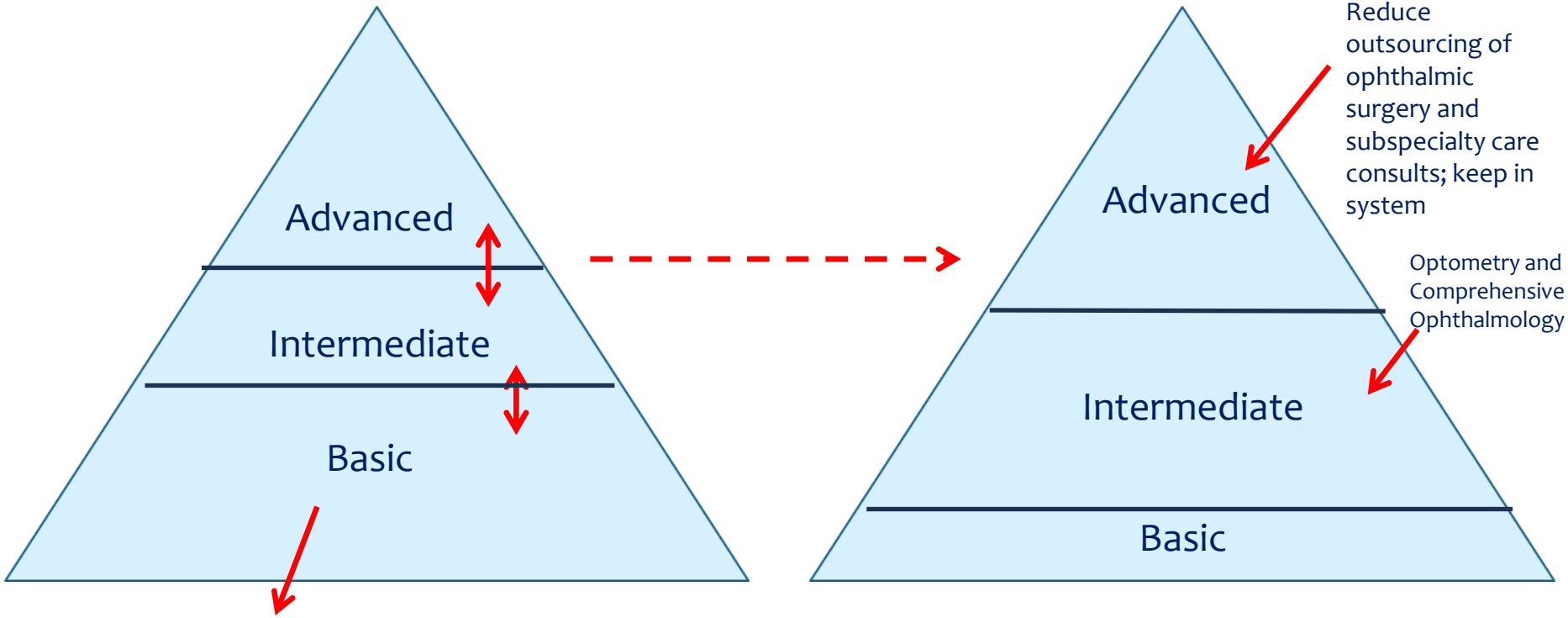
EYE CARE DELIVERY AS A SPECTRUM OF NEEDS

VA has limited resources

Goal is to devote most expensive and time consuming care to the patients who really need it.



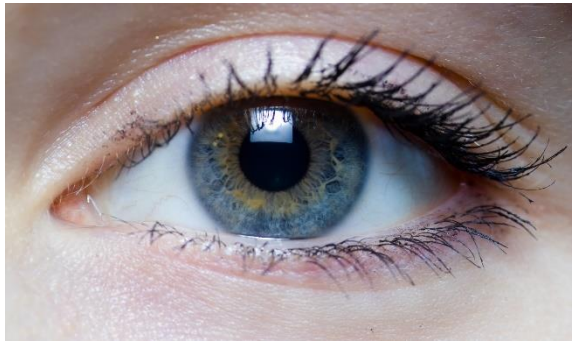
Eye Care as a Spectrum of Needs



Reduce outsourcing of ophthalmic surgery and subspecialty care consults; keep in system

Optometry and Comprehensive Ophthalmology

Increase outsourcing to telemedicine methods of basic Eye Care needs; exams and eyeglass dispensing (TECS)



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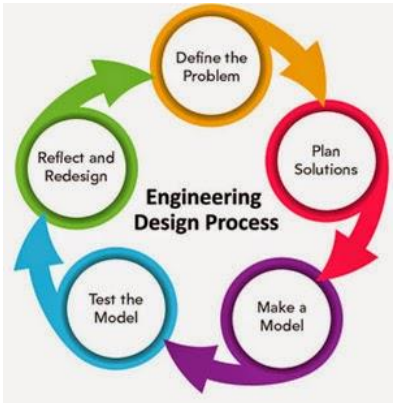
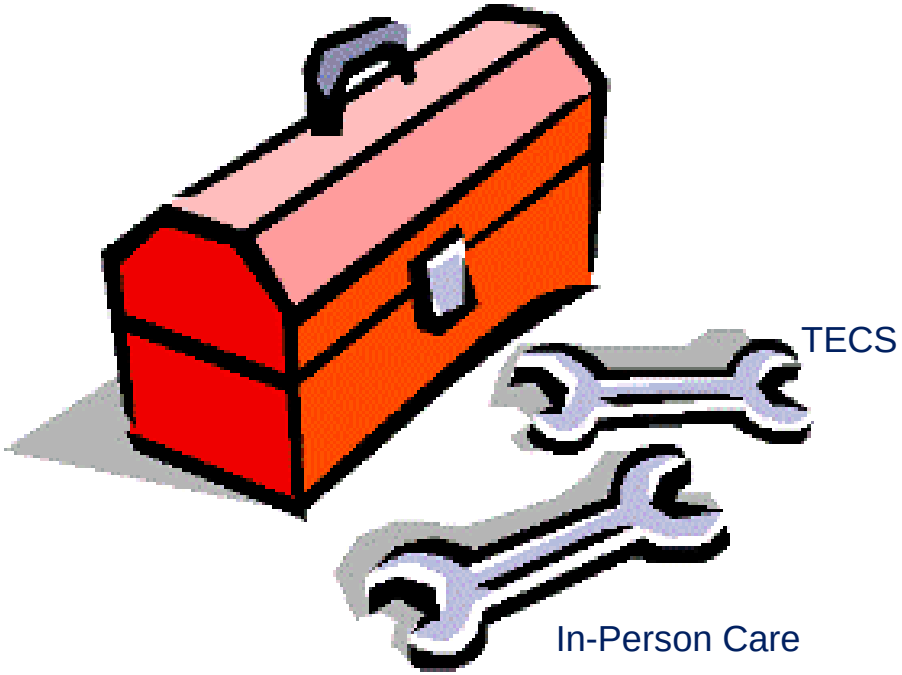


WHAT DOES THIS HAVE TO DO WITH SYSTEMS ENGINEERING?

TOOLS IN THE TOOLBOX TO CARE FOR PATIENTS

- VA now has many delivery methods to take care of Veterans' eyes.
- What tool is best in what setting?
- How should the tools be deployed?
- What factors need to be considered?
- Is TECS cost-effective/cost-neutral?



WHAT KIND OF ENGINEERING PROBLEM IS THIS?

Combinatorial matching problem

- Deciding locations to offer eye care and how to staff those locations

Constrained resources

Multi-criteria decision

- Consider cost, distance traveled, number of patients seen, etc.

ENGINEERING PROBLEM STATEMENT

Goal: Evaluate which locations to offer eye care screenings and what providers types to staff each eye care location

Assumptions:

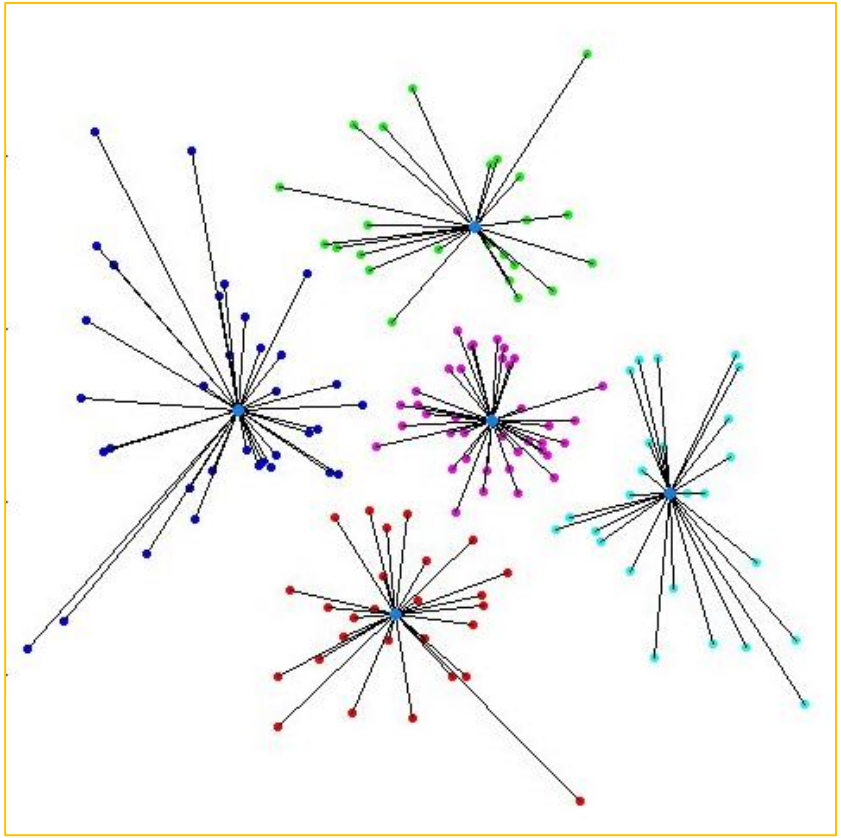
- Patients go to “assigned” clinic for eye care screening
- One-year time frame
- Patients have homogeneous screening need (one screening every other year)

Limitations:

- Considering eye care screening only (follow-up care not included)
- No consideration for patients’ provider preferences

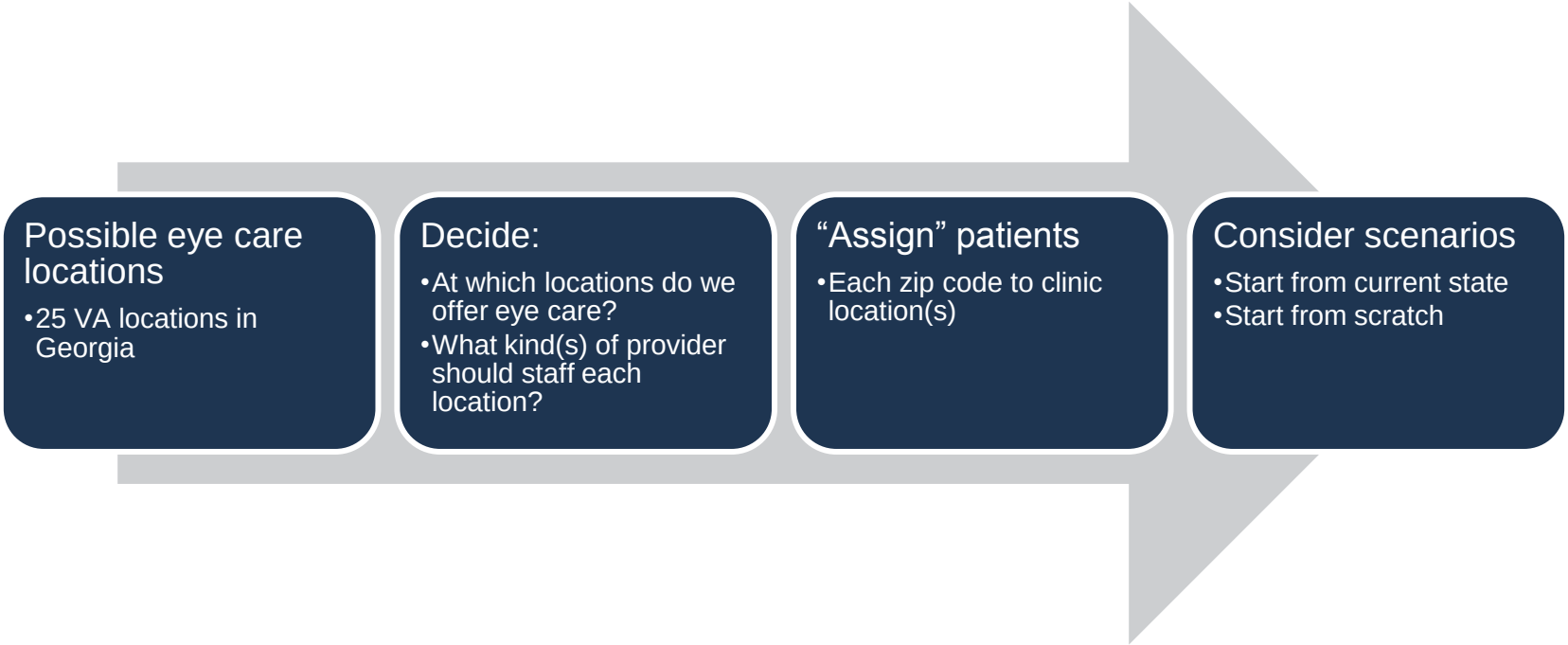
BRIEF OVERVIEW OF FACILITY LOCATION

- Mixed integer programs to optimize placement of facilities to meet demand
- Objective typically to minimize cost or distance traveled
- Constraints on allowable assignments, customer demand
- Often used in production/ distribution/ logistics



Source: Yano F, et al. APIEMS 2008

GENERAL MODELING APPROACH



MODEL OVERVIEW: FEASIBILITY CONSTRAINTS

- **Patient Capacity**
  - Number of patients assigned to clinic cannot exceed clinic capacity
    - Capacity subject to type/number of providers at each clinic
- **Demand**
  - Percent of patients assigned per zip code should be between a lower and upper required percent
- **Provider Capacity**
  - Each clinic can hold a maximum number of providers
    - Maximums exist at each clinic for providers of a given type and total number of all types of providers

MODEL OVERVIEW: OBJECTIVE FUNCTIONS

A. Maximize total number of patients assigned

1. Additional constraints:
   I. Budget
   II. Furthest distance allowed to travel

B. Minimize overall costs

1. Additional constraints:
   I. Minimum total number of people screened
   II. Furthest distanced allowed to travel

C. Minimize furthest distance traveled (future)

1. Additional constraints
   I. Budget
   II. Minimum total number of people screened

DATA OVERVIEW

- **Patients accessing Georgia VA for (any) care in 2017**
    - Approximately 200,000 patients considered
    - Group patients by zip code
- **Clinic locations**
    - 25 VA clinics in Georgia
        - 15 currently offer some type of eye care
- **Driving distance from center of each zip code to each clinic location calculated via Google API**
- **Budget/costs, provider capacities, and other clinic-specific values obtained from VA**

RESULTS: MAXIMIZE PATIENTS ASSIGNED

From scratch			
	min % seen		
Budget	0%	5%	10%
$20 Million	28980	27720	26450
$21 Million	45360	44100	44100
$22 Million	60480	60480	60480
From current			
	min % seen		
Budget	0%	5%	10%
$20 Million	Infeasible	infeasible	infeasible
$21 Million	23928	23340	22080
$22 Million	40980	39720	39720

(max dist: 150 miles, min 5000 total screen)

RESULTS: MINIMZE COST

From scratch			
	min % seen		
Max Travel Distance (Miles)	0%	5%	10%
100	$19,053,900	$19,731,600	$19,879,100
150	$19,095,500	$19,344,000	$19,641,200
200	$18,737,000	$19,000,000	$19,568,300
From current			
	min % seen		
Max Travel Distance (Miles)	0%	5%	10%
100	$20,610,700	$20,832,300	$20,930,500
150	$20,610,700	$20,755,300	$20,916,500
200	$20,610,700	$20,697,600	$20,954,000

(min 5000 total screen)

NEXT STEPS

Model minimizing maximum distance traveled objective

Incorporate stochasticity

- Consider patients not visiting their “assigned” clinic

Consider implications for follow-up care

- How are ophthalmologist/optometrist case mixes impacted?

Generalize beyond Georgia

- Apply to other VA regions considering TECS

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CLOSING/DISCUSSION