

The healthcare build environment: 50 years past and 50 years into the future

Where we Were

Where we Are

Where we're Going



The **problem** stems from a century-long development, **expansion**, and **contraction** of hospital square-footage, and subsequent **capabilities** and **capacity** changes; additionally, the **specialty**, **complexity**, and **volume** of patients, coupled with an array of changes to health insurance coverage and **reimbursables** has shaped the healthcare system to its current posture, and is making it challenging to predict its **operational**, **social**, **critical**, and **geographic** needs for the future.

The “block” was the dominant hospital style of the mid-20th century.

High patient volume
Wide-spread entitlement
Surge in health coverage



<https://artsandculture.google.com/asset/block-bellevue-hospital>

Deep floor plates
Stacked geometries
Heavy dimensioning
Retrofit constraints

The “mega hospital” was the suburban response to the modern movement

Appendages

Wards

Interstitial space

Mall-like
Historical Constraints
Typological Constraints



<https://artsandculture.google.com/asset/19-mcmaster>

The “bar” acknowledged shallower floor plates

The concept of single-occupant rooms as compared to large open wards and bays

Coupled with more private healing spaces is noise control, air quality, and staff circulation workflow optimization.

Noise control, air quality, and staff circulation workflow optimization.



<https://artsandculture.google.com/asset/early-modern-bar-paimio-aaltofound>

Lawton, OK | Reynolds Army Hospital

Area of Interest: Southwest Oklahoma
Examples of Legacy Healthcare Facilities



<https://www.hippostcard.com/listing/ok-oklahoma-fort-sillreynolds-army-hospital>

Lawton, OK | Reynolds Army Community Hospital



Area of Interest: Southwest Oklahoma
Examples of Legacy Healthcare Facilities

Lawton, OK | Comanche County Memorial Hospital

Area of Interest: Southwest Oklahoma
Examples of Legacy Healthcare Facilities



Chickasha, OK | Grady Memorial Hospital



Area of Interest: Southwest Oklahoma
Examples of Legacy Healthcare Facilities

Where we Were

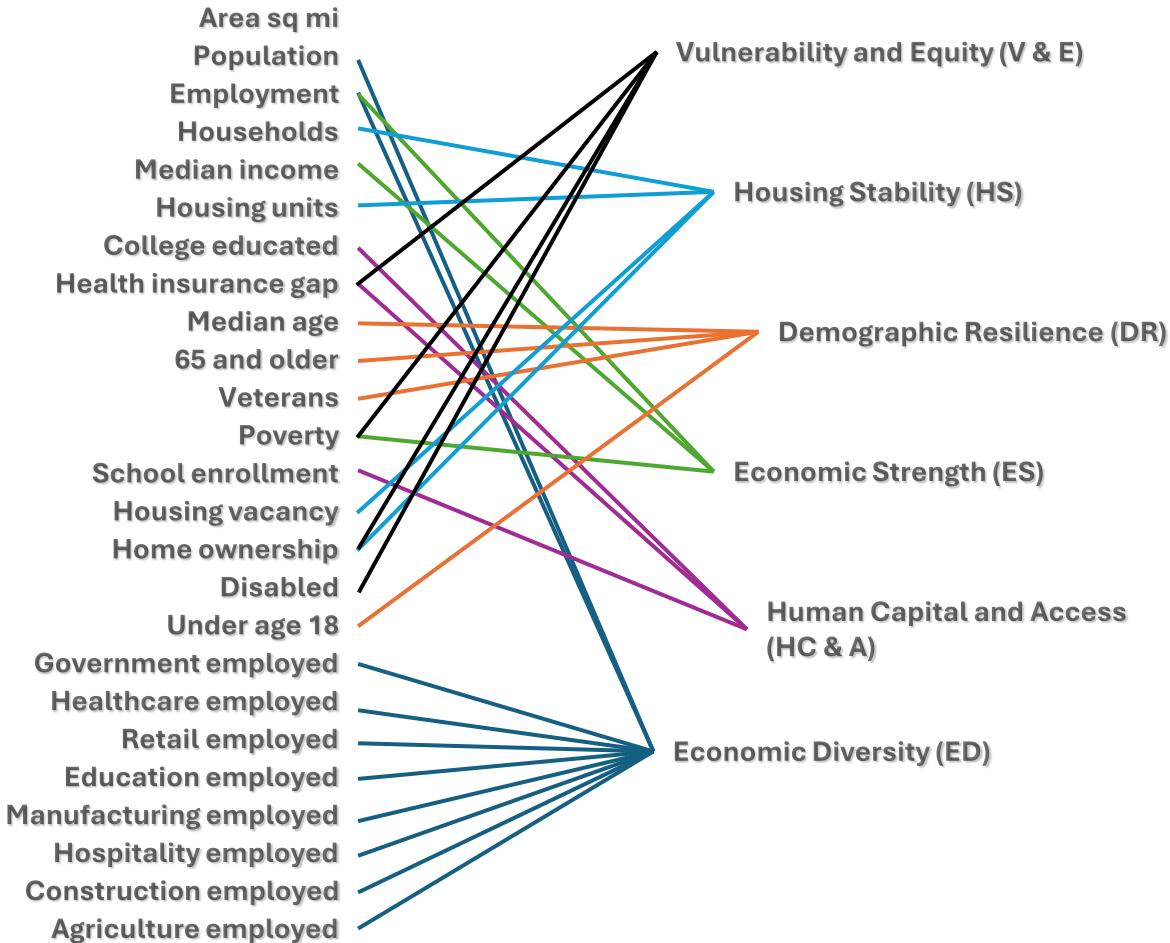
Where we Are

Where we're Going

Gaps, findings, and way ahead: The research-guided assertion is there is a case for **targeting** static, mid-size urban areas and their inventory of peripheral healthcare buildings for adaptive reuse and reinvestment

Aim to develop an **algorithm** to predict the best municipalities to analyze the building inventory, and then perform adaptive reuse to bolster the healthcare built environment

Data clustering and formulas



City	V & E ¹	HS ²	DR ³	ES ⁴	HC & A ⁵	ED ⁶
City						

- V & E** inverts poverty, disability, and health insurance gap, while using home-ownership as a positive; weighted values are .4, .3, .2, .1, respectively
 $=\text{ROUND}(((100-B2)*0.4 + (100-C2)*0.3 + (100-D2)*0.2 + E2*0.1),0)$
- HS** correlates units with households, and then gives weights to ownership and vacancy, and is indicative of economic performance, and economic resilience; weights are .4, .45, and .15, respectively
 $=(\text{MIN}(1,\text{MAX}(0,(B2/C2)-0.8)/(1.2-0.8)))*100*0.4 + D2*0.45 + E2*0.15)$
- DR** incorporates age cohorts, with balanced age structure scored to offset extreme aging and youth bulges
 $=(\text{MAX}(0,100-\text{ABS}(B2-35)/20*100)+\text{MAX}(0,100-\text{ABS}(C2-D2)/50*100)+\text{MIN}(E2/20*100,100))/3$
- ES** is the composite of the employment platform, earning power/income, and poverty; weights are .4, .4, .2, respectively
 $=(\text{RANK.EQ}(B2,\$B\$2:\$B\$9,0)-1)/(\text{COUNTA}(\$B\$2:\$B\$101)-1)*100 | =(\text{RANK.EQ}(C2,\$C\$2:\$C\$9,0)-1)/(\text{COUNTA}(\$C\$2:\$C\$101)-1)*100 | =(\text{RANK.EQ}(D2,\$D\$2:\$D\$9,1)-1)/(\text{COUNTA}(\$D\$2:\$D\$9)-1)*100 || = (0.4*M2)+(0.4*N2)+(0.2*O2)$
- HC & A** measures local skills and the population ability to use health and education services; college and school enrollment positive; lack of health insurance negatively influences value
 $=((\text{RANK.EQ}(B2,\$B\$2:\$B\$9,0)-1)/(\text{COUNTA}(\$B\$2:\$B\$9)-1)*100+(\text{RANK.EQ}(C2,\$C\$2:\$C\$9,0)-1)/(\text{COUNTA}(\$C\$2:\$C\$9)-1)*100+(\text{RANK.EQ}(D2,\$D\$2:\$D\$9,1)-1)/(\text{COUNTA}(\$D\$2:\$D\$9)-1)*100)/3$
- ED** is given a score of 'entropy' where the higher the score, the more evenly employment is distributed; lower scores are more niche pockets of employment
 $=\text{LET}(\text{popRange},\$B\$2:\$B\$9,\text{empRateRange},\$C\$2:\$C\$9,\text{sectorRange},D2:K2,\text{sectorPct},\text{sectorRange}/100,\text{sectorSum},\text{SUM}(\text{sectorPct}),\text{shares},\text{IF}(\text{sectorSum}>0,\text{sectorPct}/\text{sectorSum},\text{sectorPct}),\text{entropy},-\text{SUM}(\text{IF}(\text{shares}>0,\text{shares} * \text{LN}(\text{shares}),0)),N,\text{COLUMNS}(\text{sectorRange}),\text{entropy_norm},\text{IF}(N>1,\text{entropy}/\text{LN}(N),0),\text{empRate}_\text{cur},C2/100,\text{empRate}_\text{vec},\text{empRateRange}/100,\text{empRate}_\text{norm},\text{IF}(\text{MAX}(\text{empRate}_\text{vec})-\text{MIN}(\text{empRate}_\text{vec})>0$

Abstract Conceptualization

Equations

Vulnerability and Equity (V & E)

	A	B	C	D	E	F	G
1	Urban Center	Poverty %	Disabled Population %	Health Insurance Gap %	Home Ownership %	Vulnerability and E	
2	Altus	17	16	15	56	81	
3	Duncan	20	21	16	68	79	
4	Ardmore	17	22	14	56	79	
5	Lawton	20	25	11	48	77	
6	Wichita Falls	14	16	17	57	82	
7	Ada	16	15	20	45	80	
8	Chickasha	19	20	15	52	79	
9	OKC	15	15	12	57	83	

Economic Strength (ES)

	A	B	C	D	M	N	O	P
1	Urban Center	Median Household Income	Employment Poverty %	Income	Employe Poverty	Economic Strength		
2	Altus	55550.00	0.55	0.17	42.85714	57.14286	57.14286	51
3	Duncan	57020.00	0.52	0.20	28.57143	85.71429	100	66
4	Ardmore	52954.00	0.57	0.17	85.71429	28.57143	42.85714	54
5	Lawton	55506.00	0.47	0.20	57.14286	100	85.71429	80
6	Wichita Falls	63835.00	0.54	0.14	14.28571	71.42857	0	34
7	Ada	51792.00	0.60	0.16	100	14.28571	28.57143	51
8	Chickasha	55039.00	0.55	0.19	71.42857	42.85714	71.42857	60
9	OKC	70040.00	0.64	0.15	0	0	14.28571	3

Housing Stability (HS)

	A	B	C	D	E	F
1	Urban Center	Housing Units	Households	Home Ownership %	Housing Inventory Vacan	Housing Stability
2	Altus	9,021	7,371	56	18	68
3	Duncan	11,089	9,333	68	16	72
4	Ardmore	11,384	9,787	56	14	64
5	Lawton	39,738	33,438	48	16	63
6	Wichita Falls	43,762	38,289	57	13	62
7	Ada	8,043	6,688	45	17	60
8	Chickasha	7,735	6,391	52	17	59
9	OKC	314,255	290,311	57	17	59

Human Capital and Access (HC & A)

	A	B	C	D	E	M
1	Urban Center	Bachelors Degree %	School Enrolled %	Health Insurance Gap	Human Capital and Access	M
2	Altus	24	72	15	43	
3	Duncan	20	80	16	48	
4	Ardmore	22	80	14	29	
5	Lawton	20	74	11	33	
6	Wichita Falls	27	61	17	71	
7	Ada	26	64	20	67	
8	Chickasha	22	72	15	52	
9	OKC	70	70	12	29	

Worksheet 1 – Master Data set and formulations

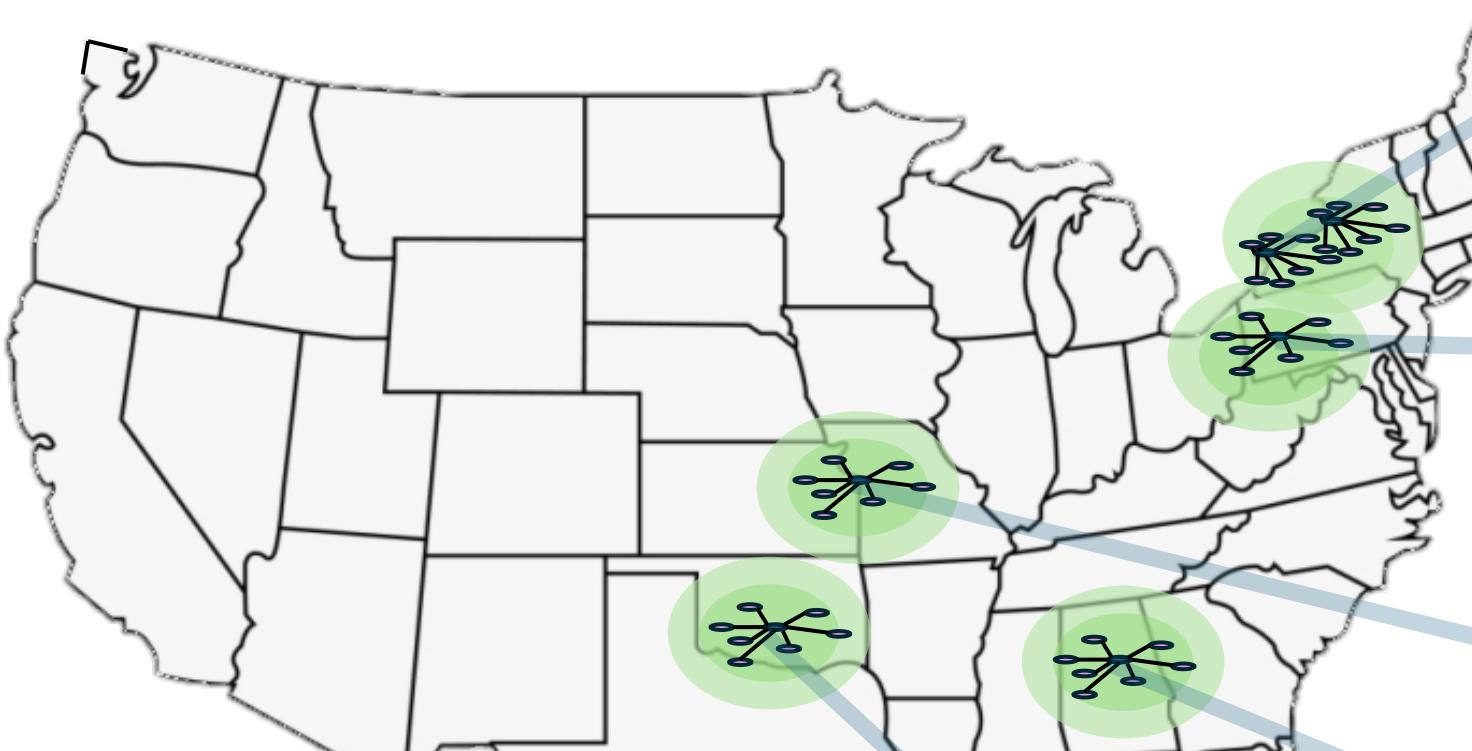
Demographic Resilience (DR)

	A	B	C	D	E	F
1	Urban Center	Median Age	Under 18 %	65 and Older	Veterans %	Demographic Resilience
2	Altus	34	25	17	18	81
3	Duncan	40	22	21	9	73
4	Ardmore	37	25	16	7	70
5	Lawton	34	23	12	17	86
6	Wichita Falls	35	21	16	9	78
7	Ada	33	25	14	7	67
8	Chickasha	37	21	16	7	72
9	OKC	35	25	14	7	71

Economic Diversity (ED)

	A	B	C	D	E	F	G	H	I	J	K	L	M			
1	Urban Center	Population	Employment %	Government	Healthcare	Er	Retail	Employ	Education	Em	Manufactur	Hospitality	En	Construction	Agriculture	Employed %
2	Altus	16,725	54.6%	14.5%	13.6%	10.1%	10.2%	0.5%	7.2%	7.0%	3.9%	7.0%	7.2%	7.0%	97	
3	Duncan	22,692	51.5%	4.3%	13.2%	13.0%	7.3%	9.4%	5.9%	6.5%	0.6%	63	92			
4	Ardmore	24,725	56.8%	3.8%	14.6%	12.7%	6.9%	13.9%	7.1%	6.8%	1.3%	72	92			
5	Lawton	90,381	46.9%	11.0%	13.7%	13.4%	9.6%	8.7%	8.3%	6.1%	1.0%	63	94			
6	Wichita Falls	102,316	54.1%	6.3%	17.6%	13.2%	9.2%	7.3%	11.1%	5.5%	0.4%	72	91			
7	Ada	16,481	60.2%	9.3%	16.6%	11.7%	11.5%	7.5%	5.2%	6.1%	1.4%	76	93			
8	Chickasha	16,051	55.3%	4.7%	14.6%	12.9%	8.5%	11.5%	8.5%	5.1%	0.9%	68	92			
9	OKC	681,054	64.0%	7.6%	13.6%	11.7%	8.8%	7.2%	7.2%	7.5%	0.6%	96	94			

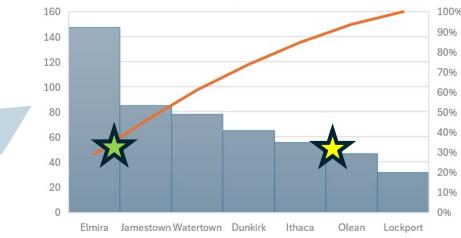
5-city algorithm results



Worksheet 2 – Rochester
Worksheet 3 – Pittsburgh
Worksheet 4 – Oklahoma City
Worksheet 5 – Kansas City
Worksheet 6 – Buffalo
Worksheet 7 - Birmingham

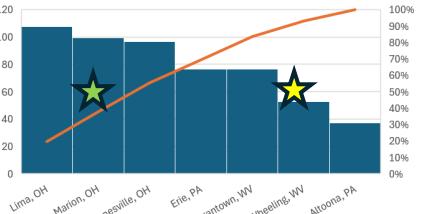
Buffalo / Rochester

Viability | Potentia



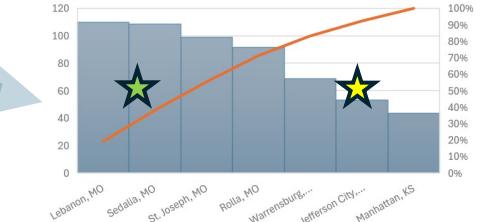
Pittsburg

Viability | Potentia



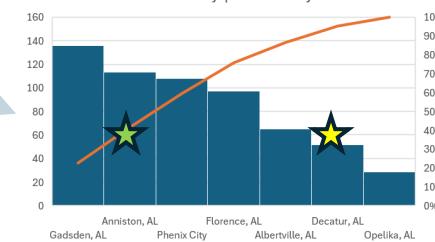
Kansas City

Viability | Potentia



Birmingham

Viability | Potentia

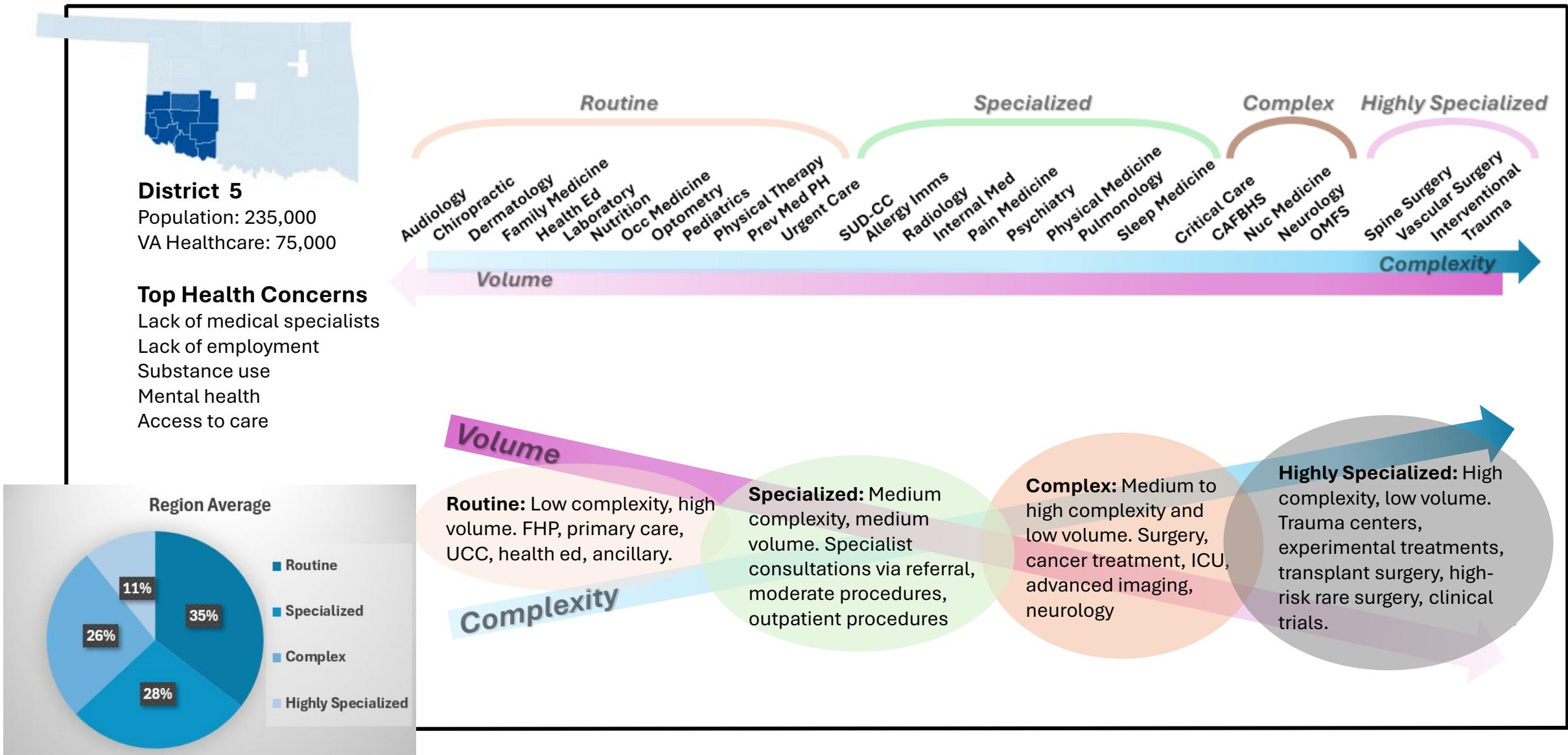


Oklahoma City

Viability | Potentia



Definitions – medical service lines, complexity, volume

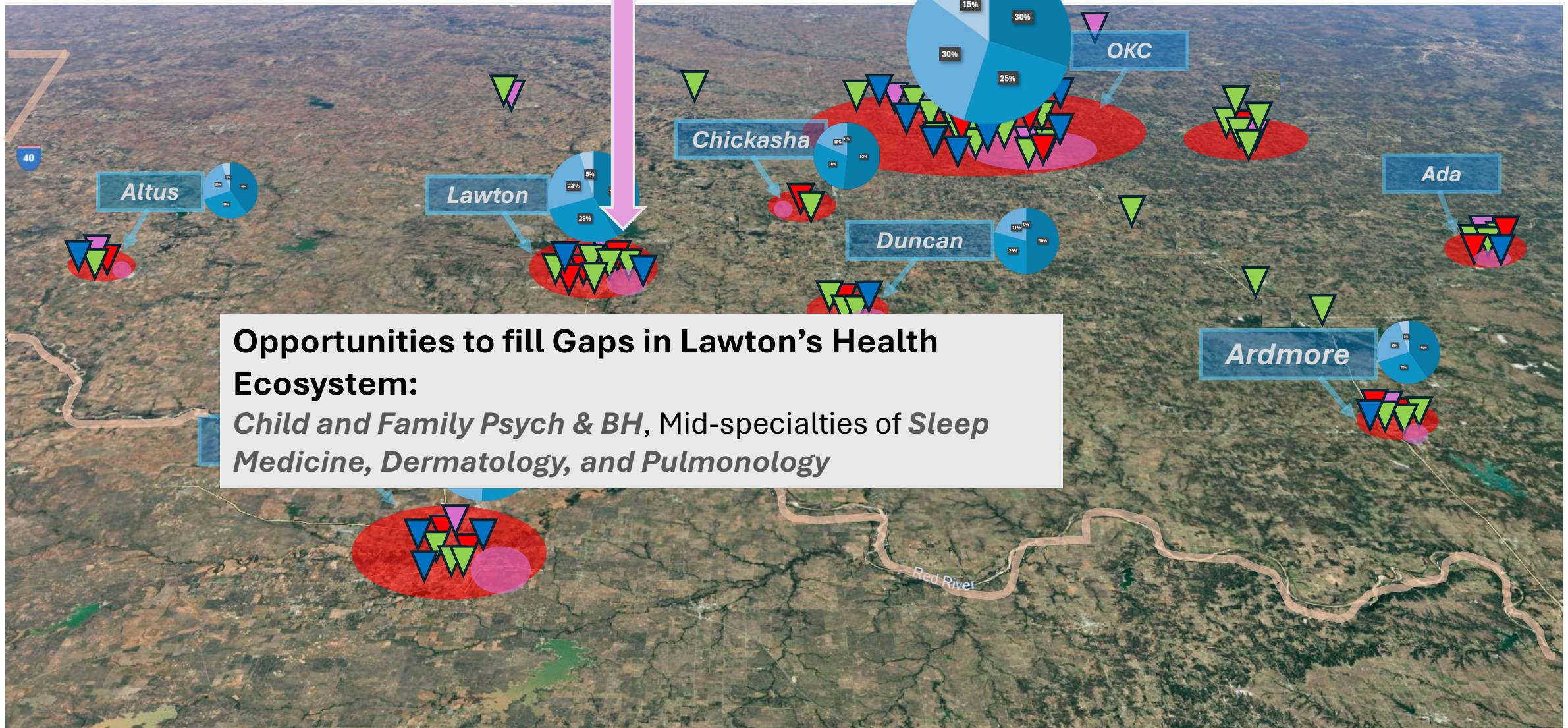


Southwest Oklahoma – medical specialty capability, complexity, volume, age-group

Specialty		Complexity	Volume	Pediatric	Young adult	Middle aged	Over 65	Military-aged	Hahu Capability	Lawton Capability	Wichita Falls Capability	Duncan Capabil	Chickasha Capability	Ardmore Capability
Addiction Medicine	Routine	High	Medium	Low	High	Medium	Low	High	Yes	Yes	Yes	Yes	Yes	Yes
Allergy Immunology	Specialized	Medium	Low	High	Medium	Medium	Low	Low	Yes	No	Yes	No	No	Yes
Audiology	Routine	Low	Medium	High	Medium	Medium	High	High	Yes	Yes	Yes	Yes	Yes	Yes
Aviation Medicine	Specialized	High	Low	Low	High	Medium	Low	High	No	No	No	No	No	No
Cardiology	Specialized	High	High	Low	Medium	High	High	Medium	No	Yes	Yes	Yes	Yes	Yes
Cardiothoracic Surgery	Highly Specialized	High	Low	Low	Low	Medium	High	Low	No	No	Yes	No	No	No
Child and Adolescent Psychiatry	Complex	High	Medium	High	Medium	Low	Low	Low	Yes	No	Yes	No	No	No
Chiropractic	Routine	Low	Medium	Low	High	High	Medium	High	Yes	Yes	Yes	Yes	Yes	Yes
Colorectal Surgery	Complex	High	Low	Low	Medium	High	Low	No	No	No	Yes	No	No	No
Cosmetic Medicine	Routine	Low	Medium	Low	High	High	Low	Medium	No	Yes	Yes	Yes	No	No
Critical Care Medicine	Complex	High	Medium	Low	Medium	High	High	Medium	No	Yes	Yes	No	Yes	Yes
Dermatology	Routine	Low	High	Medium	High	High	High	Medium	Yes	Yes	Yes	Yes	Yes	Yes
Diagnostic Radiology	Specialized	Medium	High	High	High	High	High	High	Yes	Yes	Yes	Yes	Yes	Yes
Emergency Medicine	Complex	Medium	High	Medium	High	High	High	High	No	Yes	Yes	Yes	Yes	Yes
EMS Prehospital Medicine	Routine	Low	High	Medium	High	High	High	High	No	Yes	Yes	Yes	Yes	Yes
Endocrinology	Specialized	High	Low	Medium	Medium	High	High	Low	No	No	Yes	No	No	Yes
Family Medicine	Routine	Low	High	Low	High	High	High	High	Yes	Yes	Yes	Yes	Yes	Yes
Forensic Medicine	Highly Specialized	High	Low	Low	Low	Medium	Low	Low	No	No	Yes	No	No	No
Gastroenterology	Complex	High	Medium	Low	Medium	High	High	Medium	No	Yes	Yes	Yes	No	Yes
General Surgery	Complex	High	High	Low	Medium	High	High	Medium	No	Yes	Yes	Yes	Yes	Yes
Geriatric Medicine	Specialized	Medium	Medium	Low	Medium	High	Low	No	No	Yes	No	No	Yes	Yes
Health Education / Health Promotion	Routine	Low	High	Medium	High	High	High	High	Yes	Yes	Yes	Yes	Yes	Yes
Hematology	Highly Specialized	High	Medium	Low	Medium	Medium	High	Low	No	Yes	No	No	Yes	Yes
Hepatology	Specialized	High	Low	Low	Low	Medium	High	Low	No	No	Yes	No	No	No
Hospital Medicine	Specialized	Medium	High	Low	Medium	High	High	Medium	No	Yes	Yes	Yes	Yes	Yes
Hyperbaric Medicine	Highly Specialized	High	Low	Low	Low	Medium	Low	No	No	Yes	No	No	No	No
Infectious Diseases	Specialized	High	Low	Medium	Medium	Medium	Medium	Medium	No	No	Yes	No	No	No
Internal Medicine	Specialized	Medium	High	Low	Medium	High	High	Medium	Yes	Yes	Yes	Yes	Yes	Yes
Interventional Cardiology	Highly Specialized	High	Medium	Low	Low	Medium	High	Low	No	No	Yes	No	No	No
Interventional Radiology	Highly Specialized	High	Low	Low	Low	Medium	High	Low	No	No	Yes	No	No	No
Laboratory Tech	Routine	Medium	High	High	High	High	Low	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maternal Fetal Medicine	Complex	High	Low	High	Low	Low	Low	No	No	Yes	No	Yes	Yes	Yes
Medical Genetics	Highly Specialized	High	Low	Medium	Low	Low	Low	No	No	Yes	No	No	No	No
Medical Oncology	Highly Specialized	High	Medium	Low	High	High	Low	No	No	Yes	No	No	No	No
Military Medicine	Specialized	Low	Medium	Low	High	Medium	Low	High	No	Yes	No	No	No	No
Neonatology	Complex	High	Low	High	Low	Low	Low	No	No	Yes	No	No	No	Yes
Nephrology	Complex	High	Medium	Low	Low	Medium	High	Low	No	Yes	Yes	No	No	No
Neurology	Complex	High	Medium	Low	Medium	High	High	Medium	Yes	Yes	Yes	No	No	No
Neurosurgery	Highly Specialized										No	No	Yes	
Nuclear Medicine	Highly Specialized										No	No	Yes	
Nutrition Care / Dietitian	Routine										Yes	Yes	Yes	
Obstetrics Gynecology	Complex										Yes	Yes	Yes	
Occupational Medicine	Routine										Yes	No	Yes	
Ophthalmology	Routine										Yes	No	Yes	
Optometry	Routine										Yes	Yes	Yes	
Oral Maxillofacial Surgery	Complex	High	Low	Low	Medium	Medium	Low	Low	Yes	No	Yes	No	No	No
Orthopedic Surgery	Complex	High	High	Medium	High	High	High	High	No	Yes	Yes	Yes	No	Yes
Otolaryngology ENT	Complex	High	Medium	Medium	Medium	High	High	Medium	No	Yes	Yes	Yes	No	Yes
Pain Medicine	Specialized	Medium	Medium	Low	Medium	High	High	Medium	Yes	Yes	Yes	Yes	No	Yes
Palliative Care Hospice	Specialized	High	Medium	Low	Low	Medium	High	Low	No	Yes	Yes	Yes	Yes	Yes
Pathology Cytology	Specialized	High	Medium	Low	Medium	High	High	Medium	No	Yes	Yes	Yes	Yes	Yes
Pediatric Cardiology	Complex	High	Low	High	Low	Low	Low	No	No	Yes	No	No	No	No
Pediatric Emergency Medicine	Complex	High	Medium	High	Medium	Low	Low	Low	No	No	Yes	No	No	No
Pediatric Surgery	Complex	High	Low	High	Low	Low	Low	No	No	Yes	Yes	No	No	No
Pediatrics	Routine	Medium	High	High	Low	Low	Low	Low	Yes	Yes	Yes	Yes	Yes	Yes
Physical Medicine	Specialized	Medium	Low	Medium	Medium	High	High	Medium	Yes	Yes	Yes	Yes	No	Yes
Physical Therapy (PT)	Routine	Medium	High	Medium	High	High	High	High	Yes	Yes	Yes	Yes	Yes	Yes
Plastic Surgery	Highly Specialized	High	Medium	Low	Medium	Medium	Low	Medium	No	Yes	Yes	No	No	No
Preventive Medicine Public Health	Routine	Low	High	Medium	High	High	High	High	Yes	Yes	Yes	Yes	Yes	Yes
Psychiatry Outpatient	Specialized	Medium	High	Medium	High	High	High	High	Yes	Yes	Yes	Yes	Yes	Yes
Pulmonology	Specialized	Medium	Medium	Low	Medium	High	High	Low	Yes	Yes	Yes	No	No	Yes
Radiation Oncology	Highly Specialized	High	Low	Low	Low	High	High	Low	No	No	Yes	No	No	Yes
Reproductive Endocrinology	Highly Specialized	High	Low	Low	High	Medium	Low	Medium	No	No	Yes	No	No	No

Worksheet 1 – Master Data set and formulations

Oklahoma City & southwest Oklahoma



▼ Hospital System

▼ Clinic / Outpatient Group

▼ VA System

▼ Peripheral System



Routine

Specialized

Complex

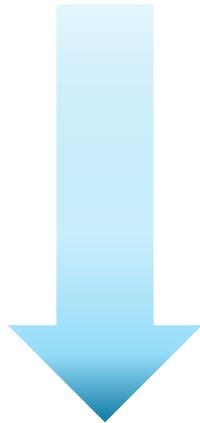
Highly Specialized

Population

Disabled Veteran

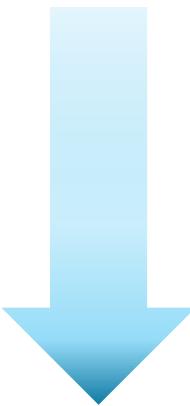
PIVOT

Identify a target municipality



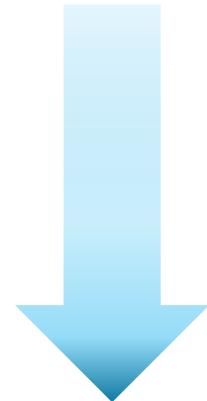
The algorithm shows
Lawton / Fort Sill is a
viable, well established
urban center

Identify gaps in healthcare service lines



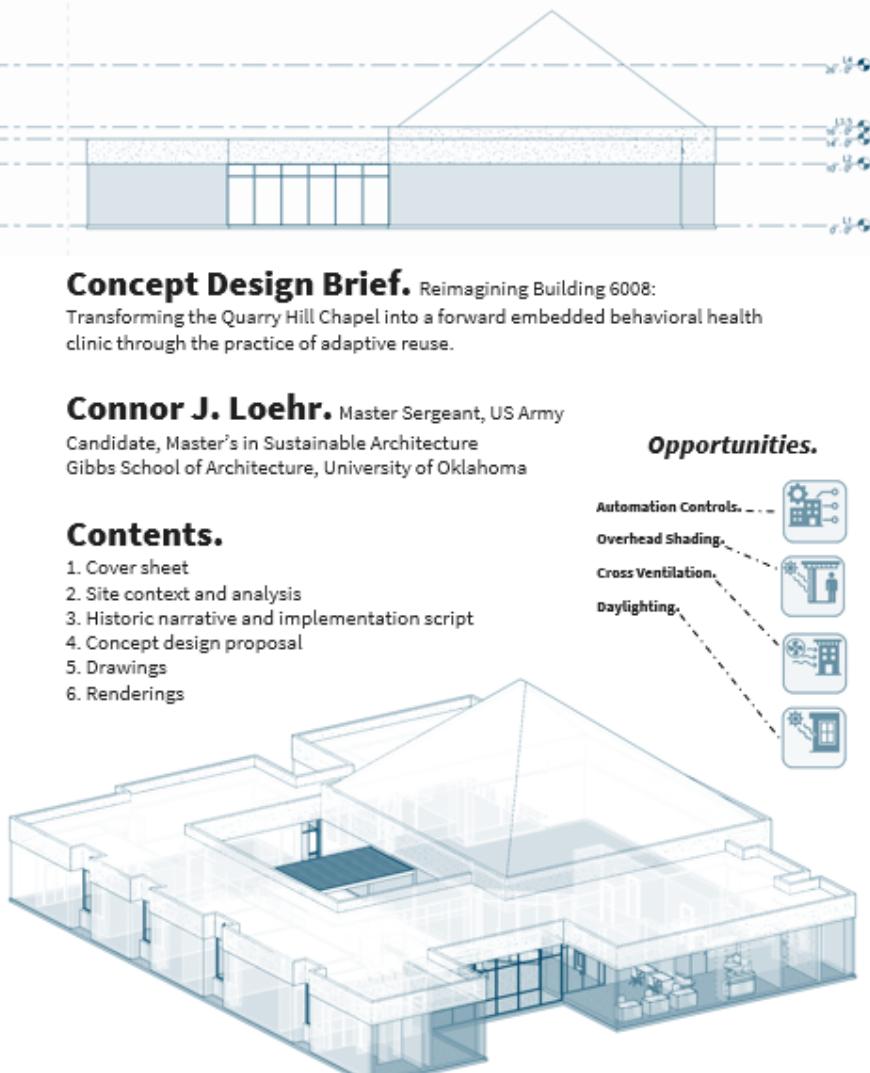
Behavioral health
Pulmonology
Sleep medicine
Dermatology

Identify complexity or volume appropriate service lines



The needs are for
high-volume, low
complexity, and
preventive

Lawton, OK and the community of Fort Sill – reimagining a vacated chapel into a BH clinic



Concept Design Brief. Reimagining Building 6008: Transforming the Quarry Hill Chapel into a forward embedded behavioral health clinic through the practice of adaptive reuse.

Connor J. Loehr. Master Sergeant, US Army
Candidate, Master's in Sustainable Architecture
Gibbs School of Architecture, University of Oklahoma

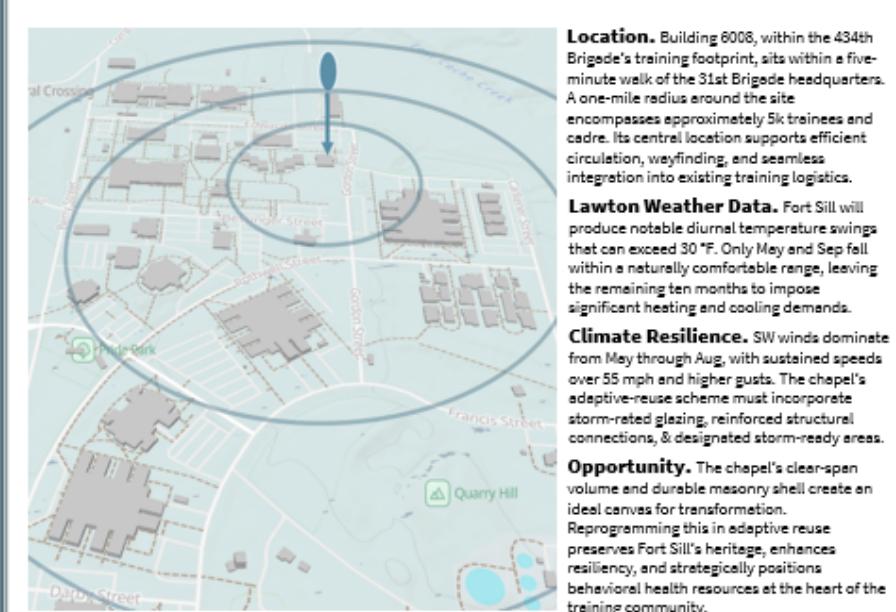
Contents.

1. Cover sheet
2. Site context and analysis
3. Historic narrative and implementation script
4. Concept design proposal
5. Drawings
6. Renderings

Opportunities.

- Automation Controls.
- Overhead Shading.
- Cross Ventilation.
- Daylighting.

Active Experimentation

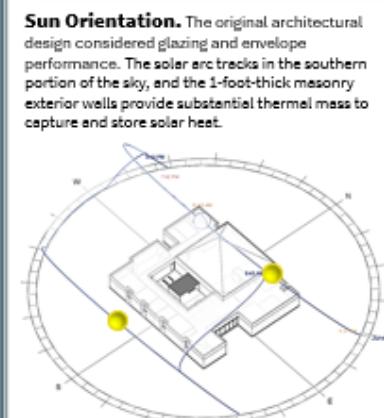


Location. Building 6008, within the 434th Brigade's training footprint, sits within a five-minute walk of the 31st Brigade headquarters. A one-mile radius around the site encompasses approximately 5k trainees and cadre. Its central location supports efficient circulation, wayfinding, and seamless integration into existing training logistics.

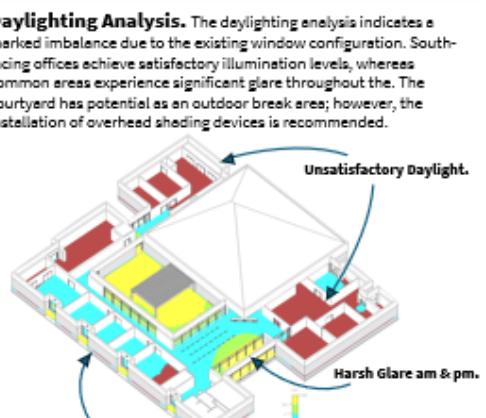
Lawton Weather Data. Fort Sill will produce notable diurnal temperature swings that can exceed 30°F. Only May and Sep fall within a naturally comfortable range, leaving the remaining ten months to impose significant heating and cooling demands.

Climate Resilience. SW winds dominate from May through Aug, with sustained speeds over 55 mph and higher gusts. The chapel's adaptive-reuse scheme must incorporate storm-rated glazing, reinforced structural connections, & designated storm-ready areas.

Opportunity. The chapel's clear-span volume and durable masonry shell create an ideal canvas for transformation. Reprogramming this in adaptive reuse preserves Fort Sill's heritage, enhances resiliency, and strategically positions behavioral health resources at the heart of the training community.



Sun Orientation. The original architectural design considered glazing and envelope performance. The solar arc tracks in the southern portion of the sky, and the 1-foot-thick masonry exterior walls provide substantial thermal mass to capture and store solar heat.

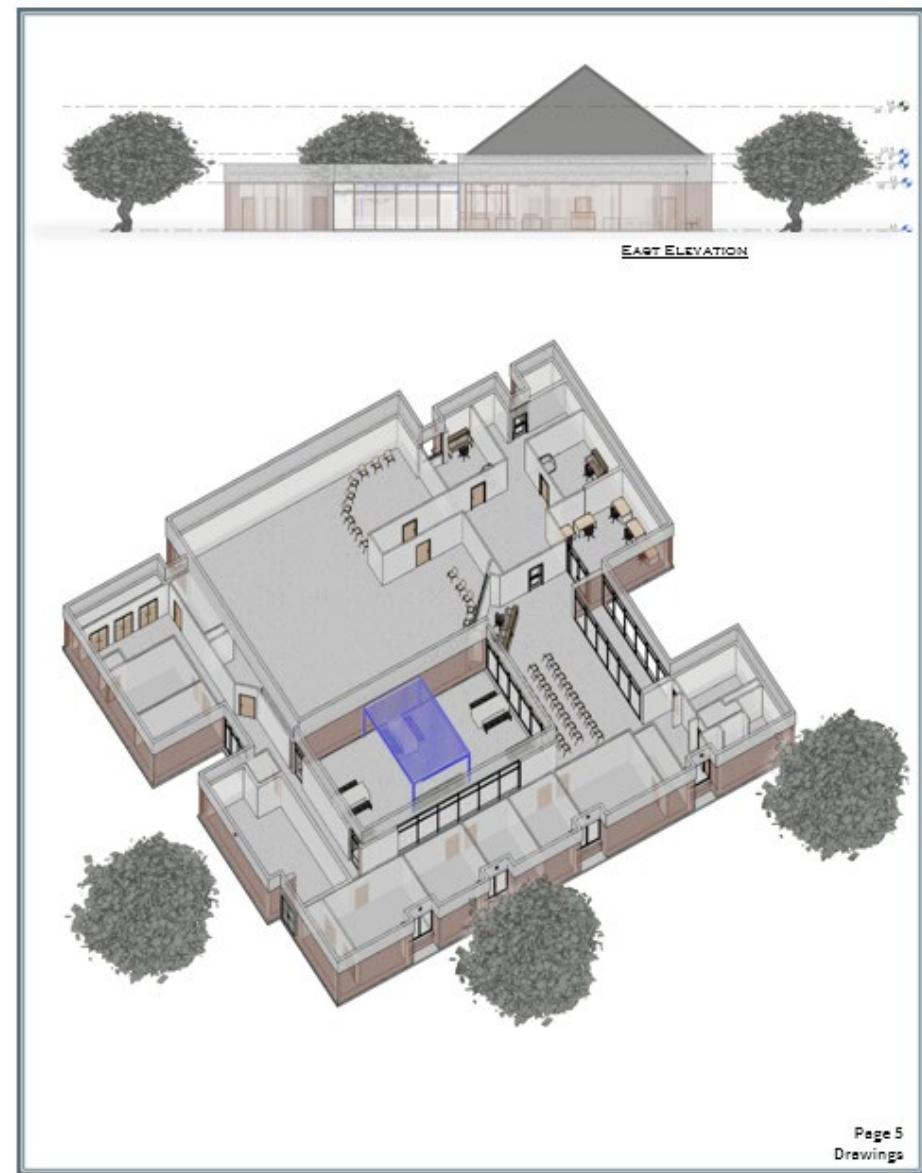
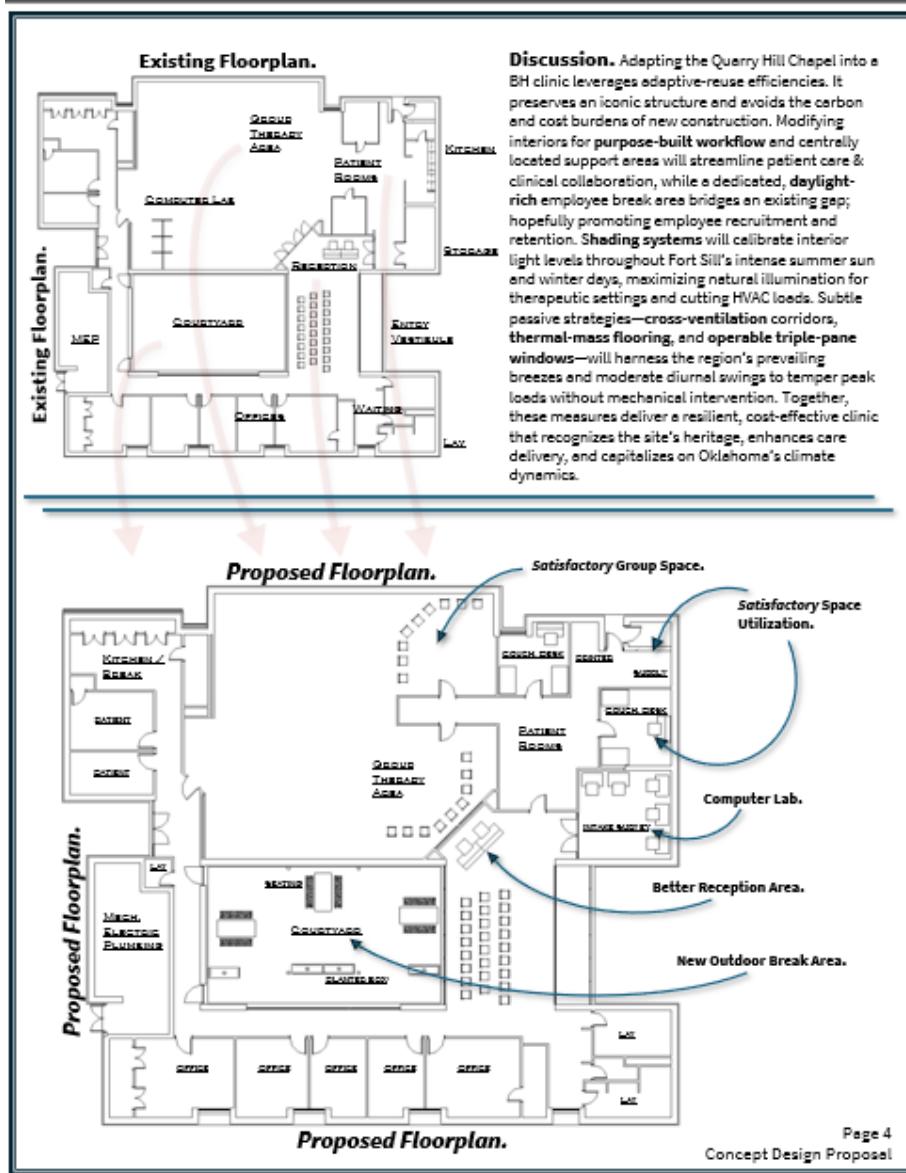


Daylighting Analysis. The daylighting analysis indicates a marked imbalance due to the existing window configuration. South-facing offices achieve satisfactory illumination levels, whereas common areas experience significant glare throughout the day. The courtyard has potential as an outdoor break area; however, the installation of overhead shading devices is recommended.

Unsatisfactory Daylight.
Harsh Glare am & pm.
South Offices Satisfactory.

Page 2
Site Context & Analysis

Lawton, OK and the niche community of Fort Sill



Lawton, OK and the niche community of Fort Sill



Outdoor break area

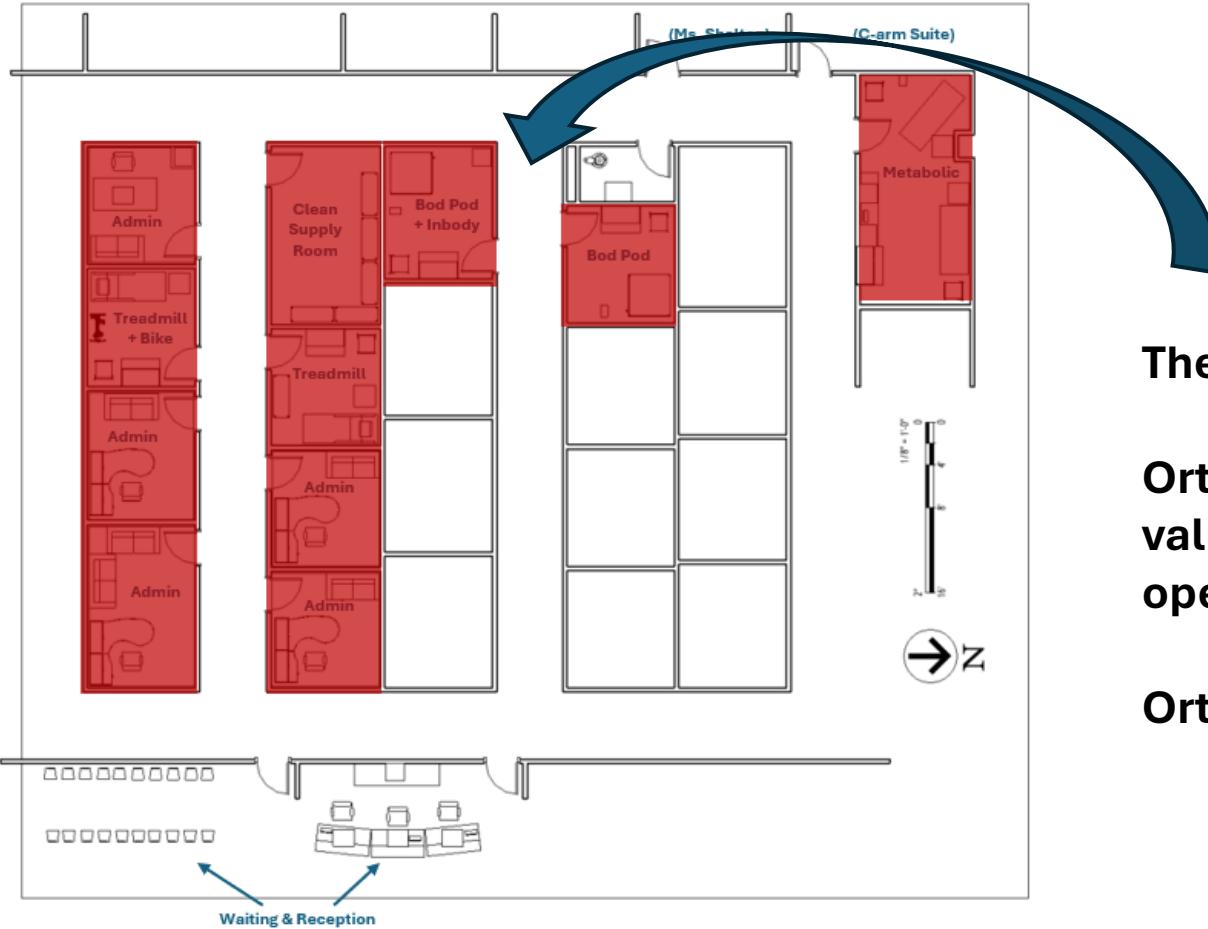


Patient computer lab



Functional reception area

Lawton, OK and the community of Fort Sill – divesting complex service lines

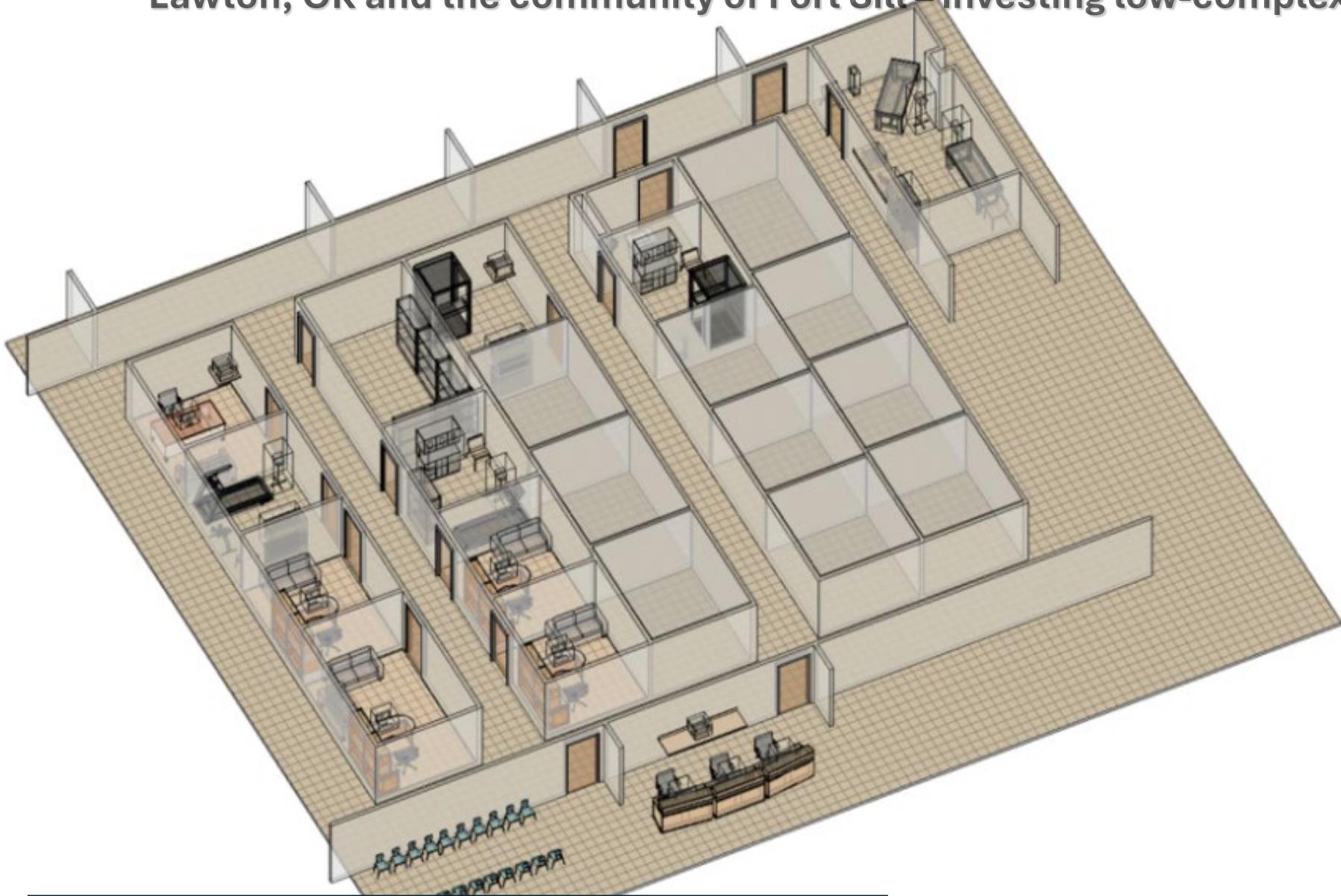


The “former” orthopedic specialty clinic

Ortho is high complexity, low volume, and not value added into the Fort Sill medical common operating picture

Ortho met criteria to be divested

Lawton, OK and the community of Fort Sill—investing low-complexity service lines



Approved – January execution

This space will be occupied by health educators and wellness coaches

Offering bodpod, Inbody, strength, and VO2 max

Biofeedback and performance coaching

Active Experimentation

Conclusion

Where we Were

Where we Are

Where we're Going

The goal of this research is to develop an **algorithm** to predict opportunity rich municipalities, to analyze the building inventory, and then perform adaptive reuse to bolster the healthcare built environment.