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Model Methodology v1.1

January 2025

Assumptions are a critical component of modeling & we will ensure our assumptions are as data-driven as possible

Every model has assumptions; no model is completely assumption-free

However, they are **informed by available data and expert insights;** assumptions are not speculation

They can **fill gaps where complete data is unavailable** or impractical to collect

They can **simplify complex systems** to enable calculations that would otherwise be unwieldy

They **enable forecasting scenarios** by providing levers that can be adjusted

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Each core assumption is supported by rationale and sources (I/II)

Assumption	Rationale	Supporting sources
Supply-driven demand	Focusing on facilities as sites of care enables high geographic granularity; additional data collection suggested for physician-owned clinics	Supply-driven approach taken by UCSF
Provider location is based on their license record	Best available data for provider location is licensing data; will use practice address when sample sizes are large enough	DCA License Registration System; HCAI Licensure Renewal Survey
Use of care settings & ratios	Enables calculation of bottoms-up demand based on facility utilization; primary research of staffing in non-hospital settings recommended to enhance assumption fidelity	HRSA leverages both care settings and staffing ratios; UCSF leverages care settings
Group sets of roles	Group roles with highly overlapping scopes of care to reflect fungibility and avoid false precision	
Group RNs: RN, CNS, PHN, and PMHN	All count toward ratio when providing direct patient care, and: only ~6% of PHN work in a public health setting, CNS provide direct care and expertise (akin to what a RN unit educator or manager might do), and majority of psych staffing needs are met by RNs given low PMHN count	CA BRN 2022 Survey of RNs (Chu & Spetz, 2024); CA BRN 2010 Survey of CNS (Spetz et al., 2010); Dr. Joanne Spetz; expert interviews
Group non-prescribing licensed clinicians: LCSW, LMFT, LPCC, psychologist	These roles all have a shared emphasis on psychotherapy and are largely fungible in statute and current staffing patterns	Board of Behavioral Sciences; Board of Psychology; California's Current and Future Behavioral Health Workforce (Coffman et al., 2018); Cal Code Regs. Tit. 22 Section 77061; expert interviews
License de-duplication	Enables conversion from total license count to total provider count	2017 Survey of NPs and CNMs (Spetz et al., 2018); expert interviews
Static care team staffing	Forecast is based on today's staffing model, which is often dependent on statute (e.g., Title 22 staffing ratios)	Neither HRSA nor UCSF model care team shifts

Each core assumption is supported by rationale and sources (II/II)

Assumption	Rationale	Supporting sources
Unmet demand care team	Limited data exists as to how the provider mix for demand not currently met may differ from the provider mix of today	Interviews; DHCS input
Unmet acute demand	Enables demand calculation without a false ceiling due to inadequate behavioral health infrastructure	Prop 1 passage indicates widespread belief that current met IP/residential demand is constrained by infrastructure
Unmet demand in counties with low current supply	Need to ensure our BH model does not reproduce existing disparities in supply – this is a mathematical approach that ensures our unmet demand is distributed in a logical way that does not produce facially inaccurate results. In the absence of this correction counties with the highest current supply (e.g., Marin) would show the greatest unmet demand, something we know to be incorrect.	
Role of allied health and primary care professionals	Existing behavioral health modeling does not account for allied health or primary care; limited data or consensus on how much behavioral health care non-specialists could or should provide	California's Current and Future Behavioral Health Workforce (Coffman et al., 2018)

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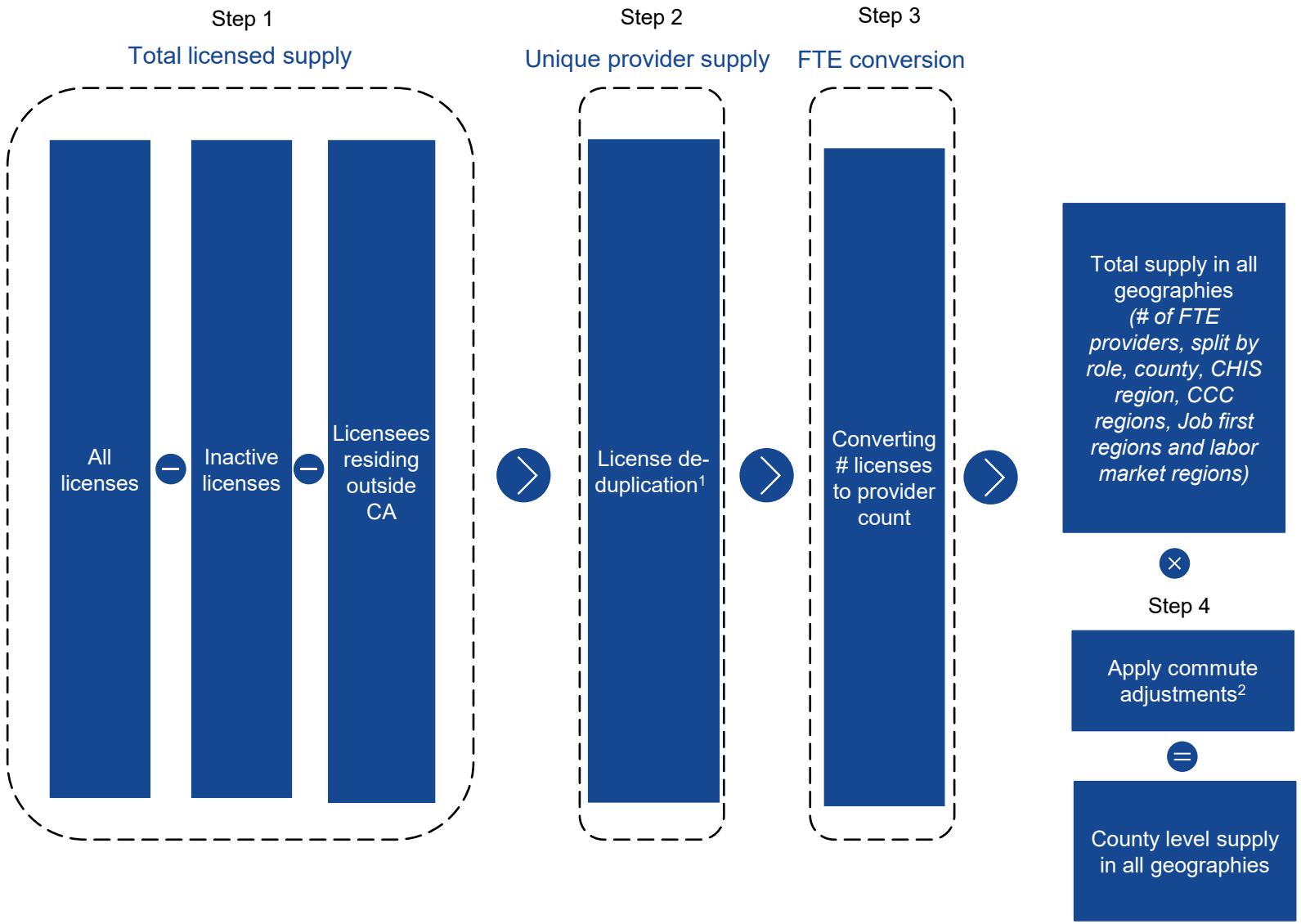
Supply Methodology

Supply Methodology | Nursing and Behavioral Health



[1] Deduplicated based on license hierarchy; accounts for individuals that might hold multiple licenses.
[2] Applied to RN role group and LVN role only

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Step 1 | Supply data sources

Supply for most roles is sourced from DCA/RDC license data. For specialty-based roles, we use data from HCAI Licensure Renewal Survey

Role Type	Role/Role Group	Data Source
Nursing	Registered Nurse group: Registered Nurse (RN), Public Health Nurse (PHN), Certified Nurse Specialist (CNS), Psychiatric Mental Health Nurse (PMHN)	DCA/RDC license data
	Nurse Anesthetist (NA)	
	Vocational Nurse (LVN)	
BH	Associate Level Clinicians: Associate Clinical Social Worker (ACSW), Associate Marriage & Family Therapist (AMFT), Associate Professional Clinical Counselor (APCC), Registered Psychological Associate (RPA),	DCA/RDC license data
	Non-Prescribing Licensed Clinicians: Licensed Clinical Social Worker (LCSW), Licensed Marriage & Family Therapist (LMFT), Licensed Professional Clinical Counselor (LPCC), Psychologist (PSY)	
	Psychiatrist	DCA/RDC licensed data & data from HCAI Licensure Renewal survey

Step 2 | Deduplication using license hierarchies

Nursing license hierarchy

1. Nurse Practitioner
2. Nurse Anesthetist, Certified Nurse Midwife, Clinical Nurse Specialist, Psychiatric Mental Health Nurse, Licensed Midwife

In absence of clear hierarchy between these roles, assign individual to whichever license issued most recently

3. Public Health Nurse
4. Registered Nurse
5. Licensed Vocational Nurse

Behavioral Health license hierarchy

1. Associate Clinical Social Worker, Associate Marriage and Family Therapist, Associate Professional Clinical Counselor, Registered Psychological Associate, Licensed Clinical Social Worker, Licensed Marriage and Family Therapist, Licensed Professional Clinical Counselor, Psychologist, Licensed Educational Psychologist, Psychiatric Technician

In absence of clear hierarchy between these roles, assign individual to whichever license issued most recently

Step 3 | Apply FTE Assumptions (Nursing Roles)

Role	Hours worked per week	FTE Equivalent	Practicing rate	Notes	Supporting evidence
RN	36	0.9	81%	Rolling Average prior 3 surveys (2018, 2020, 2022)	California Board of Registered Nursing 2022 Survey of Registered Nurses (link)
CNS	37.9	0.9475	85.1%		
PMHN	36	0.9	85%		
PHN	36.3	0.9075	81%		
LVN	36	0.9	81%	Assume same hours worked/week as RNs in lieu of other data; 81% of LPNS employed in the West region	Profile of the Licensed Practical Nurse/Licensed Vocational Nurse Workforce, 2008 and 2013 (Coffman et al., 2015, link)
NA	37.5	0.811	90%	Assume 90% practicing based on HCAI license survey responses	Anesthesia Services: A Workforce Model and Projections of Demand and Supply (Negrusa et al., 2021); HCAI license renewal survey

Supply-side assumptions enable us to get from provider count to FTE count

Step 3 | Apply FTE assumptions (Behavioral Health Roles)

Role	Hours worked per week	FTE Equivalent	Practicing rate	Notes	Supporting Evidence
ACSW, AMFT, APCC, RPA	37.7	0.942	87.5%	Assume same hours worked/week as psychologist in lieu of other data.	
LCSW, LMFT, LPCC, PSY	37.7	0.942	87.5%	Assume same hours worked/week as psychologist in lieu of other data.	American Psychological Association (link)
Psychiatrist	37.7	0.942	100%	Assume same hours worked/week as psychologist in lieu of other data.	

Step 4 | Apply Commute Adjustments

Objective

Our goal was to develop a way to account for the nursing workforce living in one county but working in another. By better representing supply based on practice location, false precision in county level supply is greatly reduced.

Approach

Compare the Address of Record (AoR) from the license data to the Primary Practice Address (PPA) reported in the HCAI License Renewal Survey

- For roles such as RN and LVN, we have a robust set of responses to analyze.[1]
- For every respondent, the county from the AoR was compared to the county of the reported PPA. This creates a 'commuting matrix' showing the percentage of the workforce crossing county lines *from* every county *to* every county.
- 54 counties for RNs and in 45 counties for LVNs reached significance.[2] Counties that did not have a representative sample were not adjusted.[3]
- For roles where we did not have sufficient data for more than half the counties, no adjustment was performed (all BH roles & Nurse Anesthetists). The data will be re-examined at the next model refresh.

[1]RN *N* = 112,628 LVN *N* = 24,972.
[2]Based on 90% confidence interval, 15% margin of error using the sample size in each county.
[3]RN = Alpine, Colusa, Sierra, Trinity. LVN = Alpine, Amador, Calaveras, Colusa, Glenn, Inyo, Mariposa, Modoc, Mono, Plumas, Sierra, Trinity, Tuolumne.

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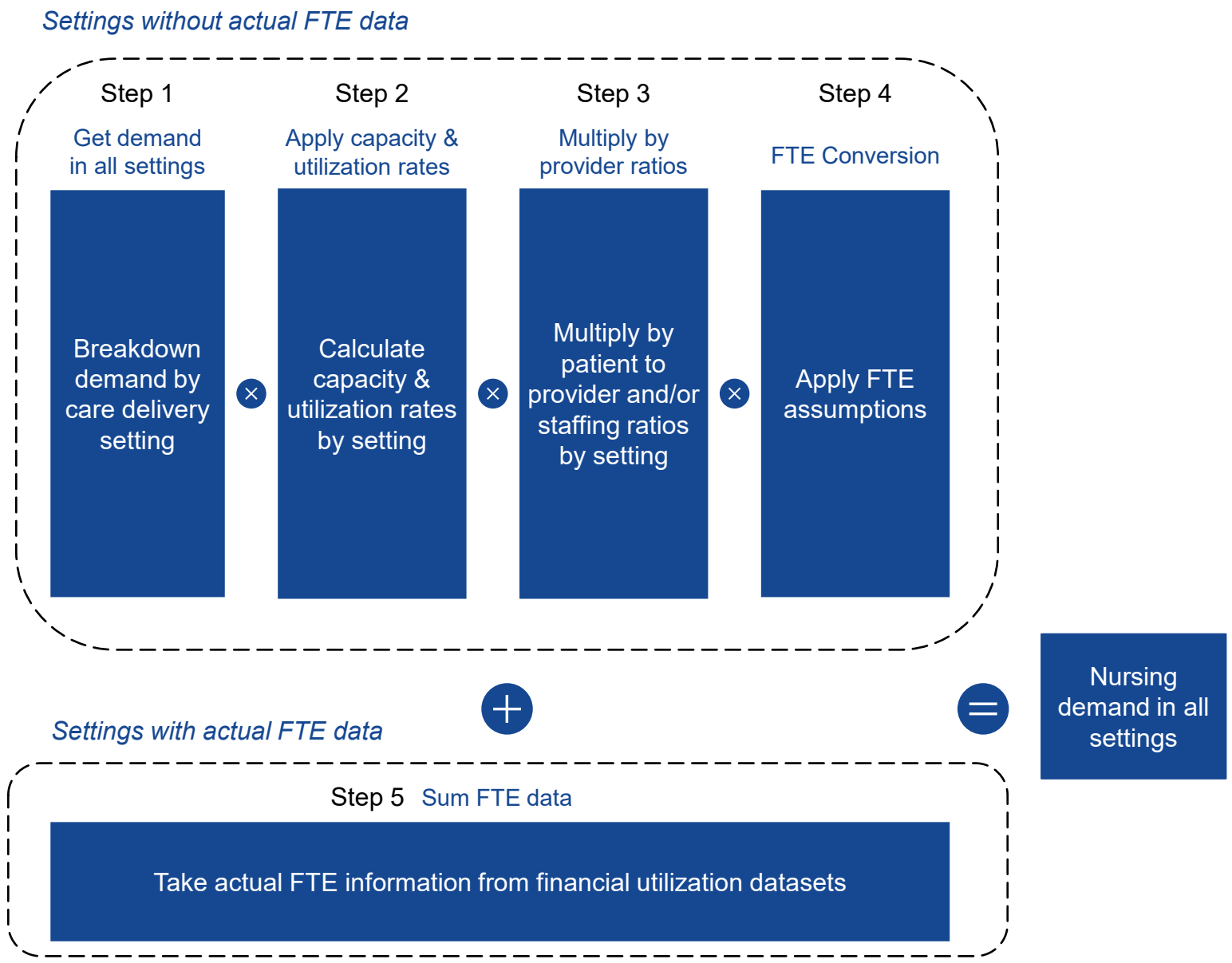
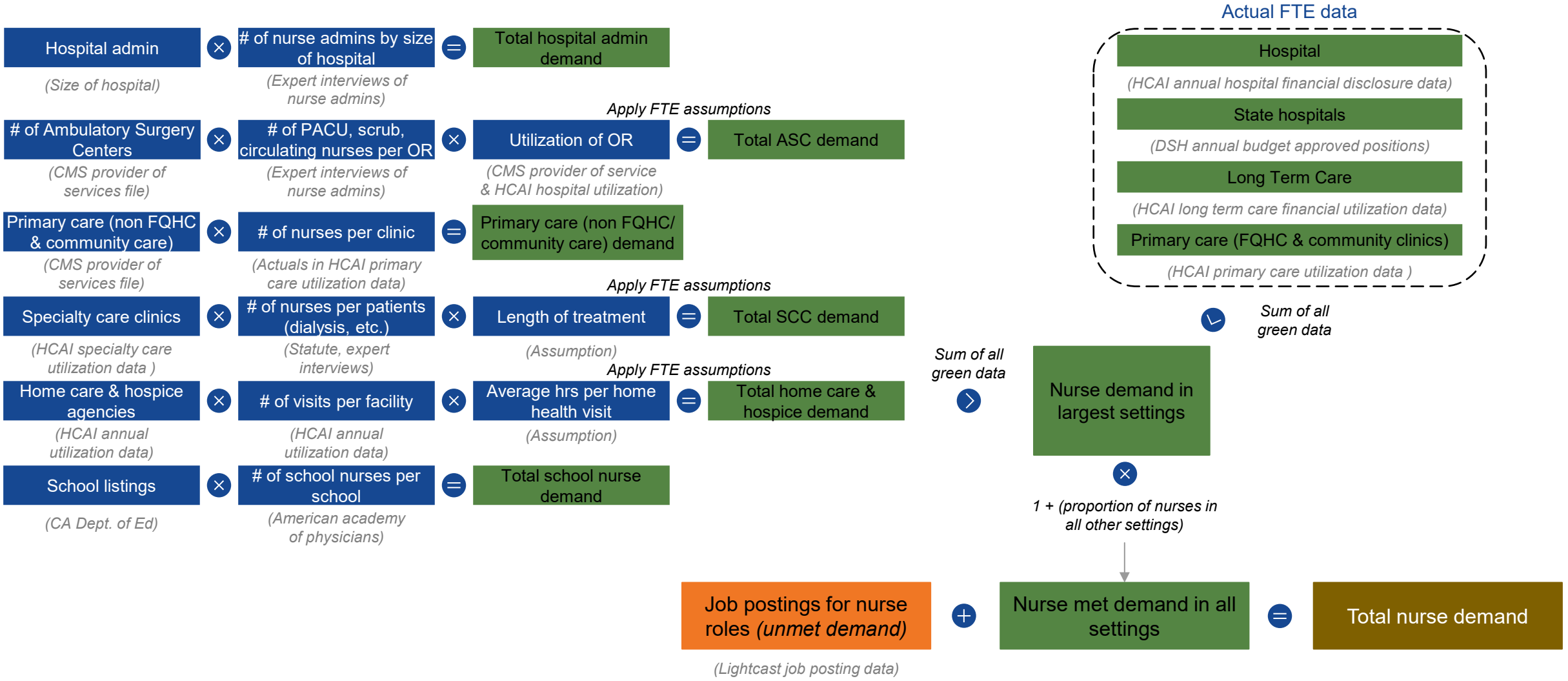
Demand Methodology

Demand Methodology | Nursing



Nursing demand methodology (detailed)



Note: RNs will have demand in all listed settings, other roles (e.g., CRNA, LVN) may not be present in all settings.

Step 1 (Nursing) | Breakdown demand by setting

Types of organizations in which RNs residing in California work the most hours each month[1]

Type	2010	2020	2022
Hospital, inpatient or emergency	53.40%	52.20%	49.40%
Hospital, nursing home unit	0.40%	0.30%	0.60%
Hospital, ambulatory unit	7.80%	7.70%	7.50%
Hospital, ancillary unit	2.30%	1.20%	1.60%
Hospital, other department	0.40%	1.90%	2.20%
Skilled nursing/extended care/rehabilitation	4.40%	3.80%	2.80%
Academic nursing program	1.60%	1.10%	1.4%
Public health dept/community health agency	1.70%	3.80%	5.70%
Home health nursing agency/service	3.30%	5.00%	4.40%
Hospice	1.40%	0.10%	0.20%
Ambulatory care setting (office, surgery center)	8.10%	6.40%	6.90%
Dialysis	1.60%	1.40%	0.70%
Telenursing organization/call center	0.70%	0.80%	1.00%
Occupational health/employee health	0.30%	0.40%	0.30%
School health (K-12 or college)	1.70%	1.30%	2.10%
Mental health/drug and alcohol treatment	1.90%	1.70%	1.60%
Forensic setting (correctional facility, prison, jail)	1.90%	1.60%	1.40%
Government agency (local, state, federal)	1.70%	1.40%	1.00%
Case management/disease management	2.20%	2.10%	1.10%
Self-employed	0.70%	0.30%	0.30%
Other	2.60%	5.90%	7.90%
Number of cases	**4,671**	**2,787**	**2,235**

Legend

Included care delivery settings

'Other' care delivery settings

Type	2022
Inpatient	53.2%
Outpatient / ASC	15.1%
Long term care	2.8%
Home	4.6%
School	2.1%
Other	21.7%
Total	**100%**

[1]California Board of Registered Nursing 2020 Survey of Registered Nurses and 2022 Survey of Registered Nurses (2020 link, 2022 link).

Note: Applied RN %s to LVNs in the absence of LVN specific data. For NAs, only 5% employed in other settings (source: "California Certified Registered Nurse Anesthetist Workforce Study" (Giron et al., 2023, link)

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Step 2 (Nursing) | Get capacity & utilization rates by setting (I/II)

Setting	Bed type / subsetting	Utilization calculation / value	Notes	Source
Non-state hospital	All	N/A given using actual staffing data		Hospital Annual Financial Data (2022), HCAI (link)
State hospital	Acute psych	0.167	Census days / Licensed bed days	2022 Hospital Annual Utilization, HCAI (link)
State hospital	Skilled nursing	0.55	Census days / Licensed bed days	2022 Hospital Annual Utilization, HCAI (link)
State hospital	Intermediate care	0.33	Census days / Licensed bed days	2022 Hospital Annual Utilization, HCAI (link)
ASC	OR - circulating	25% utilization of the OR	Apply average OP minutes / OR and divide by total number of minutes per year; use average from hospital dataset given no ASC-specific data	2022 Hospital Annual Utilization, HCAI (link); CMS Provider of Services File (Q1 2022) (link)
ASC	OR - scrub	25% utilization of the OR	Apply average hospital OP minutes / OR and divide by total number of minutes per year; use average from hospital dataset given no ASC-specific data	2022 Hospital Annual Utilization, HCAI (link); CMS Provider of Services File (Q1 2022) (link)
ASC	PACU	1500 OP surgeries / OR * post anesthesia recovery time	Apply average number of OP surgeries / O; assume post-anesthesia recovery time of 2 hrs; use average from hospital dataset given no ASC-specific data	2022 Hospital Annual Utilization, HCAI (link); CMS Provider of Services File (Q1 2022) (link)

Step 2 (Nursing) | Get capacity & utilization rates by setting (II/II)

Setting	Bed type / subsetting	Utilization calculation / value	Notes	Source
Long term care	All	N/A given using actual staffing data		Long-term Care Facilities Annual Utilization Data, HCAI (link)
Specialty care clinic	Dialysis – treatment	# encounters x 4 hrs	Assume 4 hrs is avg length of a dialysis session	Specialty Care Clinic Utilization Data, HCAI (link); National Kidney Foundation (link?)
Specialty care clinic	Dialysis – management	N/A		42 CFR Sec 494.140 – Condition: Personnel qualifications (link)
Primary care clinic	Community clinic & FQHC	N/A given using actual staffing data		Primary Care Clinic Annual Utilization Data, HCAI (link)
Primary care clinic	All	N/A given using actual staffing data		Licensed and Certified Healthcare Facility Locations (2024) (link) CMS Provider of Services File (Q1 2022) (link)
Home care and hospice	Skilled nursing (home)	N/A given using actual volume of skilled nursing visits		Home Health Agencies & Hospice Annual utilization Report, HCAI (link)
Home care and hospice	Hospice	N/A given using actual volume of RN hospice visits		Home Health Agencies & Hospice Annual utilization Report, HCAI (link)
School	All	N/A	Includes all school types except for adult education centers and ROC/ROP (career technical education)	School Data Directory Export, CA Department of Education (2024) (link)

Step 3 (Nursing) | Multiply by patient:provider and/or staffing ratios - RN (I/III)

Setting	Bed type / subsetting	Ratio	Numerical Input	Notes	Source
Non-state hospital	All	Actuals (2022)			Hospital Annual Financial Data, HCAI (link)
Non-state hospital - Admin	Admin at a small hospital (<100 beds)	15 RNs in administrative roles	15		HR Director at Sutter Roseville Medical Center; Director of Nursing at Sutter Roseville Medical Center; PHN at LA County DPH; RN at Cedars-Sinai Beverly Hills; RN at Sierra Vista Regional Medical Center; RN at UCLA Health; RN at LA General Medical Center
	Admin at a medium hospital (100-499 beds)	60 RNs in administrative roles	60		
	Admin at a large hospital (500+ beds)	110 RNs in administrative roles	110		
State hospital	All	Actuals (FY 21-22 authorized positions)		Does not disaggregate by facility	Department of State Hospitals Governor's Budget Estimate (link)
ASC	OR - circulating	1 circulating RN to 1 patient in an OR	1	Always an RN	Cal. Code Regs. Tit. 22, Sec 70217 – Nursing Service Staff (link)
ASC	OR - scrub	1 scrub RN to 1 patient in an OR	1	Can be an LVN or scrub tech; assume it is an RN 100% of the time	Cal. Code Regs. Tit. 22, Sec 70217 – Nursing Service Staff (link)
ASC	PACU	1 to 2 patient in a post-anesthesia care unit	0.5	Can be an LVN or scrub tech; based on non-state hospital actuals, assume it is RN 95% of the time and LVN 5% of the time	Cal. Code Regs. Tit. 22, Sec 70217 – Nursing Service Staff (link)

Step 3 (Nursing) | Multiply by patient:provider and/or staffing ratios - RN (II/III)

Setting	Bed type / subsetting	Ratio	Numerical Input	Notes	Source
Long term care	All	Actuals (2022)		Use for current state	Long-term Care Facilities Annual Utilization Data, HCAI (link)
Long term care	All	0.55 hrs direct RN care/resident day	0.55	Use for future state	Long-Term Care Minimum Staffing Standards, CMS 3442-F (link)
Long term care	All	1 director of nursing per facility		Each facility must have a director of nursing who is an RN and is employed 8 hrs a day, 5 hrs a week	Cal. Code Regs. Tit. 22, Sec. 72327 – Nursing Service-Director of Nursing Service (link)
Specialty care clinic	Dialysis – treatment	1 RN to 12 patients	0.083	Based on non-state hospital actuals, assume it is RN 95% of the time and LVN 5% of the time	Current dialysis clinic staffing patterns; Senior Clinical RN at Satellite Health
Specialty care clinic	Dialysis – management	1 nurse manager per facility		1 FT nurse manager required per facility (per federal statute on conditions for coverage for dialysis facilities)	42 CFR Sec 494.140 – Condition: Personnel qualifications (link); Senior Clinical RN at Satellite Health
Specialty care clinic	Dialysis – management	1 RN manager per 4 facilities	0.25	1 RN manager for every 4 facilities under a parent corporation	Senior Clinical RN at Satellite Health
Specialty care clinic	Dialysis – management	1 RN manager per all facilities		1 RN manager for all facilities under a parent corporation	Senior Clinical RN at Satellite Health
Primary care clinic	Community clinic/FQHC	Actuals (2022)			Primary Care Clinic Annual Utilization Data, HCAI (link)
Primary care clinic	All others	1 RN per primary care clinic		Apply RN/clinic ratio seen in actuals to other primary care clinics	Primary Care Clinic Annual Utilization Data, HCAI (link)

Step 3 (Nursing) | Multiply by patient:provider and/or staffing ratios - RN (III/III)

Setting	Bed type / subsetting	Ratio	Numerical Input	Notes	Source
Home care and hospice	Skilled nursing (home)	Calculated based on volume and duration of skilled nursing visits (utilization)		Based on long term care actuals, assume 25% of skilled nursing visits conducted by RNs and 75% conducted by LVNs; assume each visit is 2 hrs	Home Health Agencies & Hospice Annual utilization Report, HCAI (link)
Home care and hospice	Hospice	Calculated based on avg. duration of a RN hospice visit (utilization)		RN only; assume each visit is 2 hrs	Home Health Agencies & Hospice Annual utilization Report, HCAI (link)
Home care and hospice	Admin	1 director of nursing per parent organization			RN Case Manager at John Muir Health
Home care and hospice	Admin	1 RN manager per 300 patients per agency/parent org		Assume 0 if <300 patients	RN Case Manager at John Muir Health
School	All	1 RN per school			AAP (link); Dr. Elaine Musselman, Director at SFSU School of Nursing

Step 3 (Nursing) | Multiply by patient:provider and/or staffing ratios - NA (I/I)

Setting	Bed type / subsetting	Ratio	Numerical input	Notes	Source
Hospital	OR	1 CRNA to 1 OR		Assume there is 1 CRNA per OR when staffed, but that CRNAs are staffed 1/2 of the time as a middle ground between license counts and nationwide practices. License counts show that anesthesiology providers in CA are ~1/3 CRNA and ~2/3 anesthesiologist, but nationally anesthesiologists work solo 25-30% of the time, indicating high opportunity for CRNA utilization	DCA license list; BLS OEWS; "Anesthesia Services: A Workforce Model and Projections of Demand and Supply" (Negrusa et al., 2021, link); Former anesthesiologist
ASC	OR	1 CRNA to 1 OR			

Step 3 (Nursing) | Multiply by patient:provider and/or staffing ratios – LVN (I/II)

Setting	Bed type / subsetting	Ratio	Numerical Input	Notes	Source
Long term care	All	Actuals (2022)		Use for current state	Long-term Care Facilities Annual Utilization Data, HCAI (link)
Long term care	All	0 hrs direct LVN care / resident day	0	Use for future state; assume CNAs meet non-RN nursing demand	Long-Term Care Minimum Staffing Standards, CMS 3442-F (link)
Specialty care clinic	Dialysis – treatment	1 LVN to 4 dialysis patients, 10% of the time	0.025	LVNs can work in PCT-type role (1:4 staffing) and do so ~10% of the time	Current dialysis clinic staffing patterns; Expert interviews (Jacqueline Javier-Burns, Senior Clinical RN at Satellite Health)
Primary care clinic	Community clinic/FQHC	Actuals (2022)			Primary Care Clinic Annual Utilization Data, HCAI (link)
Primary care clinic	All others	Calculated based on LVN/clinic ratio seen in actuals to other primary care clinics		LVN/clinic ratio seen in actuals to other primary care clinics	Primary Care Clinic Annual Utilization Data, HCAI (link)
Home care and hospice	Skilled nursing (home)	Calculated based on volume and duration of skilled nursing visits (utilization)		Based on long term care actuals, assume 25% of skilled nursing visits conducted by RNs and 75% conducted by LVNs; assume each visit is 2 hrs	Home Health Agencies & Hospice Annual utilization Report, HCAI (link)
Home care and hospice	Hospice	Calculated based on avg. duration of a LVN hospice visit (utilization)		Assume each visit is 2 hrs	Home Health Agencies & Hospice Annual utilization Report, HCAI (link)
School	All	1 LVN per 50 schools	0.02	LVNs used increasingly to support RNs in schools; ballpark nature of estimate validated with Dr. Musselman	Dr. Elaine Musselman, Director at SFSU School of Nursing

Step 3 (Nursing) | Multiply by patient:provider and/or staffing ratios – LVN (II/II)

Setting	Bed type / subsetting	Ratio	Numerical Input	Notes	Source
Non-state hospital	All	Actuals (2022)			Hospital Annual Financial Data, HCAI (link)
State hospital	All	Actuals (FY 21-22 authorized positions)		Does not disaggregate by facility	Department of State Hospitals Governor's Budget Estimate (link)
ASC	OR - scrub	0 LVN per 1 patient in an OR	0	Can be an LVN or scrub tech; assume it is an RN 100% of the time	Cal. Code Regs. Tit. 22, Sec 70217 – Nursing Service Staff (link)
ASC	PACU	1 LVN to 2 patients in a post-anesthesia care unit	0.33	Can be an LVN or scrub tech; based on non-state hospital actuals, assume it is LVN only a marginal amount of the time	Cal. Code Regs. Tit. 22, Sec 70217 – Nursing Service Staff (link)

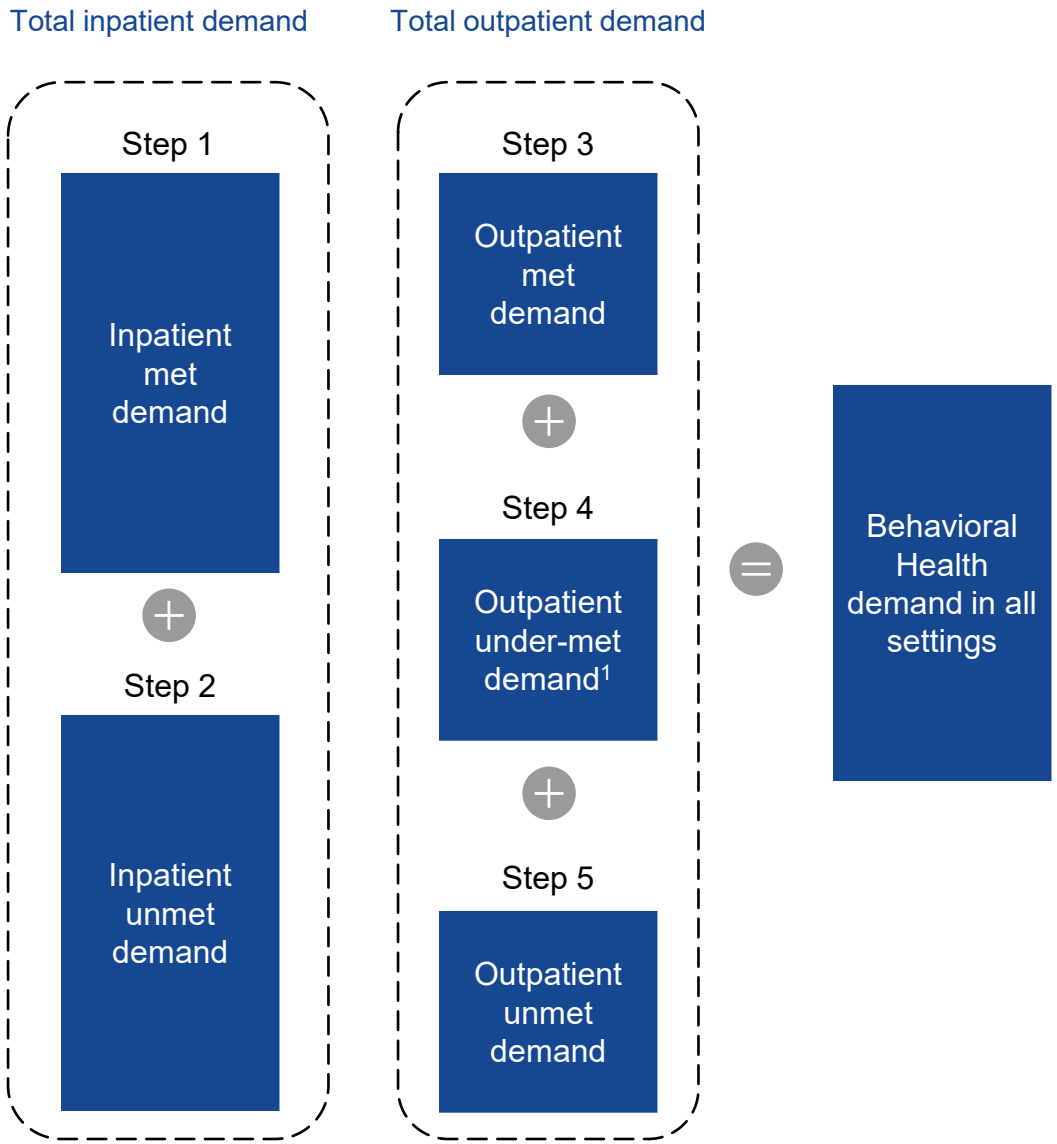
Step 4 (Nursing) | FTE conversion

Hospital & specialty care/dialysis setting

Non-hospital setting

1. CA BRN 2022 Survey of RNs

Demand Methodology | Behavioral Health



[1] "Under-met" demand will not apply to counties where outpatient met demand providers exceeds the current statewide average outpatient met demand provider ratio

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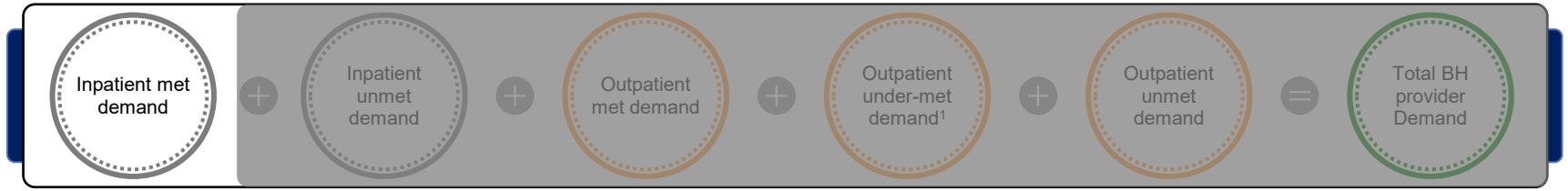
Step 1 (BH) | Calculate inpatient met demand

uses actual facility and capacity data to calculate number of providers delivering inpatient & residential care

bed capacity *facility data* × utilization rate *Typical facility utilization* × 365 days per year = # of bed days *Calculated* × BH provider to patient ratio *Statute / interviews*

# of Provider days *Calculated* × 24 hours per day = # of provider hours per year *Calculated* ÷ # of hours worked per year *FTE assumption* = # of **inpatient met** demand BH providers *Calculated*



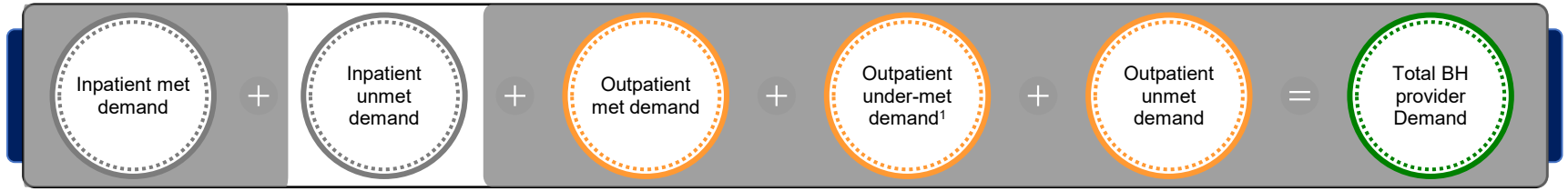
Step 2 (BH) | Calculate inpatient unmet demand

the difference between ideal behavioral health capacity, based on literature & experts, and inpatient met demand

bed capacity *Ideal bed capacity (RAND, others)* × utilization rate *Typical facility utilization* × 365 days per year = # of facility bed days *Calculated* × BH provider to patient ratio *Statute / interviews*

# of Provider days *Calculated* × 24 hours per day = # of provider hours per year *Calculated* ÷ # of hours worked per year *FTE assumption* = # of ideal inpatient BH providers *Calculated*

# of ideal inpatient BH providers *Calculated* − # of inpatient met demand BH providers *Calculated* = # of **inpatient unmet** demand BH providers *Calculated*



Step 3 (BH) | Outpatient met demand

total provider population in a geography, less the providers who are accounted for in the inpatient met demand calculation

total # of BH providers

Supply data (FTE assumptions applied)

−

# of inpatient met demand providers

Inpatient met demand calculation

=

of **outpatient met** demand BH providers

Calculated

Outpatient met demand ratio calculation (needed for "under-met" demand calculation)

# of outpatient met demand BH providers

Calculated

÷

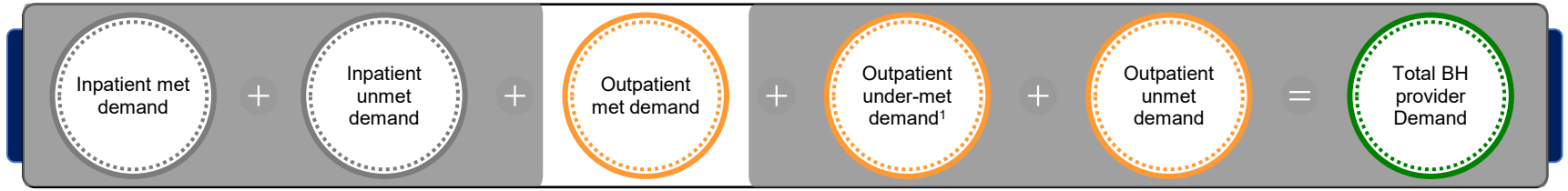
# of Population with treated outpatient BH demand

CHIS survey data

=

# of outpatient met providers / treated outpatient population

Calculated outpatient met demand ratio



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Step 4 (BH) | Outpatient “under-met” demand

added to any geography where the current provider to demand ratio is below the statewide average

If….

outpatient met demand ratio *Calculated*

<

statewide outpatient met demand ratio *Calculated*

Then….

statewide outpatient met demand ratio *Calculated*

×

population with treated outpatient BH demand *CHIS survey data*

=

ideal # of outpatient met demand BH providers *Calculated*

Otherwise….

Do not add any "under-met" demand

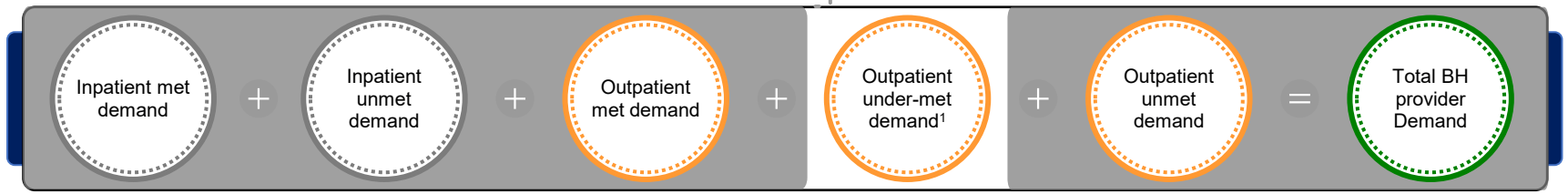
ideal # of outpatient met demand BH providers *Calculated*

−

actual # of outpatient met demand BH providers *Outpatient met demand calculation*

=

of **outpatient ‘under-met’** demand BH providers *Calculated*



Step 5 (BH) | Outpatient unmet demand

the number of providers needed to address the population who reported BH incidence but did not report receiving treatment

population who report BH incidence

CHIS survey data

−

population who report receiving BH treatment (net of inpatient treated pop.)

CHIS survey data & calculated

=

population with untreated outpatient BH demand

Calculated

population with untreated outpatient BH demand

Calculated

×

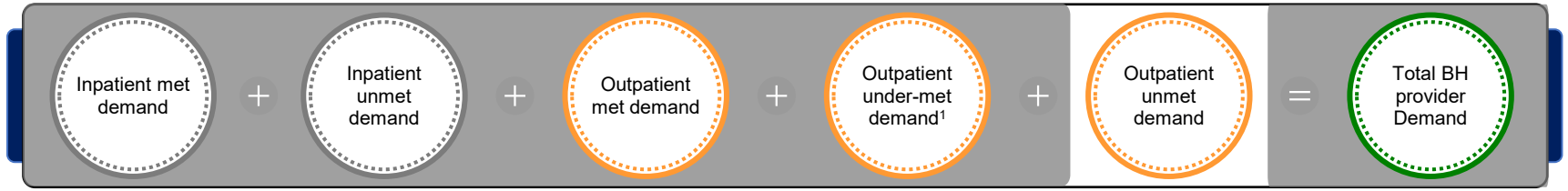
statewide outpatient met demand ratio

Calculated

=

of **outpatient unmet** demand BH providers

Calculated



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Inpatient Demand | Bed capacities by setting

Setting	Source	Notes
Hospital	2022 Hospital Annual Utilization, HCAI (link)	Acute level of care, disaggregate into state vs. nonstate and psych vs. SU beds
Psychiatric Health Facility	DHCS Licensed Mental Health Rehabilitation Centers and Psychiatric Health Facilities, DHCS (link)	Acute level of care
Mental Health Rehabilitation Center (MHRC) & Special Treatment Program (STP)	DHCS Licensed Mental Health Rehabilitation Centers and Psychiatric Health Facilities, DHCS (link)	Subacute level of care
Residential Mental Health Program (MPHC) & Social Rehabilitation Program (SRP)	Certified and Approved Residential Mental Health Programs, DHCS (link)	Filter out Community Treatment Facilities and Short Term Residential Therapeutic Programs (youth facilities), and allocate STPs to subacute level of care and SRP to residential level of care
SUD Recovery Treatment Facility	SUD Recovery Treatment Facilities, DHCS (link)	Residential level of care

Inpatient Demand | Ideal bed ratios per 100k population

BH Setting	Levels of Care	Ratio per 100k Adults	Rationale	Source (Dataset or literature)
Psychiatric	Acute	26.0	Calculated CA wide bed by analyzing bed occupancy rates, wait list volume, average length of stay, and transfer rates based on phone survey. Because **this research closely resembles our work, we used these ideal ratios as a benchmark** in the model.	Adult Psychiatric Bed Capacity, Need, and Shortage Estimates in California (RAND, 2021)
	Subacute	24.6		
	Residential	22.3		
	Acute / Subacute (State Hospitals)	13.2	Using state hospital actuals on patient days and number of beds, **we calculated the utilization per level of care[1]** for 5 state hospitals. Acute is underutilized while subacute is over utilized. **To achieve an ideal 85% utilization rate , 13.2 beds per 100k adults in subacute care is needed.**	Annual Hospital Utilization (2022, DHCS)
SUD	Acute	1.8	Using actuals on patient days and number of beds in chemical dependency recovery units in hospitals, we calculated the average utilization rate. **We found that CDR beds are underutilized (50%) and can remain at their current capacity, 1.8 beds per 100k adults.**	Annual Hospital Utilization (2022, DHCS)
	Acute / Subacute / Residential	27.7	RAND calculated bed need in five counties in CA by analyzing bed occupancy rates, wait list volume, average length of stay, and transfer rates. **We averaged the bed need across these counties and calculated 27.7 beds per 100k adults are needed.**	Psychiatric and SUD Bed Estimates: Santa Clara (RAND, 2023); Solving Bed Shortages: Sacramento, (RAND, 2022); Bed Estimates: Merced, San Joaquin, Stanislaus (RAND, 2022)

[1]Utilization rate = Patient Days / # of Beds * 365 Days ; 85% is an industry standard for healthcare bed utilization to avoid bottlenecks and allow for efficient staffing

Inpatient Demand | Utilization rates by setting

Setting	Bed type / subsetting	Utilization calculation / value	Notes	Source
Hospitals	Acute psych, CDR	Census days / Licensed bed days		2022 Hospital Annual Utilization, HCAI (link)
State hospital	Intermediate care	Census days / Licensed bed days		2022 Hospital Annual Utilization, HCAI (link)
Psychiatric health facility	All	85%	'Ideal' utilization rate according to RAND; Data roadmap will outline approach to better data collection	RAND, "Adult Psychiatric Bed Capacity Need and Shortage Estimates in California – 2021 (link)
Mental Health Rehab Center (MHRC) and STP	All	85%	'Ideal' utilization rate according to RAND; Data roadmap will outline approach to better data collection	RAND, "Adult Psychiatric Bed Capacity Need and Shortage Estimates in California – 2021 (link)
Residential Mental Health Program (MHPC)	All	85%	'Ideal' utilization rate according to RAND; Data roadmap will outline approach to better data collection	RAND, "Adult Psychiatric Bed Capacity Need and Shortage Estimates in California – 2021 (link)
SUD Residential Treatment Facility	All	70%	Approximated utilization based on RAND analysis of Sacramento, Santa Clara, Merced, San Joaquin, and Stanislaus Counties	Psychiatric and SUD Bed Estimates: Santa Clara (RAND, 2023); Solving Bed Shortages: Sacramento, (RAND, 2022); Bed Estimates: Merced, San Joaquin, Stanislaus (RAND, 2022)

Inpatient Demand | De-duplicate patients between IP/residential and OP

Setting	Average length of stay (days)	Notes	Supporting evidence
Hospital (acute)	7		SUD Counselor and former Program Director at Turning Point of Arnold (residential SUD); Director of Nursing, Telecare Corporation (acute psych); CHCF Mental Health Almanac, 2022 (link); RAND, "Adult Psychiatric Bed Capacity Need and Shortage Estimates in California – 2021 (link)
Psychiatric Health Facility (acute)	14		
Mental Health Rehabilitation Center (MHRC, subacute)	14		
Special Treatment Programs (STP, subacute)	30		Roberta Roiser (SUD Counselor), Guillermo Rodriguez (SUD Counselor), SUD Counselor and former Program Director at Turning Point of Arnold (residential SUD)
Social Rehabilitation Programs (SRP, residential psych)	30		LMFT and former Clinical Advisor at Discovery Practice Management (residential psych); SUD Counselor and former Program Director at Turning Point of Arnold (residential SUD); Director of Nursing at Avery Lane (residential psych and SUD); Director of Nursing, Telecare Corporation (acute psych)
SUD Recovery Treatment Facility (residential SUD)	45		LMFT and former Clinical Advisor at Discovery Practice Management (residential psych); SUD Counselor and former Program Director at Turning Point of Arnold (residential SUD); Director of Nursing at Avery Lane (residential psych and SUD); Director of Nursing, Telecare Corporation (acute psych); HR Director, Invigorate Behavioral Health (Res SUD)

Inpatient Demand | Staffing ratios – LCSW, LMFT, LPCC, Psychologist[1]

Setting	Bed type / subsetting	Ratio	Numerical Input	Notes	Supporting evidence
Hospital	Acute psych & CDR	1 clinician to 12 patients	0.08		LMFT and former Clinical Advisor at Discovery Practice Management (residential psych); Director of Nursing at Avery Lane (residential psych and SUD)
State hospital	All	*Actuals (2022)*		Distribute across state hospitals based on total bed count	DSH 2022-2023 Governor's Budget Estimate (link)
Psychiatric Health Facility (PHF)	All	1 clinician to 10 patients	0.1	Statute requires a psychiatrist, psychologist, CSW or MFT to be on duty 24/7 for each 1-10 patients; assume it is never a psychiatrist and include PCC given relative interchangeability and legal progression toward inclusion along CSW and MFT roles	Cal. Code Regs. Tit. 22, Sec 77061 – Staffing (link); Board of Behavioral Sciences (validated trajectory toward statutory inclusion of PCCs with MFTs and CSWs)
Mental Health Rehab Center (MHRC) and STP	All	1 clinician to 10 patients	0.1		LMFT and former Clinical Advisor at Discovery Practice Management (residential psych); Director of Nursing at Avery Lane (residential psych and SUD)
Residential Mental Health Program (MHPC) and SRP	All	1 clinician to 11 patients	0.09		LMFT and former Clinical Advisor at Discovery Practice Management (residential psych); Director of Nursing at Avery Lane (residential psych and SUD)
SUD Residential Treatment Facility	All	1 clinician to 25 patients	0.04		Oscar Stephenson (SUD Counselor); Guillermo Rodriguez (SUD Counselor) LMFT and former Clinical Advisor at Discovery Practice Management (residential psych); Director of Nursing at Avery Lane (residential psych and SUD); HR Director, Invigorate Behavioral Health (Res SUD)

[1]Allocate 33% of Non-Prescribing Licensed Clinician demand to Associate Level Clinicians based on current statewide ratio of Associate Level Clinicians to Licensed Clinicians

Inpatient Demand | Staffing ratios – Psychiatrists

Setting	Bed type / subsetting	Ratio	Numerical input	Notes	Supporting evidence
Hospital	Acute psych	1 psychiatrist to 30 patients	0.03	Based on average of staffing patterns detailed by providers	LMFT and former Clinical Advisor at Discovery Practice Management (residential psych); Director of Nursing at Avery Lane (residential psych and SUD)
State hospital	All	*Actuals (2022)*		Distribute across state hospitals based on total bed count	DSH 2022-2023 Governor's Budget Estimate (link)
Psychiatric health facility	All	1 psychiatrist to 10 patients	0.1	Statute requires a physician on duty 24/7, assume it is a psychiatrist 100% of the time	Cal. Code Regs. Tit. 22, Sec 77061 – Staffing (link); Board of Behavioral Sciences; Director of Nursing, Telecare Corporation (acute psych)
Mental Health Rehab Center (MHRC) and STP	All	1 psychiatrist to 12 patients	0.08	Based on average of staffing patterns detailed by providers	LMFT and former Clinical Advisor at Discovery Practice Management (residential psych); Director of Nursing at Avery Lane (residential psych and SUD); Director of Nursing, Telecare Corporation (acute psych)
Residential Mental Health Program (MHPC) and SRP	All	1 psychiatrist to 30 patients	0.03	Based on average of staffing patterns detailed by providers	LMFT and former Clinical Advisor at Discovery Practice Management (residential psych); Director of Nursing at Avery Lane (residential psych and SUD); Director of Nursing, Telecare Corporation (acute psych)
SUD Residential Treatment Facility	All	0 psychiatrists	0	Based on average of staffing patterns detailed by providers	SUD Counselor and former Program Director at Turning Point of Arnold (residential SUD); LMFT and former Clinical Advisor at Discovery Practice Management (residential psych); Director of Nursing at Avery Lane (residential psych and SUD); HR Director, Invigorate Behavioral Health (Res SUD)

Outpatient Demand | Population receiving or needing services

Metric	Notes	Source
Population who reported receiving services	Part of met, under-met and unmet demand calculations	CHIS survey (link)
Population who reported needing services;	Part of unmet demand calculation	CHIS survey (link)
Total Population	All population in geographic area	U.S. Census Bureau, Annual Estimates of the Resident Population for Counties in California: April 1, 2020 to July 1, 2021 (link)

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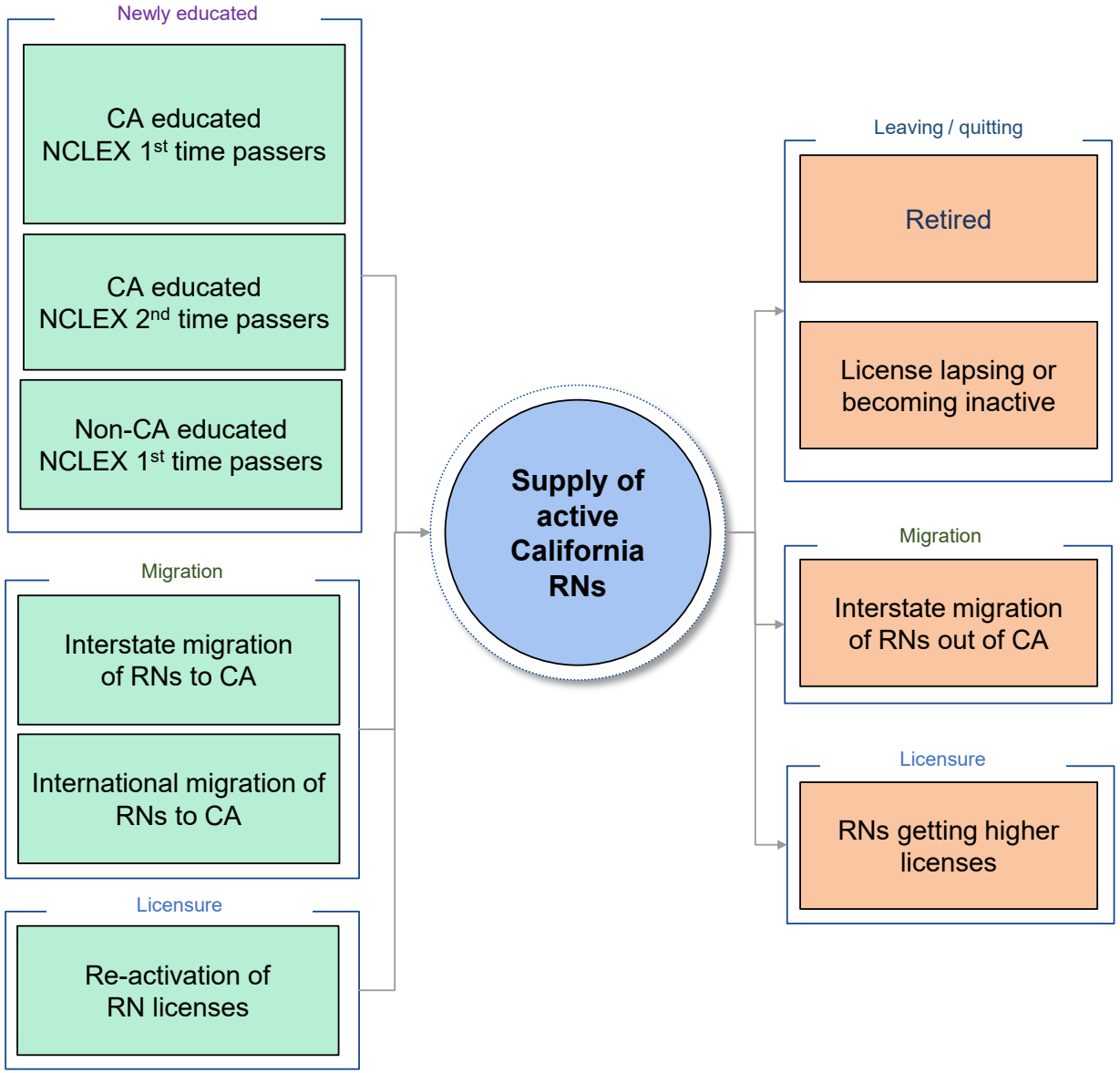
Forecasting Methodology

Supply Forecasting – Three different approaches based on role type

Forecasting is performed differently for each role based on ***availability*** of data and data ***quality***

Role Type	Role	Forecasting approach	Rationale
Nursing	RN	Stock and flow model	RNs has rich input data available enabling us to create a comprehensive forecast model
	LVN, NA, PHN, CNS, PMHN	Machine Learning forecast	Have supply data for historical years but limited data availability of input features
BH	LCSW, LMFT, LPCC, PSY, ACSW, APCC, RPA	Machine Learning forecast	
	Psychiatrist, AMFT	Growth rate assumption	No historical trend available, or no trend that can could be determined.

Supply Forecasting –Methodology for Stock and Flow model (RNs)



Stock-and-flow approach adapted from Spetz, J, Chu, L, Blash, L. Forecasts of the Registered Nurse Workforce in California. San Francisco, CA: Philip R. Lee Institute for Health Policy Studies, October 2023 (link).

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Stock-and-flow model methodology (detailed)

Bucket	Approach
CA educated	• Get the enrollment by education type growth over the horizon by taking the starting point of the weighted trailing average (20%) and decay it down to ADN level of 2% for BSN to account for growth / capacity limitations. Take the average of the weighted trailing average and apply it forward for ADN and ELM - Note, alternative forecasts follow 3 year CAGR for application and enrollment growth, or taper applications and enrollment growth to 2% over 3, years, then stay consistent • Get the historical avg. of graduates as a percentage of relevant lagged enrollment for each education type • Get the average (2012 – 2022) percentage of graduates by education type passing the NCLEX for the first time and apply forward over the forecast horizon for ADN and ELM. For BSN, the Public vs. Private pass rate was found to decrease at 1% a year (rn.ca.gov) and this was carried forward through the horizon from the starting point of each pass rate. 52% of seats were Private and this was stretched to 65%[1] by the end of the horizon to account for growing share of private seats. For repeat test takers assume the complement will take the exam again and 50% will pass (NCBSN national average)
Non-CA educated	• There are people educated outside of California who take the NCLEX. Spetz et al. referenced 2022 having a value between 984 and 1,132 with a "best estimate" of 1,058. In 2019 the best estimate was 544 people. The current approach is to approximate the values mentioned by Spetz et al. based on the number of applications in that year, as a signal of interest in the profession. Note that this is an approximation and can be refined if more reliable data is available. This approach leads to 1,088 in 2022 and 796 in 2019. We currently take the percent of the qualified applicants not enrolled ([total apps - total enrollment]/total apps), multiply it by the total apps and divide by 50
Interstate migration in	• Take the sum of "Estimated annual in-migration (C-D)" in Table A5 of Spetz et al.. This was found to be 11.7K, which is 3.6% of the stock. This is applied forward at a decaying rate down to 2% in 2038 to account for fewer RN slots in the future (accompanied with growing education numbers to fill the demand)
International migration in	• Spetz et al. referenced numbers that hovered around ~1,000, so 1,000 was chosen for each year. Spetz et al. referenced a peak of 4,107 in the early 2000's, 603 in 2017, 851 in 2019, and 1,255 in 2022
Interstate migration out	• Spetz et al. referenced 2.4% out migration in Table A10. This value is multiplied by the prior year stock
Reactivating licenses	• Spetz et al. referenced 1.1% of the RN base that re-activated their licenses in 2021 in Table A9. This percentage is used for every year and multiplied by the RN base to get the re-activated RNs
Higher licenses	• Assumed that 1.0% of RNs get a higher license each year and practice at the higher license
Retired	• Used the cited "plan to retire in the next 2 years" survey question and divided by 2 to get a yearly retirement rate. The stock of RNs was multiplied by this number to get the outflow of RNs retiring
License lapsing or otherwise becoming inactive	• Table A11 of Spetz et al. states that ~13.7K RNs let their license lapse. From the 2022 survey 2.4% of the stock (~7.8K) retired. Backing into ~13.7K left 1.9% as the non-retiring license lapse rate of the stock (e.g., relocation, change in employment, death)

Stock-and-flow approach adapted from Spetz, J, Chu, L, Blash, L. Forecasts of the Registered Nurse Workforce in California. San Francisco, CA: Philip R. Lee Institute for Health Policy Studies, October 2023 (link).

[1]Spetz has noted an increase in private seats. 65% share private would be a fairly large increase, but not overly so.

Supply Forecasting - Methodology for ML based forecast

Step 1
Prepare data for modeling

Step 2
Extrapolate the input features

Step 3
Model training

Step 4
Perform Forecasting

Roles: LCSW, LMFT, LPCC, PSY, ACSW, APCC, RPA, LVN, NA, PHN, CNS, PMHN

Step 1: Prepare training data

1. y-variable - # unique providers per role per year
2. x-variable – year, # graduates indicator per role per year
    a. Data sources: IPEDS completions data – 2010-2021; CIP Code <> Professional Role crosswalk

Step 2: Extrapolate input features

Extrapolate the input data (IPEDS) for next 10 years based on CAGR for each role during 2016-2021

Step 3: Model training

Train all models[1] and tune their hyper parameter using 6-fold cross validation (train on 5 years and test on 1 year, iteratively for each year during 2016-2021 For Supply). Identify model with least mean MAPE across all folds for each role[2]

Step 4: Perform forecasting

Leverage the cross-validated(CV only for Supply) pre-trained best model for each from step 3 for predicting on extrapolated input, hence creating the forecast

[1]Models considered are Linear Regression, Regularized linear regression (lasso/ridge), Decision trees, and random forest.
[2]Post visual inspection of the forecasted trends, we sometimes enforce less performant models on few roles since they yield a better forecast overall.

Supply Forecasting - Methodology for growth rate based forecasts

Role	Assumed annual growth rates for 2025-33	Explanation
AMFT	Start with 2022-24 annual growth rate of 10%, and gradually taper it off by reducing it by 1pp YoY [10%, 9%, 8%, 7%, 6%, 5%, 4%, 3%, 2%]	Each number is a growth rate percentage per year 2025 forecast = 2024 forecast * (1 + 10%) 2026 forecast = 2025 forecast * (1 + 9%) …….
Psychiatrist	High estimate: 1.04% Best estimate: 0.2% Low estimate: -0.6%	High estimate is based on CA EDD employment projection of 11% from 2020-2030[1] Low estimate is based on HRSA workforce trends from 2024-33[2] Annual high/low estimates are obtained based on CAGR between 2023-33 / 2020-30 Best estimate is based on average of high/low estimate

[1]CA EDD employment projection from 2020-2030: https://labormarketinfo.edd.ca.gov/data/employment-projections.html
[2]HRSA workforce projections: https://data.hrsa.gov/topics/health-workforce/workforce-projections

Supply Forecasting | Allocating state-level supply forecast to counties

Context for allocating top-down outputs to geographies:

1. County information is available accurately in both DCA and RDC data

Allocation Approach	Pros	Cons
Allocate state level supply forecast to counties based on current state county share	• Relatively high confidence in county allocation • Relatively simple	• Reliant on accuracy of county-level information from provided address • *Based on the assumption that counties associated with license don't change frequently*

Demand Forecasting - Predictor variables used to develop baseline MVP demand forecasts

Bucket	Feature, per county	Notes
Evolving population	**14 individual variables**, reflecting the # of people in 5-year age bands (e.g., 0-4, 5-9, … 65+) per county; **most significant is used**	• Association of age bands and demand is tested using an F-test at the state level, and the most significant variable is used in the regression • Projections from California Department of Finance consider historic trends for births, deaths and migration since 1990, and use data from the 2020 Census
Historic demand	**3-year lagging demand**	• Historic demand can be a helpful indicator of future demand. We are using the average of the last three years (per county, where available)
Small counties	**Small Counties**	• The county that is most highly correlated with a specific role is selected in addition to small counties that we hot encode. This is to ensure that the large counties do not skew the large model. Where we have insufficient data, we take an average of the county specific results and apply that rate for future projections[1]

[1]For the smallest 20 counties, a three-year average demand/population ratio was calculated from the historical 2020-2022 data and multiplied by the forecasted Population to get projected demand rather than machine learning to avoid skew. This was used for all roles and role groups except Registered Nurses.

Frequently asked questions (1/4)

Question	Response	Relevant model
Why are some roles shown as groups?	Creating sets of roles is not meant to diminish the differences in training and pathways for the roles we are modeling. It's a concession to the limitation of the data and a recognition that many roles have overlapping scopes of care and are fungible from a demand perspective. Creating sets of roles helps avoid false precision that would come from separately modeling roles that can all meet the same demand for care. On the supply side, we have separate counts for all roles and are not creating any sets of roles.	BH N
How are you defining demand in this model?	There are two primary ways of thinking about demand, either as "economic demand" primarily focused on the labor market or "needs based" demand focused on the health needs of the population and the professionals needed to support those needs. Our models use a combination of both approaches with the nursing model layering on a factor of economic demand from job posting data and forecasting based on the shifting care needs of our aging population, reflecting the health needs approach. In behavioral health, the needs-based approach is the primary driver with survey data on behavioral health incidence versus treatment providing one of the main inputs into the demand calculation.	BH N
How did you select roles for inclusion in this model?	The initial choice of roles was based on data availability, with strong supply data available for licensed roles that allows for the supply / demand comparisons our model makes. Select certified roles where there was better data from certifying organizations (e.g., SUD Counselors) were also included. Future efforts are planned to extend work to allied health professionals working in behavioral health that make up a key piece of the behavioral health workforce, despite challenges with data availability.	BH N

Frequently asked questions (2/4)

Question	Response	Relevant model
How have you developed and tested the assumptions in the model?	All modeling requires some degree of assumptions to allow complex systems, like supply & demand, to be calculated. In this model, we made two main types of assumptions, structural assumptions and smaller value assumptions. Structural assumptions are higher level (e.g., assuming facilities are not a constraint for workforce needs or that the behavioral health care team composition will remain constant in our baseline forecast). These assumptions impact the structure and logic of our modeling but are not specific inputs themselves. Value assumptions are the many small inputs which impact our calculations (e.g., the typical hours per week worked by each role). For both types of assumptions, we tried to source from statute or existing literature first, and if that wasn't possible, we worked with providers to understand current practice as a starting point assumption. For all assumptions, we pressure tested and validated with stakeholders and actual professionals to ensure our assumptions reflected reality.	BH N
How should the results of this model be interpreted?	The model provides a "supply / demand" gap figure for each role in each region of California. The value is the gap between demand and supply with a negative value indicating a potential shortfall of that provider type in that region. These results should not be considered in a vacuum but rather viewed alongside qualitative information about each specific region to build a full picture that can be directionally instructive for policymakers, employers, and job seekers. Forecasted values reflect a best estimate, and they all have a confidence interval reflecting a range of outcomes that are possible. Any forecast should be viewed as a potential indicator but not guarantor of future surpluses or shortfalls.	BH N

Frequently asked questions (3/4)

Question	Response	Relevant model
Why is the base year in the model 2022?	The model relies on a large number of inputs for both demand and supply, mainly from publicly available data that is regularly collected by a number of public agencies (e.g., HCAI's Hospital Annual Disclosure Report). However, much of the data used is not available in real-time. At the time of development for this model, 2022 was the most recent year where all necessary data was available to perform the supply / demand calculations. For supply, license data is available on a real-time basis with up to date counts available for the current year. Our model was tested based on the actual license data in 2023 and 2024 and should closely reflect actual counts of providers for supply. The model will be updated on a regular basis as the data inputs are refreshed. When the model is refreshed, the base year will update to the new latest year of actual data.	BH N
How were forecasts developed?	For all roles, demand and supply were calculated based on most current data available, along with as many years historically as data allowed. For most roles, historical demand and supply were able to be calculated back to 2016. For demand forecasting, we used a regression model that tested several inputs as predictor variables before settling on population age mix as the key feature. Future demand for the roles is thus primarily based on the past trend of demand growth and the impact of California's future population age breakdown.	BH N

Frequently asked questions (4/4)

Question	Response	Relevant model
How are different settings factored into demand?	For both nursing and behavioral health we built up demand based on the settings where data was available to track demand (e.g., for RNs there is strong data on RN FTE employment in hospitals). We collected demand data in as many settings as we had data available. For RNs, we then added on a factor of "other" setting demand based on survey data on RN work locations to adjust demand upwards based on the settings we did not have direct data for. Our model does not have an estimate of "need" or "unmet" demand by care setting as that data comes from aggregated job postings which are not broken out by setting.	BH N
Why aren't specialties (e.g., a nurse specialized in pediatrics) included?	Specialties aren't included for most roles due to data availability. As specialties typically don't require separate licensure we do not have an easy way to track either demand or supply at that granular of a level. We are looking to collect more data in the future, through our license renewal survey, to better understand the need for different specialties, but it is not currently included in the model.	BH N