# Kentucky Nurse Workforce Projections: 2022-2035

**Prepared for The Kentucky Hospital Association**

**by GlobalData Plc**

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# Executive Summary

Kentucky hospitals report high numbers of vacancies for nursing positions, a challenge reported by healthcare institutions across the country. The nursing shortage is contributing to high levels of burnout among the nursing workforce, which is leading to high attrition from the workforce and declining interest in nursing as a career. In recognition of these nurse staffing challenges, the Kentucky Hospital Association (KHA) commissioned GlobalData Plc to quantify the degree of shortfall and develop projections of future supply and demand. Such information helps inform actions that could help alleviate the shortfall.

The methodology for this analysis follows the approach used by the federal government and for similar analyses for other state hospital associations and governments—with the computer simulation model adapted to Kentucky and using Kentucky-specific data where available. A key source of data for understanding the current nurse workforce and for modeling future supply is the robust data collection system recently implemented by the Kentucky Board of Nursing (KBN). This system collects data for research purposes on labor force participation status, work location, nursing setting and position, average hours worked, and retirement intentions. Focus groups with nurses and nurse educators supplemented the data analysis and computer simulation to understand the current challenges within nursing and what might happen in the future.

Projections of supply and demand for registered nurses (RNs) and licensed practical nurses (LPNs) through 2035 are reported as full time equivalents (FTE) and include nurses across all settings that employ nurses. Supply is compared to the level of nurses required to provide a national average level of care (a benchmark for demand). As discussed in this report, the supply of nurses in Kentucky is insufficient to provide even a national average level of care. To the extent that the national average is inadequate given estimates of high rates of vacancies and high levels of nurse burnout across the nation, estimates in this report likely understate the magnitude of Kentucky's shortage of nurses.

Kentucky faces substantial challenges with ensuring sufficient supply of RNs and LPNs, and these challenges are projected to continue through 2035. Key findings include:

- The state's projected demographics are unfavorable to solving Kentucky's nurse workforce challenges. Between 2022 and 2035, growth of 130,000 residents aged 65 and older will drive growth in demand for nurses in hospitals, long term care facilities, and other settings. A projected decline by 6,000 in residents age 18 to 64 portends greater competition for available labor.
- In 2022, RN supply (48,130) fell 6,190 short of estimated demand (54,320). This shortfall only marginally improves to a 5,790 deficit by 2035 under the *Status Quo* scenarios.
    - RN supply is projected to grow by 5,030 (10%) between 2022 and 2035 reaching 53,160 FTEs. However, with high levels of burnout among the health workforce and a recent drop in applicants to nursing programs, there is greater likelihood that supply will be below 53,160 than the likelihood that supply will exceed this level.
    - To provide a national average level of care in 2022, Kentucky would require 54,320 FTE RNs. The demand estimate takes into account the demographics of Kentucky's population,

higher than national average prevalence of disease and other health risk factors, and socioeconomic factors. This 6,190 RN shortfall suggests that supply is sufficient to meet 89% of demand (Exhibit ES-1).

  - RN demand growth between 2022 and 2035 is about 4,630 (9%) reaching 58,950 FTEs. About half (2,300) of this demand growth will be in hospitals, about 38% (1,760) will be in long-term-care settings, and the remainder will be in other settings where nurses provide care. Kentucky will make no appreciable improvement over the thirteen year period because, by 2035, the 5,790 shortfall means that supply will be sufficient to meet only about 90% of the level required to provide a current average national level of care. Increasing the number of new RNs entering the Kentucky workforce or interventions that delay retirement could help reduce the future shortfall, while reduced numbers of new entrants or earlier retirement could exacerbate the shortfall.
  - Increasing the annual number of newly licensed RNs by about 21% (630 nurses) relative to current levels could close the gap by 2035. However, increasing RN supply adequacy likely will require a combination of efforts to increase the pipeline of new nurses, improve retention of the existing nurse workforce, and implement new technologies or models of care that better leverage RN resources.

- In 2022, LPN FTE supply (10,330) fell 760 short of estimated demand (11,090). This shortfall worsens to a 3,190 deficit by 2035 (Exhibit ES-1).
  - LPN supply is projected to decline by 360 FTEs (-3%) to 9,970 in 2035. Contributors to this decline include slowing numbers of applicants to LPN programs in recent years, and an older workforce that will lose many LPNs to retirement or career change (with some LPNs becoming RNs).
  - To provide a national average level of care in 2022, Kentucky would require 11,090 FTE LPNs. This 760 shortfall suggests that supply is sufficient to meet 93% of demand.
  - LPN demand growth between 2022 and 2035 is about 2,070 FTEs (19%) reaching 13,160 FTEs. The supply of LPNs to meet patient needs will worsen over the thirteen years. By 2035, the 3,190 shortfall means that supply will be sufficient to meet only about 76% of the level required to provide a current average national level of care. A growing shortfall of LPNs will place even greater pressures on the RN workforce.
  - Increasing the annual number of newly licensed LPNs by about 63% (370 nurses) relative to current levels could close the gap by 2035. However, increasing LPN supply adequacy likely will require a combination of efforts to increase the pipeline of new nurses, improve retention of the existing nurse workforce, and redesign how care is delivered.

- A disproportionate number of younger nurses are working in hospital units that historically have been filled by more experienced nurses. This includes critical care units, emergency/trauma units, and other hospital units A steady supply of younger nurses who can handle the physical demands of bedside nursing during a 12-hour shift, under the supervision of experienced nurses, appears vital to ensuring sufficient numbers of bedside nurses.

- Focus groups with nurses and nurse educators corroborate the empirical findings, that Kentucky faces significant challenges with attracting people into a nursing career and retaining its current nurse workforce. The COVID-19 pandemic exacerbated these challenges, with average patient acuity rising while nurses are being asked to care for more patients. A shortage of support personnel (particularly respiratory therapists, nurse aides, phlebotomists, and emergency medical technicians, but also other occupations) places additional pressures on nurses who find themselves performing the additional tasks often delegated to others.
- If current patterns of healthcare delivery were to remain unchanged, then the projections indicate that the RN workforce is likely to continue to meet current use patterns as population demographics change over the next 10 years. However, LPN supply will be insufficient to maintain current levels of care under all modeled scenarios.
- To the degree that health system leaders, educators and policy makers believe that the RN and LPN workforce in Kentucky will vary from the status quo projections provided in this report, targeted goals and a combination of collaborative efforts must be organized to guide supply and demand in consensus desired directions.
- If leaders foresee losses in the workforce continuing to increase, then efforts should be focused on workforce retention to try to at least maintain the status quo. If it is anticipated that care delivery will change, then numbers of graduates from local programs or recruitment efforts must be changed accordingly.
- Ultimately no one effort can produce all of the desired results. However, changes can be made in desired directions if all parties involved are aware of the direction the system should move toward.

## Exhibit ES-1: Nurse Full-Time Equivalent Shortfall (Supply Percent Adequacy) by Scenario, 2022 & 2035

| Year | SQ Demand vs SQ Supply | SQ Demand vs SQ Early Retirement Supply | SQ Demand vs SQ Delayed Retirement Supply | SQ Demand vs 10% Fewer Entrants Supply | SQ Demand vs 10% More Entrants Supply | Reduced Barriers Demand vs SQ Supply |
|---|---|---|---|---|---|---|
| **Registered Nurses** | | | | | | |
| **2022** | -6,190 (89%) | | | | | -7,270 (87%) |
| **2035** | -5,790 (90%) | -7,380 (87%) | -4,360 (93%) | -8,650 (85%) | -2,960 (95%) | -7,200 (88%) |
| **Licensed Practical Nurses** | | | | | | |
| | | | | | | |
| **2022** | -760 (93%) | | | | | -990 (91%) |
| **2035** | -3,190 (76%) | -3,450 (74%) | -2,990 (77%) | -3,710 (72%) | -2,690 (80%) | -3,470 (74%) |

Notes: SQ refers to the modeled *Status Quo* scenarios. For supply this scenario models the continuation of current numbers of new entrants and labor force participation patterns. For demand this scenario models the continuation of current patterns of care use and delivery. Additional supply scenarios model ± 10% change in annual number of new nurses entering the workforce, and ± 2 year shift in retirement patterns. An additional demand scenario models reducing barriers to accessing care.

# Introduction

Hospitals in Kentucky report challenges in filling vacant nursing positions.[1] Nurses are sometimes referred to as "the heart of healthcare" and the "backbone of healthcare" because of their unique role in caring for patients.[2] Nurses constitute the largest occupation group in healthcare and are employed in almost all care delivery settings—hospitals, provider offices, outpatient clinics, nursing homes, home health, school health, and more. Having a sufficient supply of nurses to meet demand for services is vital to providing high-quality accessible, and affordable care.[3]

Published estimates of nurse supply in Kentucky vary due to differences in definitions, timing of data collection, and sampling error. The Kentucky Board of Nursing (KBN) reports that in November 2022 there were 66,568 registered nurses (RNs) and 11,913 licensed practical nurses (LPNs) with an active license and indication of Kentucky residence.[4] Estimates from the 2021 American Community Survey (ACS), a survey of households conducted annually by the U.S. Census Bureau, indicate 56,200 RNs and 4,700 LPNs were active in the Kentucky workforce. Adjusting for average weekly hours worked to compute full-time equivalents (FTEs), there were approximately 54,500 FTE RNs and 5,000 FTE LPNs.[5] The Bureau of Labor Statistics (BLS) reports that in May 2021 there were 43,540 filled RN positions and 9,320 filled LPN positions.[6] The BLS numbers are calculated from a sample survey of all employers and do not distinguish between full-time and part-time positions.

Healthcare institutions across the country are reporting challenges with filling vacant positions. One study reports that in 2022 the hospital vacancy rate for RNs averaged 17%, up from 9.9% in 2021 and around 8% in 2018-2019 before the COVID-19 pandemic.[7] Kentucky hospitals also report staffing challenges—with reports of 5,060 RN and 331 LPN positions left unfilled in December 2021.[1] Kentucky hospitals reported average vacancy rates above 20% in 7 of the state's 15 Area Development Districts (ADDs). Hospital settings with highest reported vacancy rates for RNs are medical-surgical (30.4%), critical care (26.9%), and emergency room (20.1%). The nursing shortage is contributing to high levels of stress and burnout among the nursing workforce. Concern about high levels of burnout existed pre-pandemic, but COVID-19 and other factors appear to have made the situation even more challenging.[8–11]

In recognition of these nurse staffing challenges, the Kentucky Hospital Association (KHA) commissioned GlobalData Plc. to develop nurse workforce projections through 2035. The approach follows that used by the federal government and for similar analyses for other states—with the model adapted to Kentucky and using Kentucky-specific data where available.

The impact of COVID-19 and the ongoing economic challenges are considered where possible. However, as both the pandemic and economic uncertainty are ongoing, and because definitive data are available only with a lag, not all of its impact can be captured in these projections. To contextualize the projections and discuss some of the impacts of COVID-19 and changing economic conditions not captured by the workforce simulation model, focus groups were conducted with nurses, representatives from nurse training programs, and hospital administrators. Perceptions of the current state of things described by participants in these focus groups confirm and align with these recently published statistics describing high turnover, vacancy rates and post pandemic acutely exacerbated labor supply challenges.

The remainder of this report first summarizes the methods, data, and assumptions used to produce the demand and supply projections. Workforce projections are presented and contextualized with a summary of the findings from the focus groups. The final section summarizes key findings and study strengths and limitations. An appendix contains additional tables.

# Methodology

This section provides a brief overview of the approach, data, and assumptions used for demand and supply modeling.

## Modeling Overview

Projections of health workforce supply and demand use GlobalData's workforce demand and supply modeling framework described in reports and academic journals.[12–21] The study employed a microsimulation approach, meaning individual nurses (for supply modeling) and a representative sample of Kentucky's population (for demand modeling) are the units of observation. These workforce models have been validated through modeling efforts for the federal government, state governments, professional associations, and health systems. Additional information about methods is detailed in the model's technical documentation.[22]

The starting year for demand projections is 2021—as this is the latest year for which reliable population data, national employment data, and hospital use data are available. The starting year for supply projections is 2022—as the Kentucky Board of Nursing provided de-identified licensure and survey data following the October 2022 licensure renewal window. The "projection period" covers 2021-2035, though we focus on 2022-2035 which are the years for which both supply and demand are available.

Demand modeling starts with a representative sample of the population in each county projected through 2035. The model then simulates demand for healthcare services based on demographics, health risk factors, disease prevalence, hospital usage patterns observed in Kentucky, and national patterns of healthcare use applied to the state's population. Projected future demand for healthcare services are used to estimate future demand for nurses.

Supply modeling starts with information from nurse licensure files on the demographics, labor force participation patterns, and work location of the current nursing workforce. New entrants to the nursing workforce are added each year based on recent information on the number, characteristics, and geographic distribution of newly licensed nurses. The model simulates attrition from the workforce each year as nurses leave the workforce. The model accounts for LPNs who continue their training to become RNs, and for RNs who continue their training to become advanced practice nurses (APRNs). The APRN workforce is excluded from the RN workforce projections.

Comparison of current and projected future supply to projected demand provides a measure of supply adequacy. All supply and demand projections are reported as FTEs unless otherwise indicated. Survey data collected by the Kentucky Board of Nursing (KBN), which has close to 100% response rate, indicates the state's RNs average 39.0 hours/week and LPNs average 40.4 hours/week. This report used KBN reported hours worked to adjust national demand and supply models.

The core demand and supply projections are for a *Status Quo* scenario. For demand, this scenario models the continuation of national average healthcare use and delivery patterns over the projection period. Healthcare use patterns for ambulatory and home health care are based on pre-pandemic data; while hospital inpatient days and emergency visit patterns are based on a combination of national pre-pandemic data and 2021 aggregate utilization data for Kentucky. Projected changes in demand over time are driven by changing demographics and associated prevalence of disease and health risk factors. For supply modeling, the *Status Quo* scenario models continuation of current numbers and patterns of annual new nurses licensed, labor force participation rates, retirement rates, and cross-state migration patterns. A

comparison of *Status Quo* supply and demand indicates future supply adequacy absent any changes in healthcare delivery or efforts to increase workforce supply.

Undoubtedly, changes from the *Status Quo* will occur over the projection period, but when and how cannot be known during modeling. As such, alternative or "what-if" scenarios are modeled to assess how projections would be affected by changes to the *Status Quo* scenario assumptions. The alternative demand scenario models if all people were to access care at the rates of otherwise identical insured, non-Hispanic Whites in metropolitan areas. This *Reduced Barriers* scenario explores how the demand for health workforce would change with substantial progress toward healthcare access and equity goals articulated by the Kentucky Department for Public Health, other Kentucky organizations, and federal agencies.[23–26] This scenario is not meant to identify individual members of the population who face significant barriers to obtaining care and/or are underserved; nor is it meant to suggest that healthcare usage of insured, non-Hispanic Whites living in metropolitan areas is appropriate or adequate. Rather, this "what-if" scenario yields general insights regarding the relationship between expected workforce adequacy and reducing barriers of access to care.

Alternative supply scenarios include:

- *10% More Entrants*, which increases the annual supply of newly licensed nurses by 10%, thus exploring the potential impact of policies designed to enhance the nursing pipeline;
- *10% Fewer Entrants*, which decreases the annual supply of newly licensed nurses by 10%, thus exploring the potential impact of a decline in interest in nursing;
- *Early Retirement*, which changes retirement patterns such that nurses retire 2 years earlier than otherwise, thus exploring reported early retirements from burnout and other impacts of COVID-19; and
- *Delayed Retirement*, which changes retirement patterns such that nurses retire 2 years later than otherwise, thus exploring the potential impact of policies designed to increase retention.

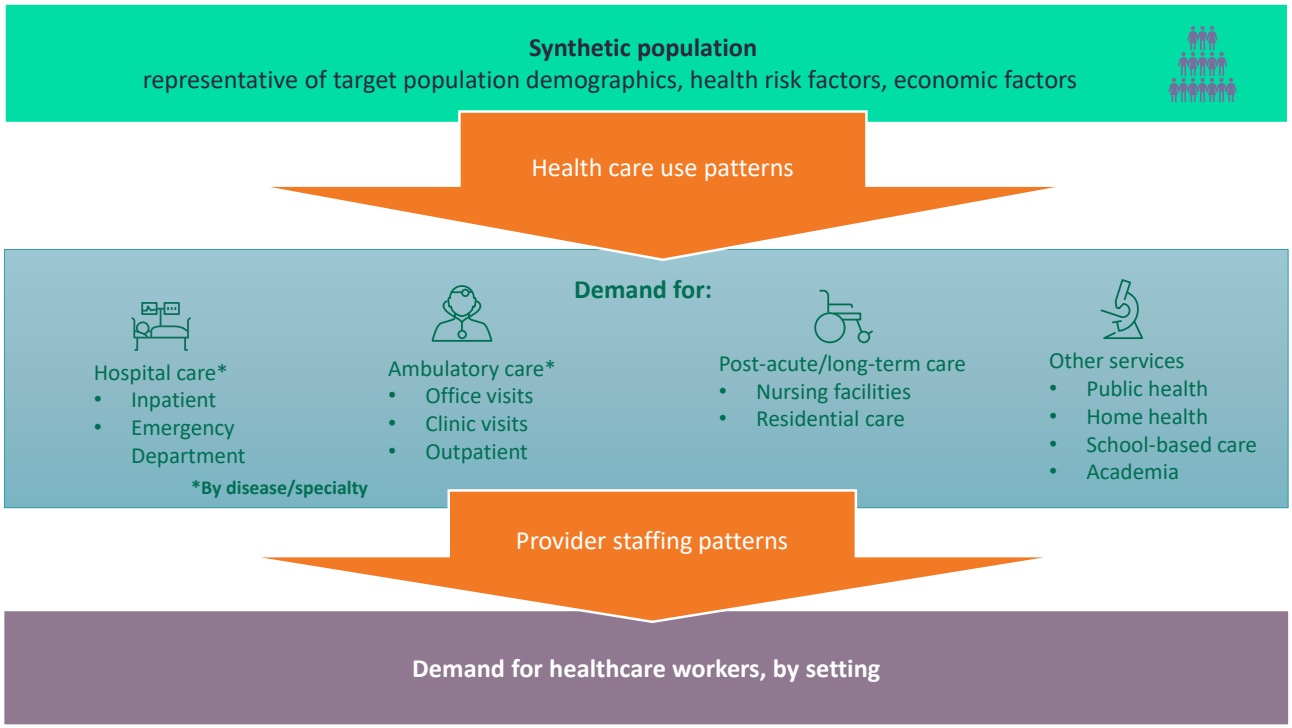
## Demand Modeling

Demand modeling entails analyzing relevant characteristics of the Kentucky population, predicting the amount of healthcare-related services they will use in future years based on these characteristics, and estimating the number of nurses required to deliver these services (Exhibit 1). These analyses are performed by delivery setting, which include: inpatient, emergency department, ambulatory settings, long-term care settings, schools, public health departments, and other patient care settings, as well as non-patient care settings such as within insurance companies and academia. Demand is estimated at baseline and projected forward through the projection period by accounting for the factors that drive employment growth in each setting over time.

Baseline demand within Kentucky is estimated by applying national patterns of healthcare use—based on demographics, socioeconomics, health characteristics and insurance status—to a population database representative of these characteristics for a representative sample of people in each county in Kentucky. Adjustments account for Kentucky-specific use of hospital-based services and that some hospital-based care in Kentucky is provided to non-Kentucky-residents, and some hospital-based care for Kentucky residents is provided in hospitals outside the state. Demand projections by county are aggregated to the state level for reporting. Healthcare utilization projections into the future are based on forecasted changes to Kentucky's population size and demographics and projected growth in prevalence of chronic disease

as the population ages. Demand for RNs and LPNs is then derived from the expected demand for the services they provide based on national staffing patterns in healthcare delivery (e.g., observed nurse-to-patient ratios). The national average is simply a benchmark for comparison and does not imply an optimal level of staffing.

**Exhibit 1. Overview of the Demand Modeling Framework**




This study estimates and projects *demand* for healthcare services and nurses, defined, respectively, as the amount and types of healthcare services patients are willing and able to purchase at prevailing prices and the number of nurses that employers are willing and able to hire at prevailing salary levels. The concept of *demand* for services differs from *need* for services, which represents the services that patients would use based on clinical or epidemiological considerations combined with an assessment of the level of care that would be considered appropriate. Likewise, the demand estimates for nurses do not imply an optimal level of nurse staffing independent of economic and other realities.

## Modeling Methods and Data Sources

Expanding on this overview, the basic components of the demand modeling are the population projections, healthcare use prediction equations, and care delivery patterns.

**Population Database.** The constructed population database contains information about the characteristics of an unidentified but representative sample of the resident population in each Kentucky county from 2021 through 2035. Characteristics used to estimate demand for healthcare services include each person's demographics (age, sex, and race/ethnicity), health conditions and risk factors (arthritis, asthma, cardiovascular disease, diabetes, hypertension, history of heart attack, history of cancer, history of stroke, body weight status, and smoking status), household income range, and health insurance status (whether insured, on public insurance, and in a managed care plan). Key data sources used to construct this file are Kentucky residents' responses to the 2020 and 2021American Community Survey (ACS),

Kentucky residents' responses to the 2020 and 2021 Behavioral Risk Factor Surveillance System (BRFSS), Kentucky-county-specific data on prevalence of health risk factors from the 2021 Centers for Disease Control and Prevention (CDC) Places, and 2019 files from the Centers for Medicare & Medicaid Services (CMS) on the characteristics and prevalence of health risk factors of residents of nursing homes and residential care facilities in Kentucky.[5,27–30]

The population database starts with 2021 ACS data on a de-identified, representative sample of Kentucky households. For each person represented in ACS, there is information on demographics, household income, and medical insurance type. ACS identifies households living in the community, as well as households living in group settings such as nursing homes. ACS does not, however, collect information on health risk factors and presence of disease. BRFSS and CMS surveys of residents in nursing homes and residential care facilities do collect information on health risk factors and presence of disease.

Therefore, each person in ACS is statistically matched to a person with similar characteristics from sources with health-related information. Individuals in ACS who live in a community setting are matched to like individuals in BRFSS within the same 5-year age group, sex, race/ethnicity, household income range, and medical insurance type. Individuals in ACS living in group settings are matched to like individuals in CMS databases on residents in nursing homes and residential care facilities within the same 5-year age group, sex, and race/ethnicity.

County-level population estimates (by demographic) for 2021, published by the U.S. Census Bureau, are used to create a representative sample of the population in each Kentucky county in 2021. Data from CDC Places is used to calibrate county-level prevalence of disease and health risk factors. The final step in preparing the population database is to apply population growth rates to each person in the representative population. Population growth rates through 2035, by demographic and county, come from the Kentucky State Data Center.[31]

**Healthcare use prediction equations.** These equations are estimated from national data sources and used to predict healthcare demand (e.g., the number of office visits, number of expected hospitalizations and inpatient bed days, number of home health visits) for each individual in the population database based on the characteristics of individuals included in the population. Key data sources are the combined 2015-2019 files of the Medical Expenditure Panel Survey (MEPS), and the 2019 National Inpatient Sample (NIS). MEPS and NIS data are available for 2020, but there are concerns that 2020 healthcare use patterns are not reflective of future healthcare use patterns due to the substantial disruptions to the healthcare system during the early stage of the COVID-19 pandemic.

Separate prediction equations exist by type of care—office visits by physician or provider specialty, hospitalizations and inpatient bed days by diagnosis category, emergency visits, home health visits, and outpatient visits. The demand driver for care in other settings—nursing homes, residential care facilities, school health, academia, and public health and "all other" settings—are, respectively, projected growth in nursing home residents, people residing in residential care facilities, students aged 6-17, nursing students, and overall population growth. Prediction equations are applied to the constructed population file to create healthcare use demand projections for individuals. Demand projections are then aggregated.

To aid in calibrating the model to Kentucky, national utilization patterns were applied to Kentucky's resident population in 2021 and resulting predicted demand for hospital-based services was compared to actual usage reported in 2021. The initial model overpredicted demand for emergency visits by 7.9% and underpredicted inpatient days by 8.7%. Demand was adjusted to set estimated and observed use of inpatient-based care equal at baseline, with the correction carrying forward through the projection period. These differences between initial model demand estimates and actual reported hospital care in 2021

reflect (a) differences in hospital use patterns of Kentucky residents relative to the national average, (b) possible differences in hospital use patterns in 2021 versus pre-COVID-19 patterns of healthcare use, (c) cross-state mobility in seeking hospital-based care, and (d) modeling error from using prediction equations based on a sample (n~170,000 patients in the combined 2015-2019 MEPS files).

In 2021, approximately 233,000 days of inpatient care in Kentucky hospitals was provided to patients from out-of-state, or 7.4% of the 3.16 million total inpatient days delivered in the state. Most of this care to out-of-state patients (170,800 days) was provided at acute care hospitals (7.2% of care provided at these hospitals). Still, 19.0% of inpatient days at children's hospitals and 11.5% of days at long term acute care hospitals were for out-of-state patients. The 3.16 million inpatient days of care provided in Kentucky hospitals includes approximately 97,800 inpatient days to patients from Indiana, 35,100 inpatient days to patients from Ohio, 28,800 inpatient days to patients from West Virginia, 23,700 inpatient days to patients from Tennessee, 15,400 inpatient days to patients from Illinois, and smaller numbers of patients from Virginia, Missouri, and other states. Projections of future demand for hospital services and the resulting demand for nurses assume that the proportion of care provided in Kentucky hospitals to out-of-state patients will continue over the projection horizon.

Approximately 116,500 (6%) of the nearly 2 million emergency department (ED) visits provided in Kentucky hospitals were for out-of-state residents. This includes approximately 32,600 ED visits by patients from Indiana, 26,000 ED visits by patients from Ohio, 19,800 ED visits by patients from West Virginia, and smaller numbers of visits by patients from various other states and international patients.

The hospital care patterns show that a substantial percentage of individuals travel across district lines to receive care (Exhibit 2). For example, of hospital inpatient days provided to residents of Barren River District approximately 69% occurred in hospitals within Barren River District; 15% occurred in hospitals within the KIPDA District; and the remainder was provided in hospitals in other districts. Of the total inpatient days by out-of-state residents, 37% were provided by hospitals in the KIPDA District, 11% in the FIVCO and Big Sandy Districts, and the remainder in other districts.

Analysis of emergency care shows that most emergency care is provided within the district where the patient resides (Exhibit 3). For example, 91% of ED visits for residents of Barren River District were provided by hospitals in that district. Of ED visits by out-of-state residents, 27% were provided by hospitals in the KIPDA District, 16% were provided by hospitals in the FIVCO District, 14% were provided by hospitals in the Big Sandy District, and the remainder provided by hospitals in other districts.

## Exhibit 2. Percent of Inpatient Days Received by Patient Residence vs. Hospital District

| | Hospital District Where Inpatient Care Received (%) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Patient Residence District** | **Barren River** | **Big Sandy** | **Bluegrass** | **Buffalo Trace** | **Cumberland Valley** | **FIVCO** | **Gateway** | **Green River** | **Kentucky River** | **KIPDA [a]** | **Lake Cumberland** | **Lincoln Trail** | **Northern Kentucky** | **Pennyrile** | **Purchase** | **Total** |
| **Barren River** | 69 | <1 | 3 | <1 | 2 | <1 | <1 | 2 | <1 | 15 | 1 | 5 | <1 | 2 | <1 | 100 |
| **Big Sandy** | 1 | 62 | 13 | <1 | 7 | 4 | <1 | <1 | 6 | 1 | 4 | <1 | <1 | <1 | <1 | 100 |
| **Bluegrass** | 1 | <1 | 84 | <1 | 3 | <1 | <1 | <1 | <1 | 4 | <1 | <1 | 1 | <1 | 6 | 100 |
| **Buffalo Trace** | 1 | <1 | 34 | 15 | 1 | 4 | 9 | <1 | <1 | 11 | 1 | 12 | 12 | <1 | <1 | 100 |
| **Cumberland Valley** | 1 | 1 | 26 | <1 | 61 | <1 | <1 | <1 | 5 | 3 | 2 | <1 | <1 | <1 | <1 | 100 |
| **FIVCO** | <1 | 1 | 12 | <1 | 2 | 75 | 6 | <1 | <1 | 2 | <1 | <1 | 1 | <1 | <1 | 100 |
| **Gateway** | <1 | 1 | 49 | 1 | 2 | 2 | 4<1 | <1 | 2 | 3 | <1 | <1 | 1 | <1 | <1 | 100 |
| **Green River** | 2 | <1 | 4 | 3 | 2 | <1 | <1 | 72 | <1 | 8 | <1 | 1 | 1 | 5 | <1 | 100 |
| **Kentucky River** | <1 | 8 | 21 | <1 | 8 | <1 | 1 | <1 | 6<1 | 2 | 1 | <1 | <1 | <1 | <1 | 100 |
| **KIPDA [a]** | <1 | <1 | 1 | <1 | <1 | <1 | <1 | <1 | <1 | 96 | <1 | 1 | <1 | <1 | <1 | 100 |
| **Lake Cumberland** | 6 | 2 | 25 | <1 | 5 | 2 | <1 | <1 | <1 | 9 | 45 | 4 | <1 | <1 | <1 | 100 |
| **Lincoln Trail** | 2 | <1 | 4 | <1 | 1 | <1 | <1 | 5 | <1 | 38 | 1 | 48 | <1 | 1 | <1 | 100 |
| **Northern Kentucky** | <1 | <1 | 3 | <1 | 2 | <1 | <1 | <1 | <1 | 3 | <1 | <1 | 91 | <1 | <1 | 100 |
| **Pennyrile** | 3 | <1 | 1 | <1 | 1 | <1 | <1 | 1<1 | <1 | 4 | <1 | 1 | <1 | 68 | 13 | 100 |
| **Purchase** | 2 | <1 | 36 | <1 | 4 | <1 | <1 | <1 | <1 | 3 | 1 | <1 | 1 | 2 | 52 | 100 |
| **Out-of-state patients** | 1 | 11 | 8 | 1 | 7 | 11 | <1 | 2 | 1 | 37 | 1 | 2 | 9 | 3 | 7 | 100 |

Source: Analysis of 2021 hospital utilization data provided by the Kentucky Hospital Association. Note: District numbers might not sum to total due to rounding.

Note: [a] KIDPA = Kentuckiana Regional Planning & Development Agency

**Exhibit 3. Percent of Emergency Visits Received by Patient Residence vs. Hospital District**

| | Hospital District Where Emergency Care Received (%) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Patient Residence District** | **Barren River** | **Big Sandy** | **Bluegrass** | **Buffalo Trace** | **Cumberland Valley** | **FIVCO** | **Gateway** | **Green River** | **Kentucky River** | **KIPDA [a]** | **Lake Cumberland** | **Lincoln Trail** | **Northern Kentucky** | **Pennyrile** | **Purchase** | **Total** |
| **Barren River** | 91 | <1 | <1 | <1 | <1 | <1 | <1 | 2 | <1 | 2 | 1 | 3 | <1 | 1 | <1 | 100 |
| **Big Sandy** | <1 | 90 | 2 | <1 | <1 | 5 | 1 | <1 | 1 | <1 | <1 | <1 | <1 | <1 | <1 | 100 |
| **Bluegrass** | <1 | <1 | 97 | <1 | 1 | <1 | 1 | <1 | <1 | 1 | <1 | <1 | <1 | <1 | <1 | 100 |
| **Buffalo Trace** | <1 | <1 | 9 | 74 | <1 | 2 | 9 | <1 | <1 | <1 | <1 | <1 | 6 | <1 | <1 | 100 |
| **Cumberland Valley** | <1 | <1 | 8 | <1 | 89 | <1 | <1 | <1 | 2 | <1 | 1 | <1 | <1 | <1 | <1 | 100 |
| **FIVCO** | <1 | 2 | 2 | <1 | <1 | 84 | 8 | <1 | <1 | 1 | 3 | <1 | <1 | <1 | <1 | 100 |
| **Gateway** | <1 | 1 | 23 | 1 | <1 | 1 | 74 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | 100 |
| **Green River** | <1 | <1 | <1 | <1 | <1 | <1 | <1 | 93 | <1 | 1 | <1 | <1 | <1 | 5 | <1 | 100 |
| **Kentucky River** | <1 | 8 | 10 | <1 | 2 | <1 | 3 | <1 | 76 | <1 | <1 | <1 | <1 | <1 | <1 | 100 |
| **KIPDA [a]** | <1 | <1 | 1 | <1 | <1 | <1 | <1 | <1 | <1 | 98 | <1 | 1 | <1 | <1 | <1 | 100 |
| **Lake Cumberland** | 1 | <1 | 7 | <1 | 5 | 1 | <1 | <1 | <1 | 1 | 83 | 2 | <1 | <1 | <1 | 100 |
| **Lincoln Trail** | <1 | <1 | 2 | <1 | <1 | <1 | <1 | 1 | <1 | 14 | 1 | 81 | <1 | <1 | <1 | 100 |
| **Northern Kentucky** | <1 | <1 | 2 | <1 | <1 | <1 | <1 | <1 | <1 | 1 | <1 | <1 | 96 | <1 | <1 | 100 |
| **Pennyrile** | 2 | <1 | <1 | <1 | <1 | <1 | <1 | 4 | <1 | 1 | <1 | <1 | <1 | 85 | 8 | 100 |
| **Purchase** | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | 99 | 100 |
| **Out-of-state patients** | 2 | 14 | 7 | 3 | 4 | 16 | 1 | 4 | 1 | 27 | 2 | 2 | 9 | 2 | 8 | 100 |

Source: Analysis of 2021 hospital utilization data provided by the Kentucky Hospital Association. Note: District numbers might not sum to total due to rounding.

Note: [a] KIDPA = Kentuckiana Regional Planning & Development Agency

**Care delivery patterns.** National average levels of nurse staffing were applied to projections of healthcare use. For example, demand for RNs in the ED is calculated by multiplying (a) projected Kentucky ED visits in each year and (b) the 2021 national ED RNs to national ED visits ratio. Staffing ratios are calculated for RNs and LPNs and are applied analogously to estimate demand in the inpatient, outpatient, office, and home health settings. For residential care and nursing home settings, the factors expected to drive demand for nurses are the size of the population living in residential care facilities and nursing homes, respectively. The aged 6-17 population is assumed to drive demand for nurses in schools, and the total Kentucky population is assumed to drive demand for nurses in the public health and "all other" settings. The number of new nurses being trained is the main driver of demand for nurses in teaching/academia. The staffing ratios for these settings are calculated by dividing national estimates of the demand driver by national estimates of FTE nurses working in the setting. Staffing ratios are modeled as remaining constant throughout the modeling period.

## Population Growth and Aging and Projected Demand for Healthcare Services

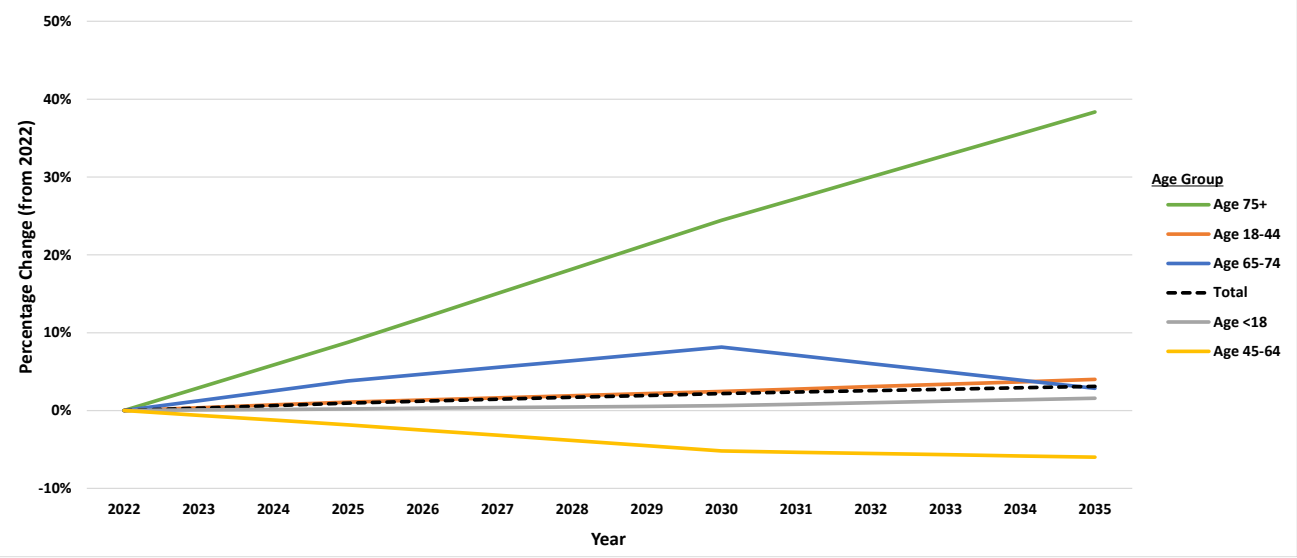
Population growth and changing demographics are the key drivers of changes in expected demand for healthcare services (and therefore the demand for nurses) over the projection period. The aging effect in particular will have an outsized impact on future demand for services, as the oldest population cohorts

generally use services at a higher rate than those in younger age groups. Both the *Status Quo* and *Reduced Barriers* scenarios employ the same projected population changes over time.

Kentucky's population of over 4.5 million in 2022 and is projected to reach nearly 4.7 million in 2035—growing by about 141,000 resident (3.1%). There is considerable variation in population growth rates by age group (Exhibit 4Exhibit 4. Expected Population Growth in Kentucky by Age Group, 2022-2035). Most of this growth is among the population aged 75 years or older with a projected increase of 116,000 residents (38.3%). The population aged 65-74 is projected to grow by 14,000 residents (2.0%). The rapidly growing population of older Kentuckians is projected to drive high growth in demand for healthcare services.

Meanwhile, the traditional working age population is projected to decline. The population aging into the 18-44 year old range is projected to increase by 63,000 residents (4.0%), while the number of Kentucky residents aging into the 45-64 year old range is projected to decline by nearly 69,000 (-6.0%). The decline in the age 45-64 population forbodes a loss of experience in the workforce. In net, the traditional working age population aged 18-64 years is projected to decline by about 6,000 residents (-0.2%). Slow growth is projected among the population under age 18 (15,000 residents, or 1.5%).

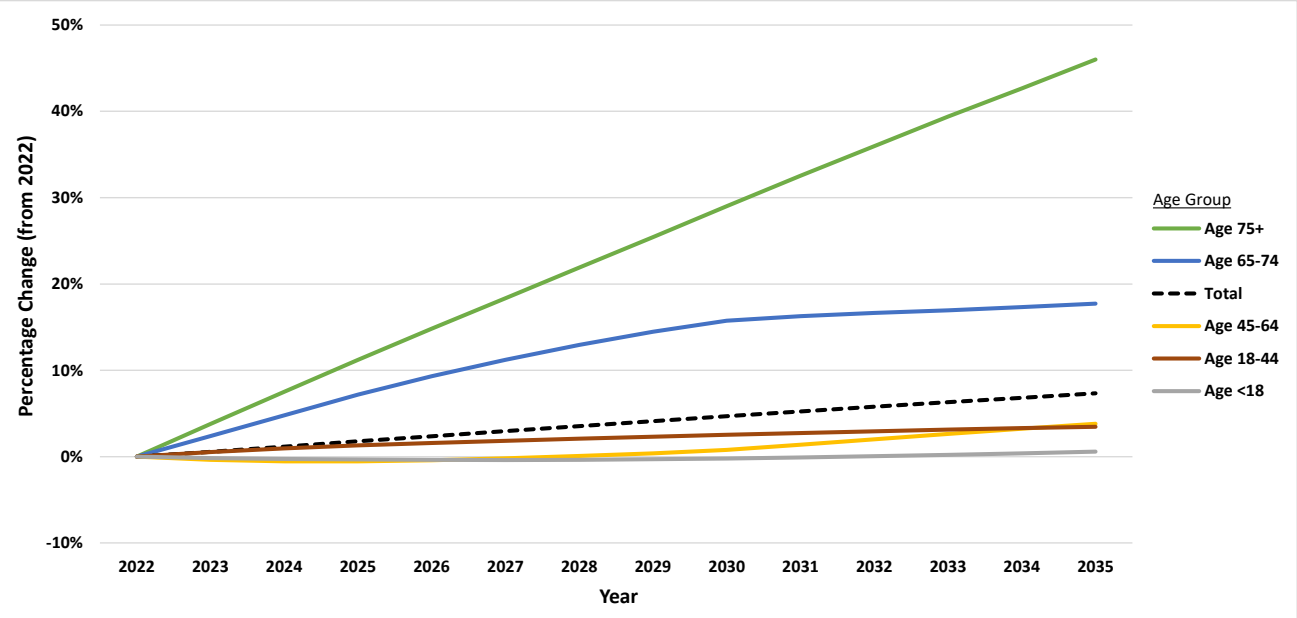
**Exhibit 4. Expected Population Growth in Kentucky by Age Group, 2022-2035**




Source: Analysis of Kentucky State Data Center population projections, University of Louisville.

The variation in population growth rates by age group is also observed nationally (Exhibit 5). Similar to Kentucky population trends, much of the growth in population is among the elderly. The population aged 75 years or older is projected to increase by 46%, and the population aged 65-74 years is expected to grow by 18%. In contrast to Kentucky, the overall national working age population (18–64 year old range) is projected to increase at about 4%. This is driven by a projected 3% increase in the age 18-44 group and a 4% increase in the age 45-64 group.

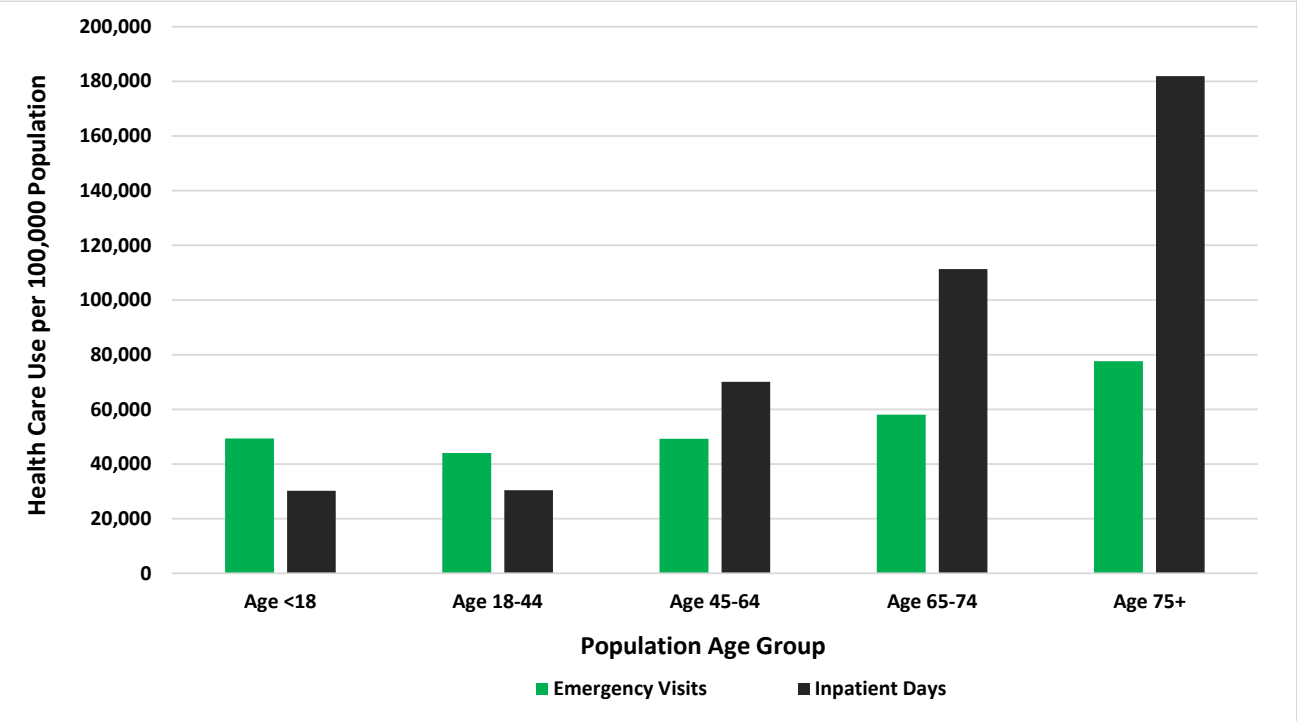
**Exhibit 5. Expected Population Growth in U.S. by Age Group, 2022-2035**




Source: Various State-specific database and 2022 S&P Global Projections

Exhibit 6 illustrates the relationship between population age and demand for hospital-based services. As people age they tend to use more hospital services. For example, a population of 100,000 adults aged 18-44 has approximately 44,000 ED visits and 30,500 bed days annually. A population of 100,000 adults aged 75-years-and-older has approximately 77,600 ED visits and 181,900 bed days annually.

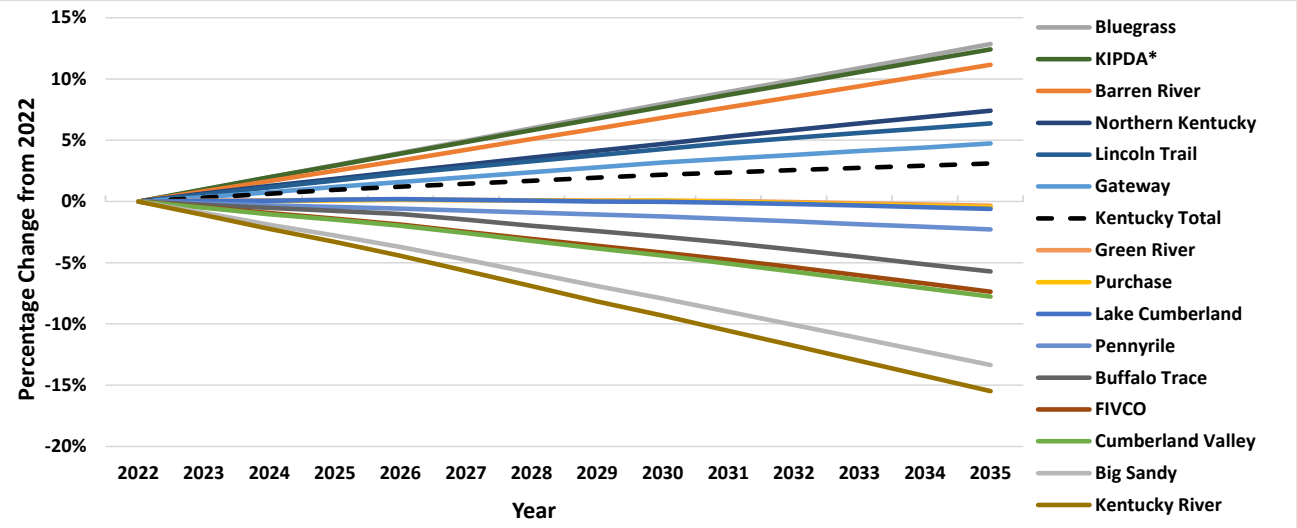
**Exhibit 6. Rate of Annual Use of Hospital-based Care by Age Group, 2021**




Source: Analysis of Medical Expenditure Panel Survey data for 2015-2019, and hospital utilization data for 2021 from the Kentucky Hospital Association.

Population growth across the state varies by ADD, as shown in Exhibit 7. Bluegrass and the KIPDA District—that includes Louisville—are projected to experience large growth with a 12% increase over the projection period. The Barren River District that includes Bowling Green is projected to experience 11% growth. There are large projected declines in population areas at Kentucky River (-15%), Big Sandy (-13%), Cumberland Valley (-8%), FIVCO (-7%), and Buffalo Trace (-6%). Hence, growth in demand for healthcare services and demand for nurses will vary substantially by district.

**Exhibit 7. Expected Population Growth in Kentucky by Area Development District, 2022-2035**




Source: Analysis of Kentucky State Data Center population projections, University of Louisville. *KIDPA = Kentuckiana Regional Planning & Development Agency.

## Prevalence of Disease and Health Risk Factors

Demand modeling takes into consideration the prevalence of disease and other health risk factors that affect demand for healthcare services. The health care use prediction equations, which are based on analysis of the Medical Expenditure Panel Survey, estimate the relationship between annual use of healthcare services (hospitalizations and inpatient days, emergency visits, visits to doctor offices and outpatient clinics, and home health visits) to people's demographics, presence of various diseases, health risk factors such as smoking and obesity, and other socioeconomic information including household income level and having medical insurance.

As summarized in Exhibit 8, Kentucky has higher prevalence of disease, smoking, and obesity compared to the national average. There is also variation in prevalence across counties and ADDs. Obesity prevalence among adults is 37% in Kentucky compared to 32% nationwide. Within Kentucky, obesity prevalence ranges from a high of 42% in the FIVCO and Kentucky River Districts, to a low of 34% in the Kentuckiana Regional Planning & Development Agency District. Smoking prevalence among adults is also much higher in Kentucky (23%) compared to the national average (16%). Across all modeled disease categories and smoking and obesity, every ADD meets or exceeds the national prevalence rate. The projections of healthcare use to quantify demand for nurses account for these levels of disease prevalence and health risk factors.

**Exhibit 8. Prevalence of Disease and Health Risk Factors among Adults, by ADD**

| | Current Condition | | | | | History of Condition | | | Current Risk Factor | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Area Development District | Arthritis | Asthma | Hypertension | Heart Disease | Diabetes | Cancer | Heart Attack | Stroke | Smoker | Obese | Population Age 65+ |
| **Lake Cumberland** | 38 | 11 | 46 | 10 | 16 | 9 | 6 | 5 | 27 | 39 | 20 |
| **Barren River** | 33 | 10 | 41 | 8 | 13 | 7 | 6 | 4 | 24 | 36 | 17 |
| **Bluegrass** | 31 | 10 | 38 | 7 | 12 | 7 | 6 | 4 | 20 | 36 | 17 |
| **Purchase** | 35 | 10 | 43 | 9 | 14 | 8 | 5 | 4 | 22 | 38 | 21 |
| **Gateway** | 35 | 11 | 43 | 9 | 14 | 8 | 7 | 4 | 26 | 39 | 17 |
| **Cumberland Valley** | 39 | 11 | 46 | 11 | 16 | 8 | 9 | 5 | 29 | 39 | 18 |
| **Northern Kentucky** | 32 | 9 | 38 | 7 | 12 | 8 | 5 | 3 | 21 | 35 | 16 |
| **FIVCO** | 39 | 11 | 45 | 10 | 15 | 9 | 9 | 5 | 25 | 42 | 21 |
| **Buffalo Trace** | 38 | 10 | 45 | 10 | 15 | 8 | 7 | 5 | 27 | 40 | 20 |
| **Kentucky River** | 41 | 11 | 48 | 11 | 17 | 9 | 12 | 6 | 31 | 42 | 20 |
| **Lincoln Trail** | 34 | 10 | 41 | 8 | 13 | 8 | 5 | 4 | 24 | 38 | 17 |
| **KIPDA** [a] | 31 | 10 | 40 | 7 | 12 | 8 | 6 | 4 | 22 | 34 | 17 |
| **Pennyrile** | 34 | 10 | 43 | 9 | 14 | 8 | 8 | 4 | 25 | 37 | 18 |
| **Green River** | 34 | 10 | 42 | 9 | 14 | 8 | 7 | 4 | 24 | 38 | 19 |
| **Big Sandy** | 40 | 11 | 47 | 11 | 16 | 8 | 9 | 5 | 28 | 41 | 20 |
| **Kentucky Average** | **34** | **10** | **41** | **8** | **13** | **8** | **6** | **4** | **23** | **37** | **17** |
| **National Average** | **24** | **9** | **32** | **6** | **11** | **7** | **4** | **3** | **16** | **32** | **17** |

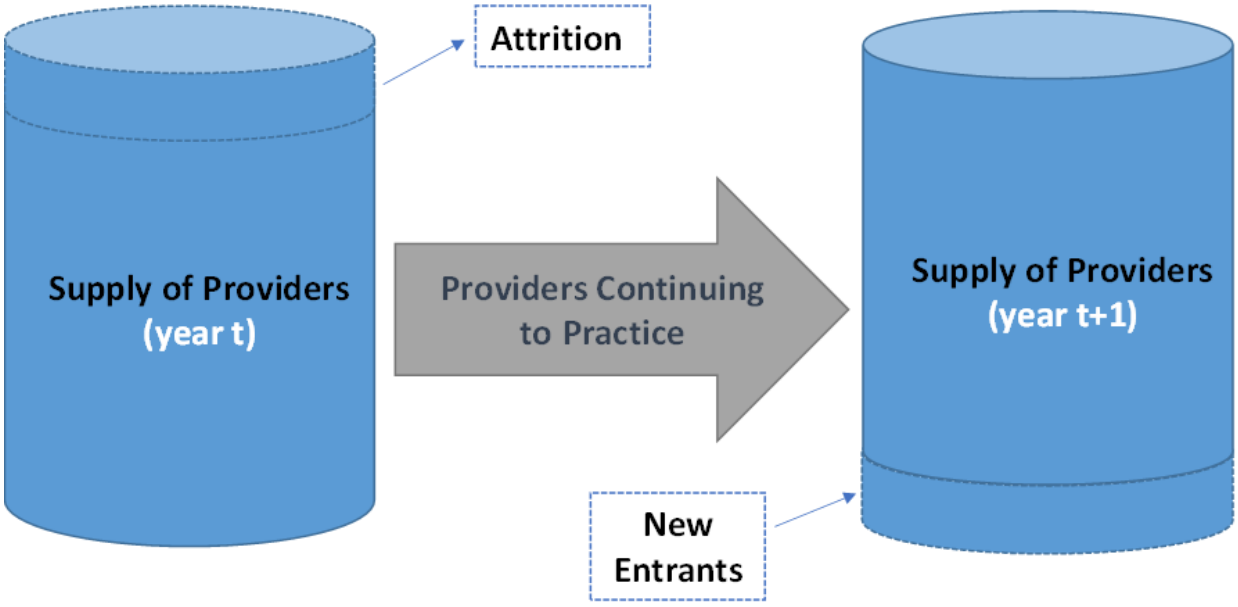
Source: Centers for Disease Control and Prevention. PLACES: Local Data for Better Health. Published April 2022.

Note: [a] KIDPA = Kentuckiana Regional Planning & Development Agency.

## Supply Modeling

Supply is modeled using a microsimulation approach, starting with building a representative population of nurses licensed in Kentucky. The major components to supply modeling are: (1) estimating the size and characteristics of the starting year supply; (2) modeling the number and characteristics of new entrants to the nursing workforce; (3) modeling the labor force participation rate and weekly hours worked for those in the workforce; and (4) modeling attrition from the workforce—including nurses who retire, those who move out of state, and nurses who further their education level such as LPNs becoming RNs and RNs becoming advanced practice nurses (Exhibit 9). Using simulation during each subsequent year of modeling, workers' age increases by one-year, weekly hours worked, and retirement probabilities are calculated for these new ages, new entrants are added to the workforce, and attrition is subtracted from the workforce.

**Exhibit 9. Overview of the Supply Modeling Framework**




## Developing Starting Supply

Licensure data maintained by the Kentucky Board of Nursing is the basis for both the starting supply and estimates of new entrants to the nurse workforce. The licensure data contains complete information for age, sex, race/ethnicity, education, and original license date. Demographic information (especially age) is important for supply modeling as labor force participation, hours worked, and retirement probabilities are correlated with demographics. Starting in 2022, KBN implemented a robust data collection system where licensure includes completion of a brief survey that collects information for research purposes on primary and secondary employment (status, geographic location, setting, position, and hours worked), and retirement intentions.

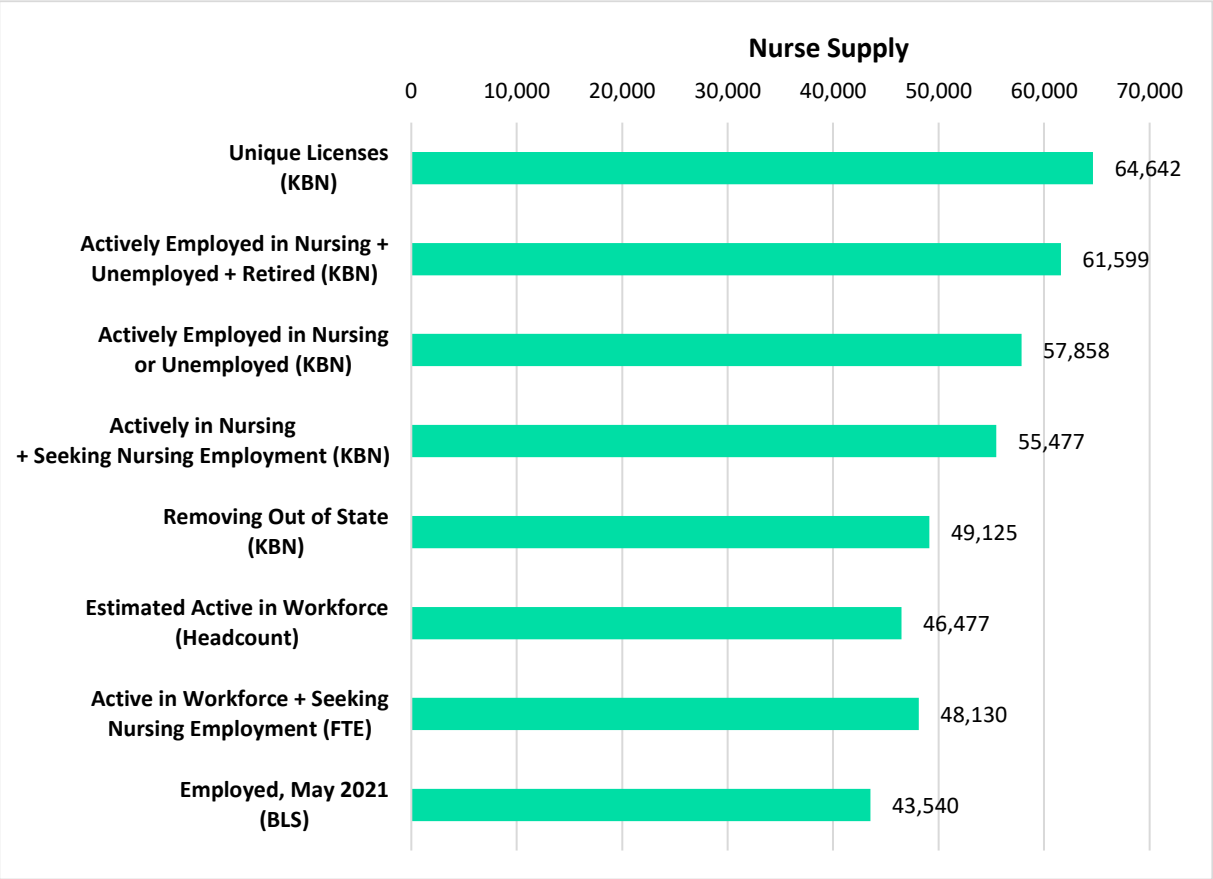
Nurses who received their initial license after April 25, 2022, did not complete the workforce survey as they were not required to renew their license during the annual (September 15-October 31) re-licensure period. Consequently, for 3,488 RNs and 547 LPNs there was not information on practice location, employment status, retirement intentions or hours worked per week. To fill in missing information for these new nurses with missing survey data, we matched them with a nurse of the same age and occupation for whom there was survey data.

Below, we summarize analyses to estimate starting supply for RNs and LPNs.

**Registered Nurses**: Exhibit 10 depicts the process to create the starting supply of RNs. The initial KBN licensure file contained 66,568 RN licenses, and with duplicates removed there were 64,642 unique RNs. Removing out-of-state RNs and keeping only those actively employed in nursing or seeking employment as a nurse reduced the available pool of nurses to 49,125 RNs. KBN workforce survey responses were then used to estimate the head count of active RNs in the workforce to 46,477. Accounting for hours worked, for modeling purposes supply starts with 48,130 FTE RNs that includes both nurses in a nursing role and nurses who are unemployed but actively seeking a nursing role. For comparison, the Bureau of

Labor Statistics estimates 43,540 filled RN positions in May 2021, including full time and part time positions, based on a survey of a sample of employers in Kentucky.[6]

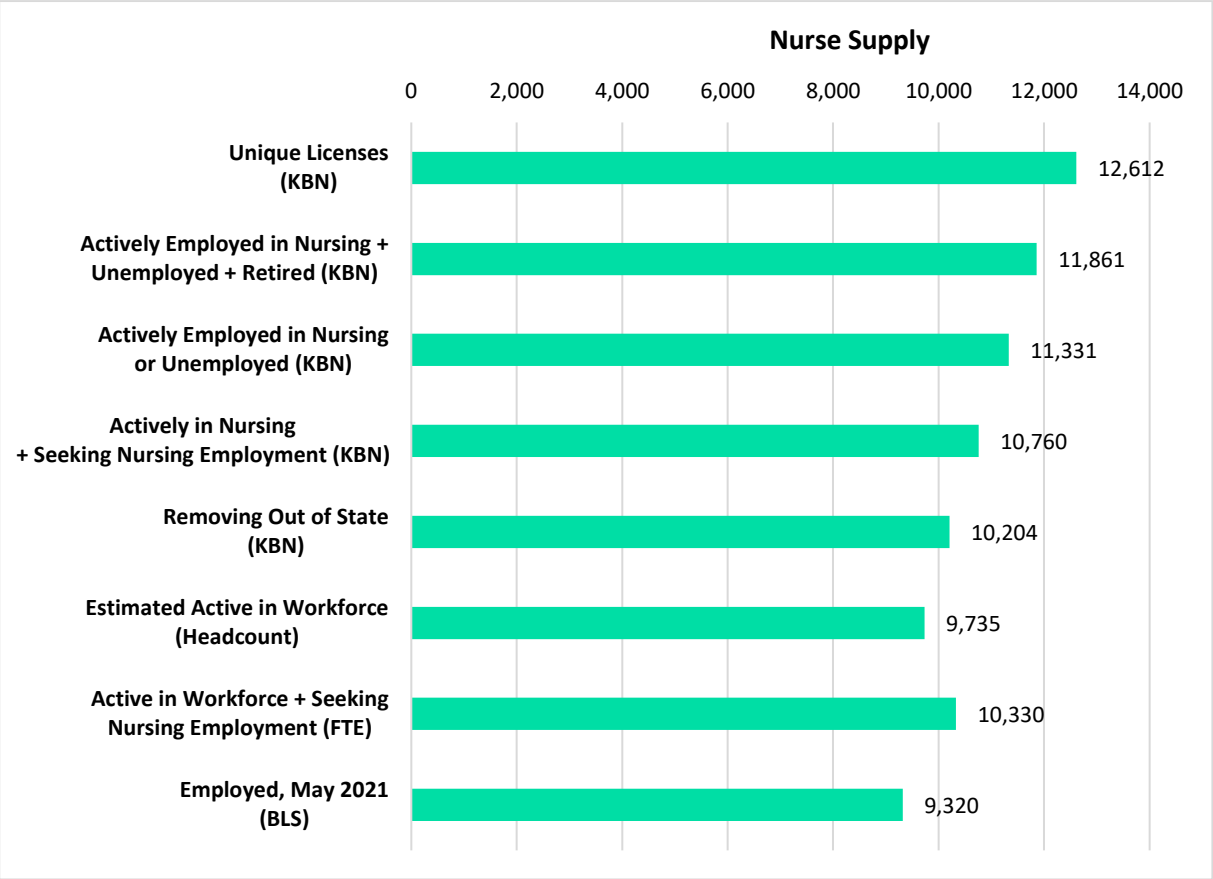
**Exhibit 10. Registered Nurse 2022 Starting Supply Estimates**




Source: Analysis of Kentucky Board of Nursing 2022 licensure and workforce survey data.

**Licensed practical nurses**: The initial KBN licensure file contained 12,612 unique LPNs. Removing out-of-state LPNs and keeping only those actively employed in nursing or seeking employment as a nurse reduced the starting supply to 10,204. KBN workforce survey responses on labor force participation were used to estimate the head count of 9,735 LPNs active in the workforce. Adjusting for average hours worked per week, starting supply for modeling purposes starts with 10,330 FTE LPNs (including both those nurses in a nursing role and nurses who are unemployed but actively seeking a nursing role). For comparison, the Bureau of Labor Statistics estimates 9,320 filled LPN positions in May 2021, including full-time and part-time positions, based on a survey of a sample of employers in Kentucky.[6]

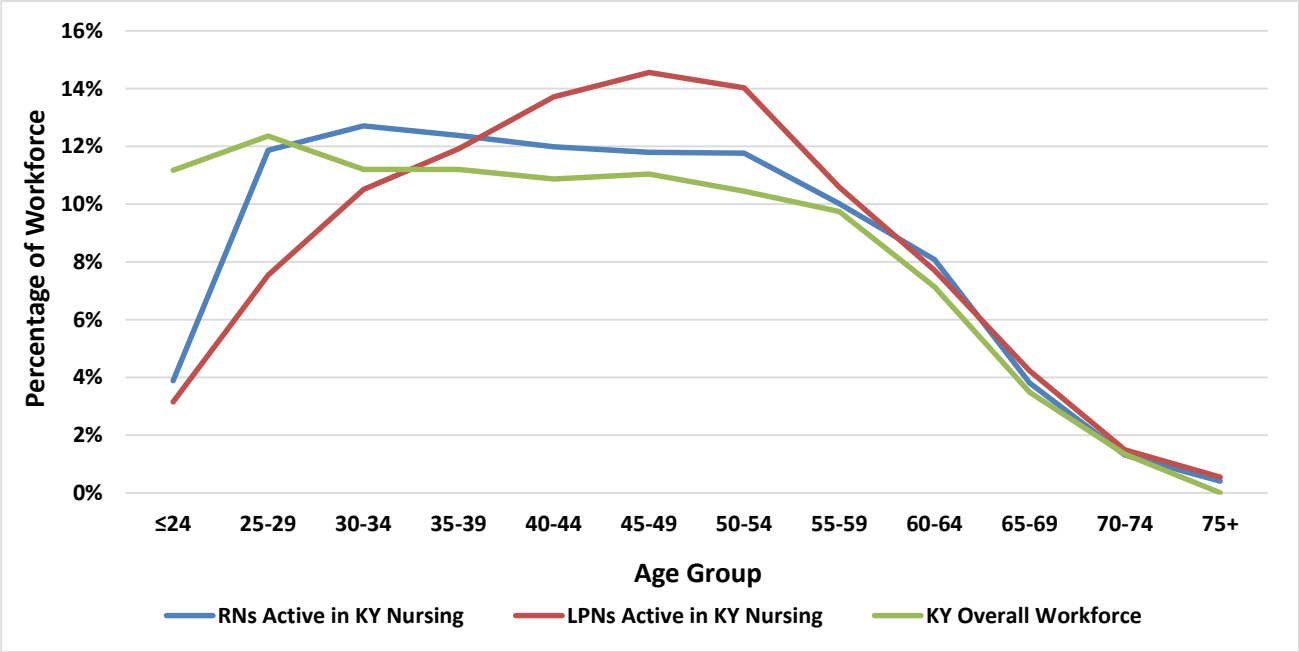
**Exhibit 11. Licensed Practical Nurse 2022 Starting Supply Estimates**




Source: Analysis of Kentucky Board of Nursing 2022 licensure and workforce survey data.

**Demographics:** Analysis of the KBN licensure data shows that the Kentucky nurse workforce is predominately female (RNs = 91%, LPNs = 94%) and non-Hispanic White (RNs = 86.7%, LPNs = 81.1%). The RN workforce is slightly younger than their LPN counterparts on average, with mean ages of 43.7 and 45.2, respectively. Whereas the LPN distribution peaks at age 45-49, the RN workforce is more consistently distributed with a peak at age 30-34 years. The age distribution of the active nurse workforce in Kentucky is summarized in Exhibit 12. The RN age distribution is similar to the age distribution of the entire Kentucky workforce.[32] The age distribution of Kentucky's overall labor force is based on our analysis of the 2021 American Community Survey for adults who indicate working at least 20 hours per week, on average.

**Exhibit 12. Age Distribution of Kentucky's Active Nurse Workforce**




Source: Analysis of Kentucky Board of Nursing 2022 licensure and workforce survey data. KY overall workforce age distribution is calculated from the 2021 American Community Survey for Kentucky residents who report working at least 20 hours per week.

## Supply Modeling Inputs

The primary source for inputs to supply modeling is KBN's licensure and survey data. Where needed, we supplement or compare Kentucky data with national sources. In this section we describe the data, assumptions, and methods for key modeling inputs.

### New Entrants to the Kentucky Nurse Workforce

Based on the number of new licenses issued from April 2019 through April 2022, an estimated 3,024 RNs and 585 LPNs are added each year to the Kentucky workforce (Exhibit 13). New entrants include nurses who recently passed the NCLEX exams and became licensed, as well as nurses who moved to Kentucky from another state. The number of new entrants to the RN workforce each year includes LPNs who become RNs. The *Status Quo* scenario models the number of annual new entrants remaining constant through 2035. The demographic distributions of new nurses, estimated from analysis of the KBN licensure data, are modeled as constant when projecting into the future. For example, supply projections assume that approximately 88% of new RNs and 93% of new LPNs are female.

**Exhibit 13. Number and Characteristics of Annual New Nurse Entrants**

| Measure | Registered Nurses | Licensed Practical Nurses |
|---|---|---|
| **Annual New Entrants** | 3,024 | 585 |
| **% Female** | 88 | 93 |
| **% Age** | | |
| **<25** | 35 | 28 |
| **25-34** | 41 | 44 |
| **≥35** | 24 | 28 |
| **% Race/Ethnicity** | | |
| **White** | 67 | 59 |
| **Non-White** | 33 | 41 |
| **% Entry Education Level** | | |
| **Associate/Diploma** | 45 | 98 |
| **Bachelors** | 51 | 2 |
| **Masters or Higher** | 4 | 0 |

Source: Analysis of Kentucky Board of Nursing licensure data for people whose initial license in Kentucky was granted between April 2019 and April 2022. These numbers include both recent graduates from nursing programs and experienced nurses moving from other states.

## Labor Force Participation and Attrition

Many nurses licensed in Kentucky are not actively working in a nursing role in Kentucky. As summarized in a later section, a substantial number of licensed nurses are retired or not currently seeking a nursing role, some nurses are working outside of Kentucky, and some are working in a non-nursing role. While the KBN survey data provide insights on the current nurse workforce, modeling requires estimating future labor force participation and attrition from the workforce as nurses retire, move out of the state, or change careers. As licensure data can be unreliable with removing individuals after they retire, individuals over the age of 74 are removed for analysis. Our analysis of ACS data and other surveys indicates few nurses above age 70 in the workforce, and those nurses typically work part-time. KBN workforce survey responses on employment status indicated if an individual was employed as a nurse (full-time, part-time, or per diem) seeking employment as a nurse, or not seeking employment as a nurse. This information is sufficient to determine labor force participation rates for RNs and for LPNs by nurse age.

The 2019 National Sample Survey of Registered Nurses (NSSRN) is used to model the probability that LPNs will become RNs and RNs will become advanced practice nurses (APRNs).

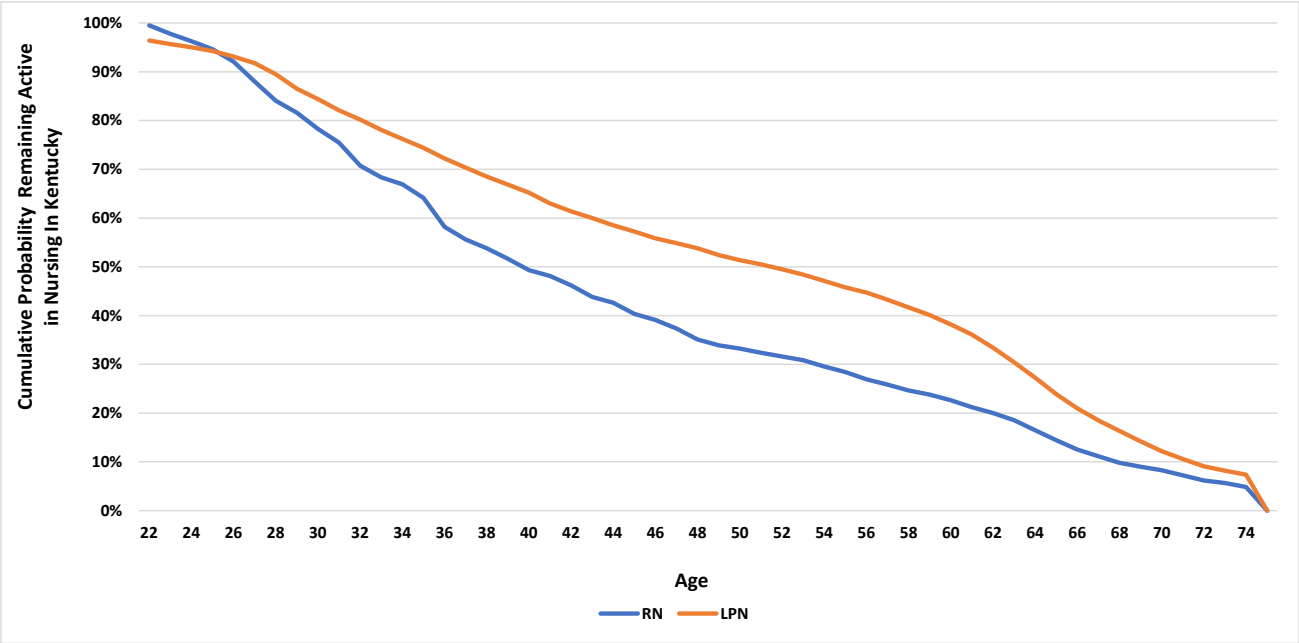
Geographic migration probabilities out of Kentucky are calculated from prediction equations based on nurse age, race/ethnicity, and sex (and by education level for RNs) estimated using 2016-2020 American Community Survey (ACS) data. Estimated probabilities specifically account for the number of individuals leaving Kentucky each year. Migration into Kentucky is also accounted for in the model, but in-migration is tracked as new entrants to the Kentucky health workforce.

Retirement patterns for RNs and LPNs, by age, are derived from KBN survey responses. As the modeling process progresses from year to year, an individuals' probability of retiring will change based on their new age, and this probability increases with age.

Exhibit 14 illustrates the simulated probability that a nurse who begins his or her career at age 22 will remain active in Kentucky's nursing workforce—accounting for all forms of attrition and probability of being active. By age 40, approximately 49% of RNs and 65% of LPNs will still be part of Kentucky's

nursing workforce as an RN or LPN, respectively. (In addition, some RNs will still be practicing in Kentucky as APRNs, and some LPNs will be practicing as RNs). By age 50, 33% of RNs and 51% of LPNs will still be practicing in Kentucky. By age 65, which for many U.S. workers is a traditional retirement age, approximately 14% of RNs and 24% of LPNs will still be practicing in Kentucky.

**Exhibit 14. Cumulative Probability a 22-year Old Nurse Will Remaining Active in the Kentucky Nursing Workforce**



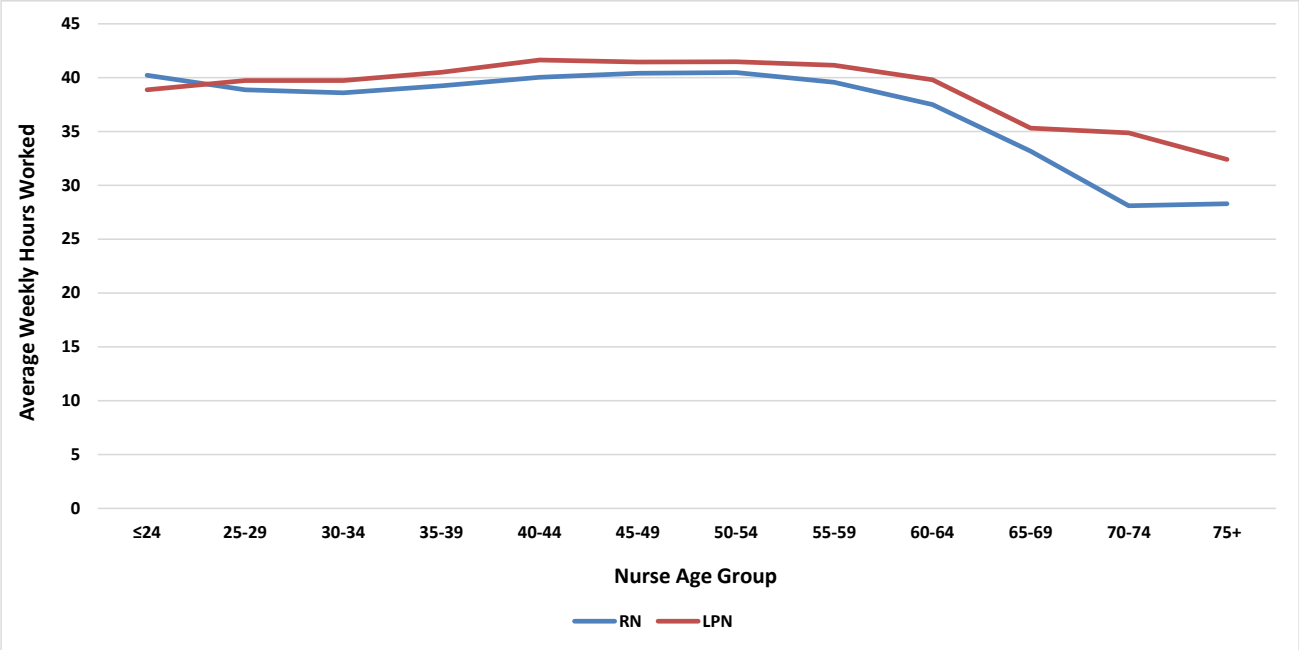

Source: Analysis of Kentucky Board of Nursing 2022 licensure and workforce survey data.

## Hours Worked Patterns

We used survey responses from the KBN workforce survey to model weekly hours worked. Prediction equations for RNs and LPNs are based on Ordinary Least Squares regression with weekly hours worked as the dependent variable. Weekly hours includes all hours worked in nursing in Kentucky—which includes primary and secondary employment, and includes both scheduled hours and overtime hours. Explanatory variables in the regression consist of age group, sex, race/ethnicity, and RN education level (associate degree, or baccalaureate degree or higher). The regressions used data only on individuals working at least 8 hours per week.

Average weekly hours worked by nurse age group and occupation are summarized in Exhibit 15. Average hours worked dip slightly during early child rearing years, remain relatively constant from ages 40-55, and then start to decline after age 55.

**Exhibit 15. Average Hours Worked Per Week by Nurse Age Group**




Source: Analysis of Kentucky Board of Nursing 2022 licensure and workforce survey data.

As noted previously, all supply and demand projections are reported as FTEs and based on the average hours worked per week among nurses working at least 8 hours per week. The definition of a supply FTE has been scaled by the average hours worked for RNs and LPNs as reported on the KBN survey.

## Supply Scenarios Modeled

The supply modeling described above reflects the modeling assumptions for the *Status Quo* scenario. That is, over the projection horizon, the annual number of new licenses and demographics of newly licensed nurses will remain constant and labor force participation patterns and hours worked patterns will remain unchanged.

Several alternative scenarios are modeled to account for uncertainties in future health workforce patterns. Two scenarios reflecting changing retirement patterns are modeled—the *Early Retirement* scenario, reflecting individuals retiring two years earlier than they do currently, and the *Delayed Retirement* scenario, reflecting individuals retiring two years later than they do currently. The former scenario could reflect the impact of worsening nurse burnout, while the latter could reflect the results of efforts by employers to retain senior staff. Similarly, two scenarios are modeled that assume, alternately, a 10% increase and a 10% decrease in annual new entrants to the workforce projected into the future (named the *10% More Entrants* and *10% Fewer Entrants* scenarios, respectively). The former scenario could reflect, for example, the impact of increased efforts within the state to attract and recruit new health workers to the profession, while the latter could reflect the challenges of growing the health workforce pipeline. (Supply projections for these alternative scenarios are summarized in the Appendix.)

# Findings

Analysis of licensure data along with computer modeling of status quo and possible growth scenarios suggests a large and persistent shortfall of RNs, and a growing shortfall of LPNs. Comparisons of Status Quo versus the alternative scenarios can be found in the appendix in Exhibit 27 and Exhibit 28.

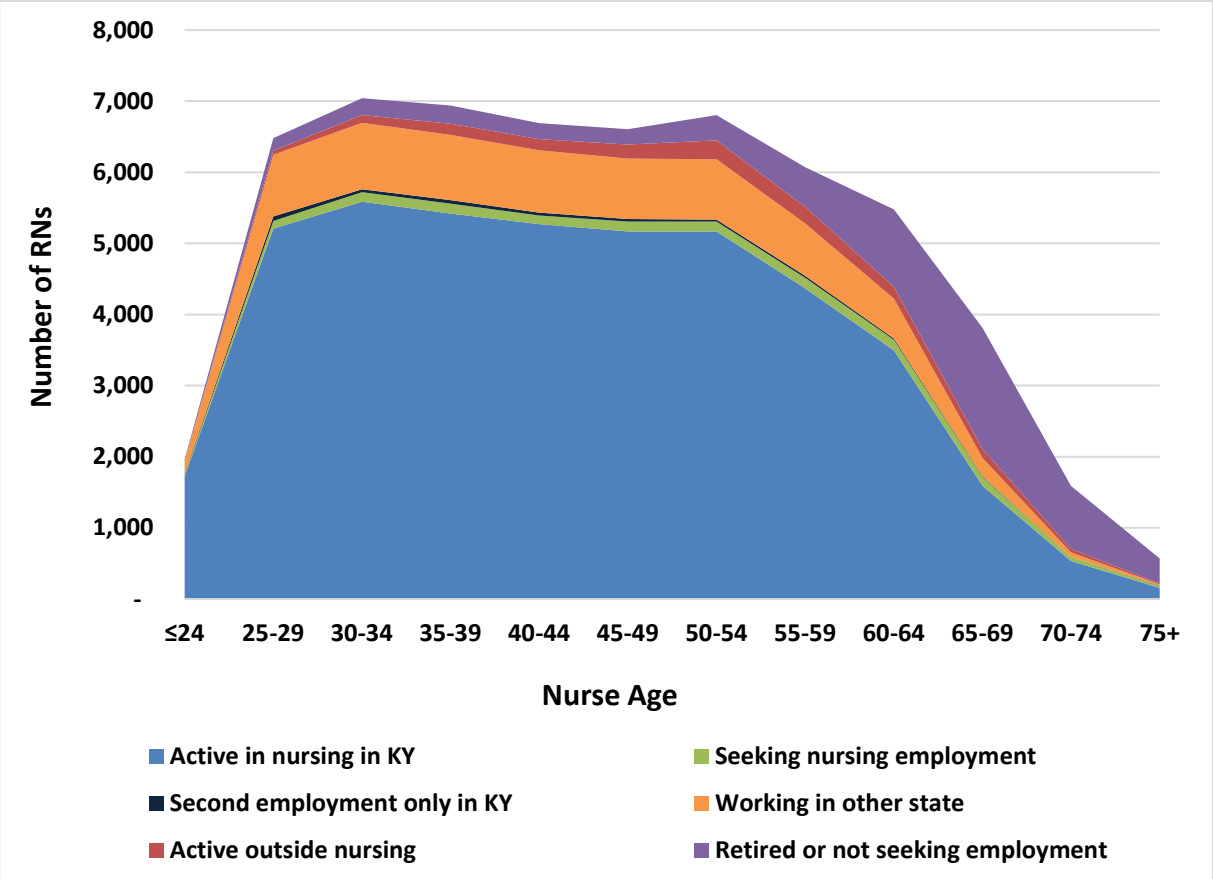
## RN Supply and Demand Projections

Of the 64,642 RN licenses, a large portion are not in the nursing workforce or work outside of Kentucky. The percentage of licensed RNs who are working in a nursing position declines with age (Exhibit 16). Focusing on the workforce under age 65 and looking at the reported primary employment status and location at the time of re-licensure (September 15 to October 31, 2022), approximately:

- 78% (44,730 RNs) were active in nursing in Kentucky
- 12% (6,800 RNs) were working in another state
- 6% (3,170 RNs) were retired or not seeking employment
- 2% (1,410 RNs) were active outside of nursing
- 2% (1,200 RNs) were unemployed but seeking nursing employment

Among RNs of all ages, 46,477 reported their primary employment in a nursing position in Kentucky or reported their secondary employment (part time) in Kentucky with their primary employment out-of-state. For comparison, the Bureau of Labor Statistics estimates 43,540 filled RN positions in May 2021 based on a survey of a sample of employers in Kentucky.[6] Using responses on nurse employment and hours worked for nurses of all ages, we estimate supply of 48,130 FTEs in 2022 (including RNs who are unemployed but seeking a nursing position).

**Exhibit 16. Labor Force Participation by RN Age, 2022**




Source: Analysis of Kentucky Board of Nursing 2022 licensure and workforce survey data.

Estimated demand for RNs in 2022 is 54,320 FTEs. Demand is defined as the number of FTEs required to provide a 2021 national average level of care in Kentucky in future years taking into account the characteristics of the state's current and projected future population (demographics, prevalence of disease and health risk factors, and socioeconomic factors) as well as the projected level of care provided to patients from out-of-state based on current observed levels of care and demographic projections.

Comparing supply to demand, Kentucky required about 6,190 more RNs in 2022 to be able to provide the national average level of care (Exhibit 17, Exhibit 23, Exhibit 25, and Exhibit 27). That is, Kentucky's supply of RNs was sufficient to meet about 89% of demand. To the extent that the national average is insufficient, given reports of vacancies across the nation, the shortfall could be even greater than 6,190.[7]

Under the *Status Quo* supply scenario, RN supply is projected to grow by 5,030 FTEs (10%) between 2022 and 2035 (Exhibit 25). Among the range of assumptions modeled, projected supply growth is lowest under the *10% Fewer Entrants* scenario (5% growth, or 2,170 FTEs) and highest under the *10% More Entrants* scenario (16% growth, or 7,860 FTEs). Lower growth is projected under the *Early Retirement* scenario (7% growth, or 3,440 FTEs), and higher growth is projected under the *Delayed Retirement* scenario (13% growth, or 6,460 FTEs). While 10% growth is the projection based on current labor force participation patterns and number of new entrants to the Kentucky workforce, there is likely greater risk for slower supply growth than potential for faster supply growth. The state's projected demographics are unfavorable to increasing the supply of new graduates from nursing programs absent efforts to encourage more people to choose nursing as a career, with projected growth of 4.0% among the

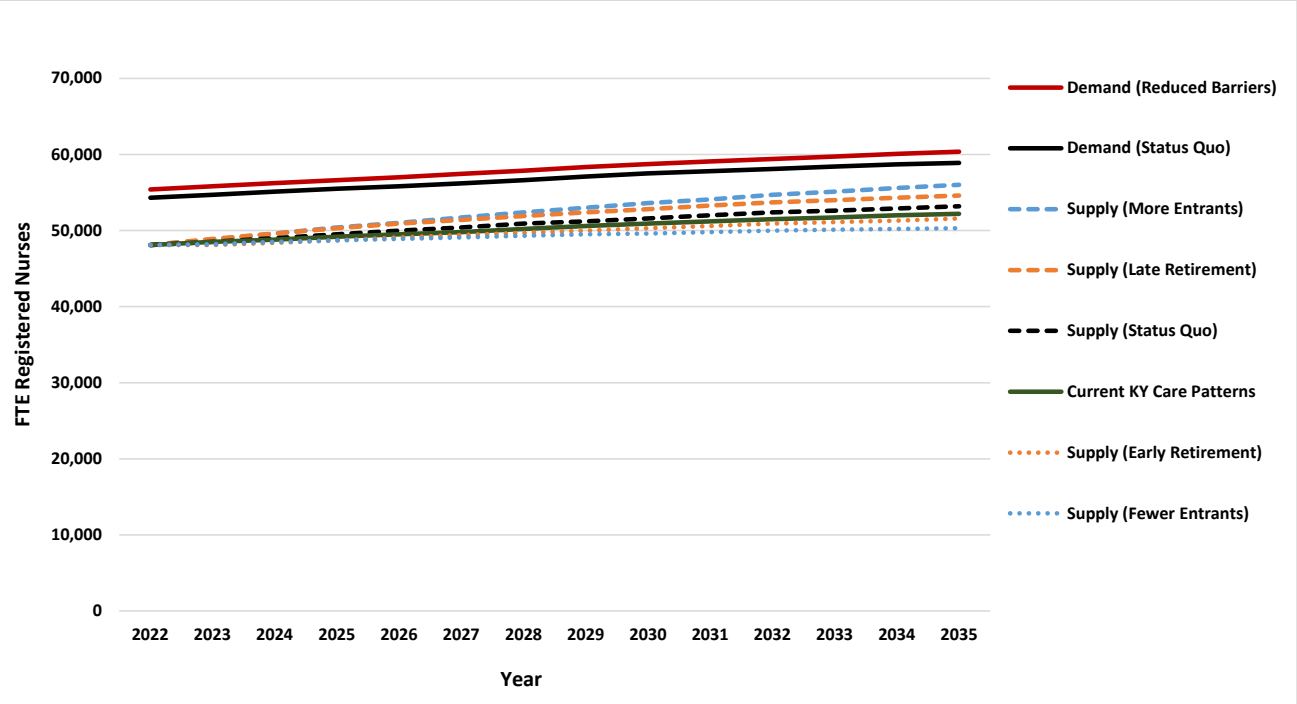
age 18-44 population between 2022 and 2035. This slow growth in the population from which new nurses might be recruited means increased competition from other economic sectors for available labor. Furthermore, high levels of burnout among healthcare workers in general and nurses in particular make it more likely that nurses will leave the workforce earlier than historical patterns rather than delay exiting from the workforce.[8–11]

To provide the national average level of care, demand for RNs in Kentucky will rise from 54,320 to 58,950 FTEs by 2035. This represents growth of 9% over the projection period. The increased demand for RNs is driven by the projected increase in Kentucky's population—particularly the outsized growth of the eldest population age groups which use a disproportionate amount of healthcare services. Under the *Reduced Barriers* scenario, demand for RNs would be approximately 1,080 FTEs (2%) higher than under the *Status Quo* scenario at baseline and 1,410 FTEs higher in 2035.

One scenario in Exhibit 17, the *Current KY Care Patterns* scenario, shows the future number of RNs required simply to maintain Kentucky's current low use of RNs. This scenario starts with the current number of FTE RNs employed in Kentucky and models the rate of demand growth as the population grows and ages. Comparison of *Status Quo* supply to this *Current KY Care Patterns* scenario suggests that Kentucky is producing enough nurses to maintain current levels of care while falling far short of the number required to close the RN shortfall.

Because RN supply and demand are growing at close to the same rate, the current shortfall is projected to persist. A projected shortfall of 5,790 RNs in 2035 means that Kentucky will not make any appreciable gains in having enough nurses to meet patient demand with 2035 projected supply sufficient to meet only 90% of demand.

**Exhibit 17. RN Supply and Demand Projections, 2021-2035**




Source: Health Workforce Simulation Model Projections, GlobalData

Demand for RNs under the *Status Quo* scenario, by employment setting, is summarized in Exhibit 18. The factor driving demand in the office setting is office visits, in the inpatient setting it is inpatient days, and in nursing home and residential care settings the demand driving factor is the projected size of the population living in those settings. Demand for nurses in academia is modeled as remaining constant over time. (The *Status Quo* supply scenario models the assumption that the annual number of new entrants to the nurse workforce will remain constant over time, with the implicit assumption that Kentucky continues to graduate the same number of new nurses each year). If the size of the nurse training pipeline grows, then demand for nurses in academia will grow at the same rate. For example, if Kentucky were to close the gap between projected supply and demand for nurses solely by training new nurses then Kentucky would need to increase by nearly 200 FTEs the number of nursing faculty.

The 2022-2035 projected nurse FTE growth rates for other employment settings ranges from 2% for school health and outpatient care, to 47% and 42% in the residential care and nursing home settings, respectively. This variation in growth rate across settings reflects the demographics served in each setting and population projections by demographic. Approximately half of the projected growth in demand for RNs is in hospitals, for which demand is projected to increase by approximately 2,300 FTEs.

**Exhibit 18. Demand for RNs by Setting (Status Quo Scenario)**

| | Base Year | Projection Horizon for Comparison to Supply | | | |
|---|---|---|---|---|---|
| **Setting** | **2021** | **2022** | **2035** | **FTE Change** | **% Change** |
| **Hospital** | **30,080** | **30,120** | **32,420** | **2,300** | **8%** |
| Inpatient | 27,190 | 27,240 | 29,430 | 2,190 | 8% |
| Emergency | 2,890 | 2,880 | 2,990 | 110 | 4% |
| **Ambulatory** | **10,430** | **10,390** | **10,730** | **340** | **3%** |
| Outpatient | 7,720 | 7,680 | 7,860 | 180 | 2% |
| Office | 2,710 | 2,710 | 2,870 | 160 | 6% |
| **Long Term Care** | **6,330** | **6,400** | **8,160** | **1,760** | **28%** |
| Nursing Home | 1,190 | 1,200 | 1,700 | 500 | 42% |
| Residential Care | 1,420 | 1,440 | 2,110 | 670 | 47% |
| Home Health | 3,660 | 3,700 | 4,280 | 580 | 16% |
| Adult Day Service | 60 | 60 | 70 | 10 | 18% |
| **Other Settings** | **7,430** | **7,410** | **7,640** | **230** | **3%** |
| School | 1,370 | 1,370 | 1,400 | 30 | 2% |
| Academia | 550 | 550 | 550 | 0 | 0% |
| Public Health | 1,830 | 1,820 | 1,890 | 70 | 4% |
| All Other | 3,680 | 3,670 | 3,800 | 130 | 4% |
| **Total** | **54,270** | **54,320** | **58,950** | **4,630** | **9%** |

Source: Health Workforce Simulation Model Projections, GlobalData

Notes: Demand is based on national average levels of care and national average staffing patterns applied to Kentucky's resident population. Due to rounding, totals might not equal the sum of the components. Growth rates are calculated from the unrounded numbers.

## LPN Supply and Demand Projections

Of the 12,612 licensed LPNs, about a quarter (24%) are age 50 or older and thus are at high risk for leaving the workforce over the next decade (Exhibit 19). Focusing on the workforce under age 65 and looking at the reported primary employment status and location at the time of re-licensure, approximately:

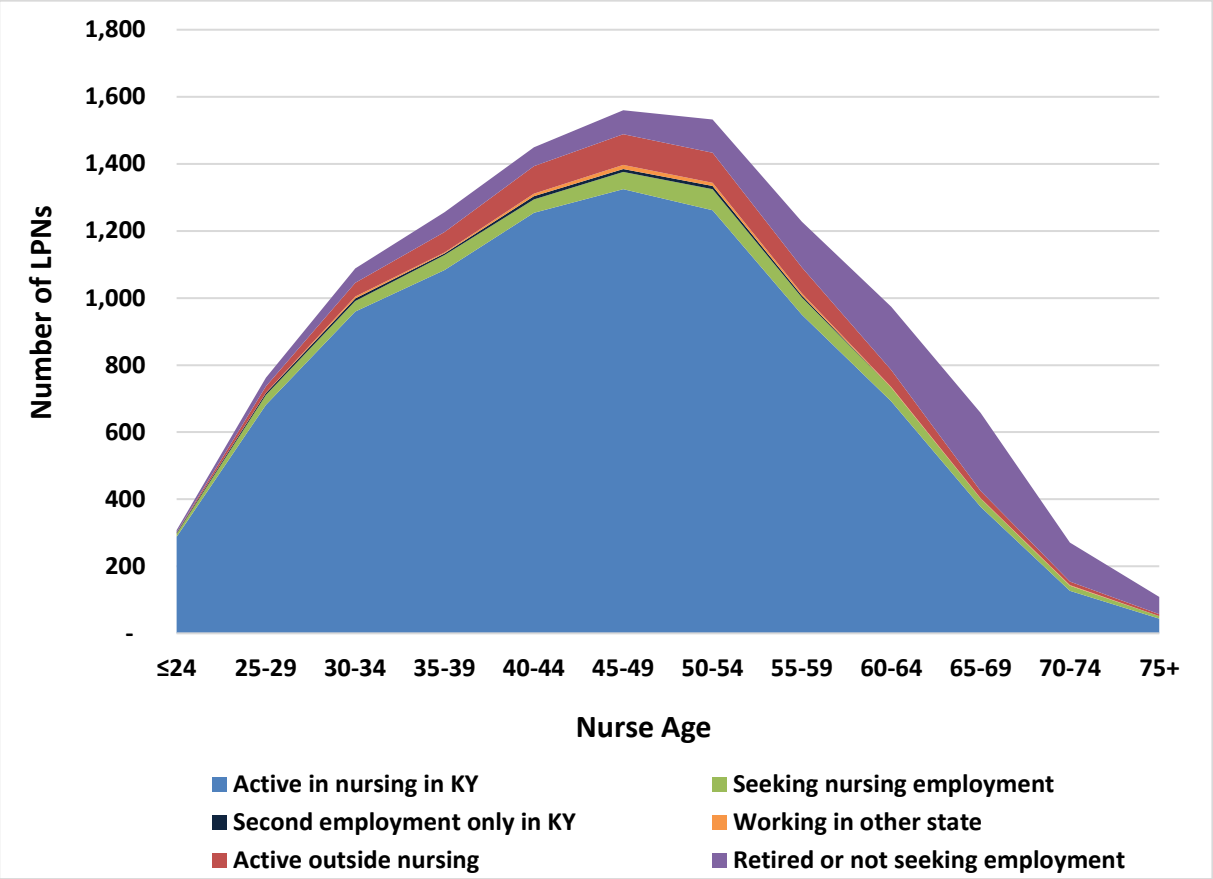
- 80% (9,120 LPNs) were active in nursing in Kentucky
- 5% (620 LPNs) were working in another state

- 6% (690 LPNs) were retired or not seeking employment
- 5% (530 LPNs) were active outside of nursing
- 3% (390 LPNs) were unemployed but seeking nursing employment

Among LPNs of all ages, there were 9,735 who reported working in a nursing position in Kentucky either as their primary employment or their secondary employment. For comparison, the Bureau of Labor Statistics estimates 9,320 filled LPN positions in May 2021 based on a survey of a sample of employers in Kentucky.[6]

Using responses on nurse employment and hours worked for nurses of all ages, we estimate supply of 10,330 FTEs in 2022 (including LPNs who are unemployed but seeking a nursing position).

**Exhibit 19. Labor Force Participation by LPN Age, 2022**




Source: Analysis of Kentucky Board of Nursing 2022 licensure and workforce survey data.

Comparing LPN supply (10,330) to demand (11,090) in 2022 indicates a shortfall of 760 FTEs to provide a national average level of care (Exhibit 20, Exhibit 24, Exhibit 26, and Exhibit 28). This shortfall means that Kentucky has about 93% of the supply to provide a national average level of care. For bedside nursing, the shortfall of LPNs (and the shortfall of other support staff discussed in a later section) exacerbates the shortfall of RNs by increasing workload on the existing nurse workforce. States with greater availability of LPNs can help offset a shortage of RNs by shifting some nursing activities to LPNs, but this option is less available to healthcare facilities in Kentucky.

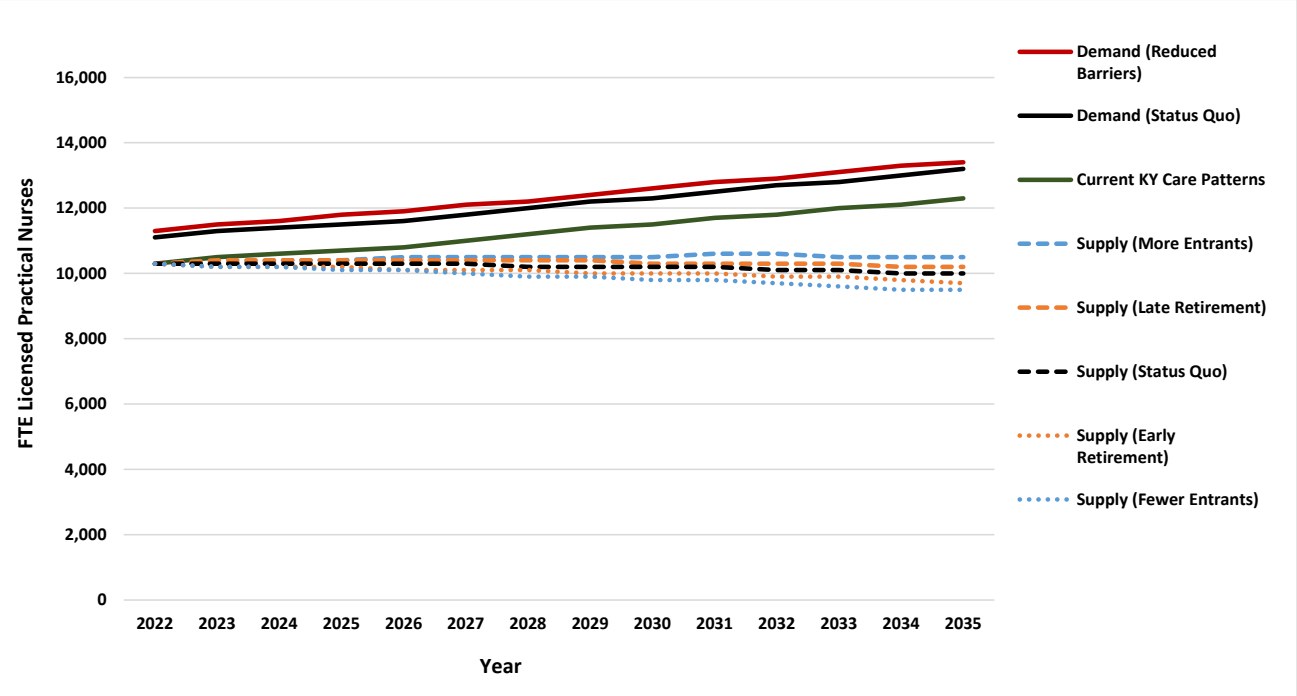
Projected supply of LPNs decreases over the projection period for most scenarios, with a 360 FTE (3%) decline projected under the *Status Quo* scenario (Exhibit 26). The decrease in supply over the projection period reflects that the LPN workforce is disproportionately older (thus, containing many nurses reaching retirement age over the period). Enrollment in LPN programs has been declining both nationally and in Kentucky; the National Council of State Boards of Nursing reports 685 first-time takers of the NCLEX-PN exam in Kentucky 2021, versus 1,172 first-time takers ten years earlier in 2011.[33,34] Under alternative scenarios modeled, LPN supply is expected to increase by 140 FTEs (1%) under the *10% More Entrants* scenario and decline by 880 FTEs (9%) under the *10% Fewer Entrants* scenario. Supply declines by 160 FTEs (2%) under the *Delayed Retirement* scenario and declines by 620 FTEs (6%) under the *Early Retirement* scenario.

As with the RN workforce, there is possibly greater likelihood that future supply will be lower than the *Status Quo* projections than future supply being above the *Status Quo* projections. Low growth in the population of adults age 18-44 means increased competition for labor of young adults, and high levels of burnout and attrition from the workforce hamper efforts to increase supply. Declines in the supply of LPNs could put further strains on the RN workforce.

The 11,090 FTEs required to provide a national average level of care is projected to increase to 13,160 FTEs (19%) by 2035. The *Reduced Barriers* scenario projects demand for 11,320 LPNs at baseline growing to 13,440 FTEs in 2035 (around 2% higher than under the *Status Quo* scenario).

The *Current KY Care Patterns* scenario starts with the current number of FTE LPNs employed in Kentucky and models the rate of demand growth as the population grows and ages. Comparing this scenario to *Status Quo* supply projections suggests that Kentucky is producing insufficient numbers of LPNs to even maintain its below-national-average level of care.

**Exhibit 20. LPN Supply and Demand Projections, 2021-2035**




Source: Health Workforce Simulation Model Projections, GlobalData

Demand for LPNs under the *Status Quo* scenario, by employment setting, is summarized in Exhibit 21. As with RNs, the 2022-2035 projected nurse FTE growth rates range from 2% for school health and outpatient care to 47% and 42% in the residential care and nursing home settings, respectively. Most of the growth will occur in long-term care settings (1,700 FTEs), with hospital-based demand projected to grow by 240 FTEs. To the extent that RN shortfalls persist, demand growth for LPNs in hospitals could be substantially larger than modeled under the *Status Quo* scenario as facilities re-design care delivery.

**Exhibit 21. Demand for LPNs by Setting (Status Quo Scenario)**

| | Base Year | Projection Horizon for Comparison to Supply | | | |
|---|---|---|---|---|---|
| **Setting** | **2021** | **2022** | **2035** | **FTE Change** | **% Change** |
| **Hospital** | **2,950** | **2,960** | **3,200** | **240** | **8%** |
| Inpatient | 2,950 | 2,960 | 3,200 | 240 | 8% |
| Emergency | <10 | <10 | <10 | NA | NA |
| **Ambulatory** | **1,880** | **1,880** | **1,960** | **80** | **4%** |
| Outpatient | 970 | 970 | 990 | 20 | 2% |
| Office | 910 | 910 | 970 | 60 | 6% |
| **Long Term Care** | **4,790** | **4,820** | **6,520** | **1,700** | **35%** |
| Nursing Home | 3,070 | 3,080 | 4,360 | 1,280 | 42% |
| Residential Care | 480 | 490 | 710 | 220 | 47% |
| Home Health | 1,210 | 1,220 | 1,410 | 190 | 16% |
| Adult Day Service | 30 | 30 | 40 | 10 | 18% |
| **Other Settings** | **1,440** | **1,430** | **1,480** | **50** | **3%** |
| School | 90 | 90 | 90 | 0 | 2% |
| Academia | <10 | <10 | <10 | NA | NA |
| Public Health | <10 | <10 | <10 | NA | NA |
| All Other | 1,350 | 1,340 | 1,390 | 50 | 4% |
| **Total** | **11,060** | **11,090** | **13,160** | **2,070** | **19%** |

Source: Health Workforce Simulation Model Projections, GlobalData

Notes: Demand is based on national average levels of care and national average staffing patterns applied to Kentucky's resident population. Due to rounding, totals might not equal the sum of the components. Growth rates are calculated from the unrounded numbers.

## Employment by Setting

The Bureau of Labor Statistics collects information from a sample of employers in May each year on the number of employed positions by occupation group. This data collection effort, the Occupational Employment and Wage Statistics (OEWS), provides useful insights when comparing how Kentucky employs nurses relative to the national patterns. As illustrated in Exhibit 22, Kentucky accounted for about 1.4% of the nation's filled RN positions and 1.4% of filled LPN positions. Because 1.4% of the US population resided in Kentucky in 2021, including 1.4% of the U.S. population age 65 or older, on the surface Kentucky appears to have a national average level of nurses as defined simply by a nurse-to-population ratio. However, such an observation does not account for characteristics of the population in Kentucky. As illustrated previously in Exhibit 8, Kentucky has much higher prevalence of disease, smoking, and obesity relative to the national average. Hence, one would expect greater per capita use of healthcare services for people in Kentucky and thus greater demand for nursing care.

Looking at the distribution of RNs across employment settings, patterns were similar for Kentucky and the nation with marginal differences across the various employment settings. The employment distribution for LPNs shows a higher degree of variation compared to the national distribution. The use of LPNs across employment settings indicates 8% of Kentucky's filled LPN positions were in provider offices, compared to 13% of the nation's filled LPN positions. Approximately 23% of filled LPN

positions in Kentucky are in hospitals, while at the national level, this is 15%. The OEWS data are collected from a quarterly sample of employers in Kentucky. The sample size is not reported so the variation across settings for LPNs could be due to small sample size in the OEWS survey. KHA reports from their own survey that there are about 1300 LPNs employed in hospitals (versus the 2,100 number of filled jobs estimated by BLS).

The overall RN-to-LPN ratio in Kentucky in May 2021 was identical to the national ratio at 4.8:1. Within hospitals, which are more RN intensive than other settings, the ratio was 12.8 for Kentucky and 19.9 for the nation. In Kentucky nursing homes there are 0.7 RNs per LPN, the same as the national average.

### Exhibit 22. Kentucky versus National Patterns of Employing Nurses, 2021

| | Setting Distribution of Nurses | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Office | Outpatient | Hospital | Home Health | Nursing Home | Residential Care | School Health | Academia | Other | Total |
| **KY Employment** | | | | | | | | | | |
| **RNs** | 2,650 | 2,670 | 26,910 | 2,290 | 2,390 | 210 | 600 | 120 | 5,490 | 43,330 |
| **LPNs** | 760 | 290 | 2,100 | 450 | 3,360 | 630 | <30 | <30 | 1,450 | 9,040 |
| **KY % of US Nurses** | | | | | | | | | | |
| **RNs** | 1.2% | 1.6% | 1.4% | 1.3% | 1.8% | 0.4% | 1.0% | 0.5% | 1.5% | 1.4% |
| **LPNs** | 0.9% | 0.8% | 2.2% | 0.5% | 1.9% | 1.1% | 0.0% | 0.0% | 1.7% | 1.4% |
| **RN Distribution** | | | | | | | | | | |
| **Kentucky** | 6% | 6% | 62% | 5% | 6% | 0% | 1% | 0% | 13% | 100% |
| **National** | 7% | 5% | 61% | 6% | 4% | 2% | 2% | 1% | 12% | 100% |
| **LPN Distribution** | | | | | | | | | | |
| **Kentucky** | 8% | 3% | 23% | 5% | 37% | 7% | 0% | 0% | 16% | 100% |
| **National** | 13% | 6% | 15% | 14% | 28% | 9% | 2% | 1% | 13% | 100% |
| **RN:LPN Ratio** | | | | | | | | | | |
| **Kentucky** | 3.5 | 9.2 | 12.8 | 5.1 | 0.7 | 0.3 | NA | NA | 3.8 | 4.8 |
| **National** | 2.5 | 4.4 | 19.9 | 1.9 | 0.7 | 0.9 | 5.2 | 6.7 | 4.3 | 4.8 |

Source: Bureau of Labor Statistics, May 2021 Occupational Employment and Wage Statistics. Information for Kentucky is based on a sample of employers in Kentucky, and information for the U.S. is based on a sample of employers across the U.S.

# Discussion

Kentucky is experiencing many of the same nurse workforce challenges being experienced by states in the region and reported throughout the U.S. One key differentiator is that Kentucky recently implemented a robust data collection system that provides the state with information to inform workforce planning. Most states collect a minimal amount of information required to ensure the nurse is licensed and eligible to work in the state. Starting in 2022, Kentucky's Board of Nursing required nurses to complete a brief survey as part of the license renewal process. The survey collects information on labor force participation status, work location, nursing setting and position, average hours worked, and retirement intentions.

In recognition of the nurse workforce challenges experienced in Kentucky hospitals, the Kentucky Hospital Association commissioned this study to quantify the degree of shortfall, develop projections of future supply and demand, and inform actions that could help alleviate the shortfall. The Kentucky Board of Nursing provided access to de-identified licensure data with their recent survey data to help inform this analysis. This study combined data analysis, computer simulation, and focus groups with nurses and nurse educators to understand the current challenges within nursing and what might happen in the future under different modeled scenarios. This section summarizes key findings and implications, and study strengths and limitations.

## Key Findings and Implications

Kentucky currently faces substantial challenges with ensuring sufficient supply of nurses, and these challenges are projected to continue through 2035. Key findings include the following:

- The state's projected demographics are unfavorable to solving Kentucky's nurse workforce challenges. The population of Kentucky is expected to grow 3.1%, or about 141,000 residents between 2022 through 2035. Most of this growth is driven by a 116,000 (38.3%) increase in the size of the population aged 75 and older and a 14,000 (2.9%) increase in the population aged 65 to 74. Growth in the size of these populations will spur rapid growth in demand for nursing services. At the same time, the traditional working age population (aged 18 to 64) is projected to decline by 6,000 (-0.2%). The population aged 18-44 has projected growth of 63,000 (4.0%), offset by population decline of 69,000 (-6.0%) adults aged 45-64. While growth in the number of younger adults could contribute to growth in number of new nurses, the large decline in the aged 45-64 population portends fewer experienced nurses in the workforce.
- In 2022, RN supply (48,130) fell 6,190 short of estimated demand (54,320). This shortfall only marginally improves to a 5,790 deficit by 2035 under the *Status Quo* scenarios.
    - Many of the 64,642 RNs licensed in Kentucky are not working as a nurse in Kentucky, with many of the nurses age 65 and older report being retired. Among those under age 65, only 44,730 (78%) were active in nursing in Kentucky. Another 6,800 of these nurses under age 65 report working in another state, 3,170 report that they were retired or are not seeking nursing employment, 1,410 report working in a non-nursing position, and 1,200 report being unemployed but seeking nursing employment. Calculated FTE supply takes into account reported weekly hours worked.
    - RN supply is projected to grow by 5,030 (10%) between 2022 and 2035 reaching 53,160 FTEs. However, with high levels of burnout among the health workforce and a recent

drop in applicants to nursing programs, there is greater likelihood that supply will be below 53,160 than the likelihood that supply will exceed this level.

- To provide a national average level of care in 2022, Kentucky would require 54,320 FTE RNs. The demand estimate takes into account the demographics of Kentucky's population, higher than national average prevalence of disease and other health risk factors, and socioeconomic factors. This 6,190 RN shortfall suggests that supply is sufficient to meet 89% of demand. To the extent that the national average is inadequate, given estimates of high rates of vacancies and high levels of nurse burnout across the nation, the shortfall could exceed this 6,190 RN estimate.
- RN demand growth between 2022 and 2035 is about 4,630 FTEs (9%) reaching 58,950 FTEs. About half (2,300) of this demand growth will be in hospitals, about 38% (1,760) will be in long-term-care settings, and the remainder will be in ambulatory and other settings where nurses provide care. Kentucky will make no appreciable improvement over the thirteen year period because, by 2035, the 5,790 shortfall means that supply will be sufficient to meet only about 90% of the level required to provide a current average national level of care. Increasing the number of new RNs entering the Kentucky workforce or interventions that delay retirement could help reduce the future shortfall, while reduced numbers of new entrants or earlier retirement could exacerbate the shortfall.
- Increasing the annual number of newly licensed RNs by about 21% (630 nurses) relative to current levels could close the gap by 2035. However, increasing RN supply adequacy likely will require a combination of efforts to increase the pipeline of new nurses, improve retention of the existing nurse workforce, and implement new technologies or models of care that better leverage RN resources.

- In 2022, Kentucky's LPN FTE supply (10,330) fell 760 short of estimated demand (11,090). This shortfall worsens to a 3,190 deficit by 2035.
  - Of the 12,612 LPNs licensed in Kentucky, only 9,735 report working in a nursing position in Kentucky (either as their primary employment or their secondary employment). Focusing on LPNs under age 65, 9,120 (80%) were active in nursing in Kentucky. Another 690 report being retired or not seeking employment, 620 report working in another state, 530 report being active outside of nursing, and 390 report being unemployed but seeking nursing employment.
  - LPN supply is projected to decline by 360 FTEs (-3%) to 9,970 in 2035. Contributors to this decline include slowing numbers of applicants to LPN programs in recent years, and an older workforce that will lose many LPNs to retirement or career change (with some LPNs becoming RNs).
  - To provide a national average level of care in 2022, Kentucky would require 11,090 FTE LPNs. This 760 shortfall suggests that supply is sufficient to meet 93% of demand.
  - LPN demand growth between 2022 and 2035 is about 2,070 FTEs (19%) reaching 13,160 FTEs. The supply of LPNs to meet patient needs will worsen over the thirteen years. By 2035, the 3,190 shortfall means that supply will be sufficient to meet only about 76% of the level required to provide a current average national level of care. A growing shortfall of LPNs will place even greater pressures on the RN workforce.

  - Increasing the annual number of newly licensed LPNs by about 63% (370 nurses) relative to current levels could close the gap by 2035. However, increasing LPN supply adequacy likely will require a combination of efforts to increase the pipeline of new nurses, improve retention of the existing nurse workforce, and redesign how care is delivered. Increasing new entrants to the LPN workforce could have a future positive benefit on RN supply, as some LPNs will further their career in nursing and become an RN.

- A disproportionate number of younger nurses are working in hospital units that historically have been filled by more experienced nurses. This includes critical care units, emergency/trauma units, and other hospital units A steady supply of younger nurses who can handle the physical demands of bedside nursing during a 12-hour shift, under the supervision of experienced nurses, appears vital to ensuring sufficient numbers of bedside nurses.

- Focus groups with nurses and nurse educators corroborate the empirical findings, that Kentucky faces significant challenges with attracting people into a nursing career and retaining its current nurse workforce. The COVID-19 pandemic exacerbated these challenges, with average patient acuity rising while nurses are being asked to care for more patients. A shortage of support personnel (particularly respiratory therapists, nurse aides, phlebotomists, emergency medical technicians, and other occupations) places additional pressures on nurses who find themselves performing the additional tasks often delegated to others.

## Study Strengths and Limitations

The study approach and data used have many strengths. The microsimulation models used to produce the supply and demand projections have been developed and refined for over 10 years and have been documented in peer-reviewed journals and presented at national conferences. The results of these models have been trusted for both health workforce and strategic planning by the federal government and state governments, hospitals and health systems, healthcare associations, and other stakeholders.

Where possible, Kentucky-specific data sources are used as modeling inputs. For supply modeling, the main source is licensure data obtained from KBN that includes information on the nurse supply in 2022, and the number and characteristics of newly licensed nurses, labor force participation status, retirement expectations, and weekly hours worked. For demand modeling, Kentucky-specific data are used to provide population characteristics (e.g., demographics, disease and health behavior prevalence, and socioeconomic information) by county, as well as information regarding the expected size and demographics of the future population.

Continued efforts in improving data collection must be a part of improving estimates and projections. A key theme in the Institute of Medicine (IOM) 2010 report on the future of nursing is that “Effective workforce planning and policy making require better data collection and an improved information infrastructure.”[37] Recent actions by the Kentucky Board of Nursing to collect nurse workforce data as part of the annual licensure renewal process has made Kentucky a leader in collecting information to provide a clear picture of the current nurse workforce for use in workforce planning. Very few states collect the quality of data that is now being collected by Kentucky. The next step to improving the information infrastructure is to create a longitudinal research database that links 2022 survey response to responses in 2023 and beyond. Such data will provide valuable information on career pathways and inform activities to help attract and retain nurses at the bedside.

Modeling and projecting into the future involve simplifying assumptions and data limitations that preclude perfect precision in forecasting. Even with careful optimization of models, data, and study approach employed, the results must be interpreted within the context of necessary limitations. Study limitations reflect both data gaps and uncertainty of care use and delivery patterns, as well as how nurse career decisions might change in the future. Key limitations are the following:

**Margin of error.** Given the nature of modeling and forecasting, all projections have some degree of imprecision. As a general rule, if supply is within ±5% of demand, then one might conclude the labor market is essentially in equilibrium. Imprecision arises because generalizations must be made. Data regarding healthcare use, health risk factors, healthcare provider hours worked per week, healthcare provider productivity, and other important modeling parameters are unavailable at local levels and must be estimated with national values.

**Workforce implications resulting from COVID-19 are still unclear.** The pandemic is still ongoing and it is impossible to know with certainty what workforce implications will arise as a result. COVID-19 may change amounts of demand (e.g., due to increased healthcare needs of people with "long COVID"), and/or affect the way care is delivered (e.g., increased use of telehealth). Likewise, COVID-19 might have long-term implications on health workforce supply. The supply scenarios modeled reflecting early and delayed retirement, as well as increased and decreased new entrants, may provide insights into the potential effects of possible long-term pandemic-related changes to retirement and new entrants. Many of the early effects of the pandemic—e.g., nurses leaving the workforce, and excess mortality—are incorporated into modeling inputs with a 2022 initial forecasting year for nurse supply.

**National data are used to fill gaps in Kentucky-specific data.** National data sources are used for demand modeling to provide information regarding population healthcare use patterns as well as nurse staffing patterns. To the extent that the Kentucky population uses services at a different rate than the national average or Kentucky providers staff health workers at levels different from the national average, error may be introduced into Kentucky health workforce supply and demand projections. With reports that across the nation that hospital vacancy rates for nurses are high and there are high levels of nurse burnout, the national average likely understates what might be a more optimal level of nurse staffing. Consequently, the nurse shortage estimates in this report might understate the true gap between supply and demand.

**Substitution between RNs, LPNs, and other health workers must be considered.** In areas facing a shortage of RNs, providers may be able to employ LPNs to help address staffing needs by shifting some duties. When a shortfall of LPNs and other support workers exists, RNs might be tasked with filling additional duties that otherwise would have been provided by these support staff. While adequacy of RN supply and LPN supply are projected separately, the combined information conveyed in projections for both professions provides a more complete picture of the state's nursing workforce.

**Newly trained and experienced workers differ in their productivity.** Employing average productivity patterns to all nurses conceals productivity differences between experienced individuals and newer entrants. Thus, overall supply adequacy summaries can mask shortfalls in key areas that require specific experience—such as nursing in intensive care units, or mentoring roles.

**Demand projections model the continuation of baseline levels of healthcare use and delivery patterns.** Projections into the future do not capture shifts in factors such as technological innovations, national or state-level health policies, patient preferences, or payer or provider policies that change the way care is consumed or delivered. Patterns will continue to evolve over time, but in ways that cannot be known at the time of the modeling. For example, if the pandemic has accelerated the trend of shifting

hospital care from inpatient to outpatient settings, any staffing implications due to this acceleration would not be accounted for in the projections reported here. Similarly, increased use of telemedicine services, more rigorous discharge planning and other changes to the way care is delivered due to the pandemic may not factor into the projections. Recently published work on the physician workforce indicates that some components of an evolving care delivery system increase demand for healthcare services (e.g., increased access to care), other components decrease demand (e.g., increased emphasis on preventive care), and some components simply redirect care (e.g., from inpatient care to appropriate ambulatory settings).[17] Thus, the net effect of evolving care delivery on demand might be small.

**The numbers of new entrants entering the health workforce annually are assumed to be constant over the projection period.** The *Status Quo* supply scenario models the implications if the number of individuals entering the workforce remains constant over time. The scenario does not allow for market forces that help correct surpluses and shortages over time. Rather, this scenario helps inform policies to increase the education pipeline of new entrants being trained. If the Kentucky nurse workforce shortage becomes too severe relative to national levels, the increased job opportunities could increase the net inflow of nurses from other states.

Despite these limitations, the workforce projections presented offer best estimates given the information available. Understanding that a shortfall of nurses will persist over the foreseeable future can inform nurse workforce planning, as well as highlight career opportunities for people considering nursing as a career. Nurse workforce modeling aids in determining whether existing workforce programs and policies are producing a sufficient supply of nurses to provide patients with access to high quality care. In light of the limitations described and an ever-changing healthcare system, workforce projections should be updated periodically to use the most current data and other updated information.

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# Appendix: Additional Tables

### Exhibit 23. Registered Nurse Status Quo Scenarios for Supply, Demand, and Supply Adequacy, 2022-2035

| Year | Supply | Demand[a] | Adequacy (#)[a] | Adequacy (%)[b] |
|---|---|---|---|---|
| **2022** | 48,130 | 54,320 | -6,190 | 89% |
| **2023** | 48,530 | 54,720 | -6,190 | 89% |
| **2024** | 49,030 | 55,090 | -6,060 | 89% |
| **2025** | 49,530 | 55,480 | -5,950 | 89% |
| **2026** | 49,950 | 55,820 | -5,870 | 89% |
| **2027** | 50,430 | 56,250 | -5,820 | 90% |
| **2028** | 50,850 | 56,620 | -5,770 | 90% |
| **2029** | 51,220 | 57,070 | -5,850 | 90% |
| **2030** | 51,610 | 57,460 | -5,850 | 90% |
| **2031** | 51,980 | 57,780 | -5,800 | 90% |
| **2032** | 52,350 | 58,070 | -5,720 | 90% |
| **2033** | 52,640 | 58,370 | -5,730 | 90% |
| **2034** | 52,890 | 58,670 | -5,780 | 90% |
| **2035** | 53,160 | 58,950 | -5,790 | 90% |

Note: [a] FTEs required to provide a 2021 national average level of care applied to Kentucky's population in 2022 adjusting for demographics, disease prevalence, and select other determinants of care. [b] Adequacy of 100% equates to the national average.

### Exhibit 24. Licensed Practical Nurse Status Quo Scenarios for Supply, Demand, and Supply Adequacy, 2022-2035

| Year | Supply | Demand[a] | Adequacy (#)[a] | Adequacy (%)[b] |
|---|---|---|---|---|
| **2022** | 10,330 | 11,090 | -760 | 93% |
| **2023** | 10,290 | 11,260 | -970 | 91% |
| **2024** | 10,280 | 11,370 | -1,090 | 90% |
| **2025** | 10,290 | 11,510 | -1,220 | 89% |
| **2026** | 10,280 | 11,610 | -1,330 | 89% |
| **2027** | 10,280 | 11,800 | -1,520 | 87% |
| **2028** | 10,240 | 11,980 | -1,740 | 85% |
| **2029** | 10,210 | 12,190 | -1,980 | 84% |
| **2030** | 10,190 | 12,320 | -2,130 | 83% |
| **2031** | 10,170 | 12,500 | -2,330 | 81% |
| **2032** | 10,130 | 12,670 | -2,540 | 80% |
| **2033** | 10,080 | 12,840 | -2,760 | 79% |
| **2034** | 10,020 | 13,000 | -2,980 | 77% |
| **2035** | 9,970 | 13,160 | -3,190 | 76% |

Note: [a] FTEs required to provide a 2021 national average level of care applied to Kentucky's population in 2022 adjusting for demographics, disease prevalence, and select other determinants of care. [b] Adequacy of 100% equates to the national average.

## Exhibit 25. Registered Nurse Supply and Demand Growth and Adequacy by Scenario

| Scenario | 2022 | 2035 | Growth | % Growth |
|---|---|---|---|---|
| **Demand** | | | | |
| ***Status quo***[a] | 54,320 | 58,950 | 4,630 | 9% |
| ***Reduced barriers*** | 55,400 | 60,360 | 4,960 | 9% |
| **Supply** | | | | |
| ***Status quo*** | 48,130 | 53,160 | 5,030 | 10% |
| ***10% Fewer Entrants*** | 48,130 | 50,300 | 2,170 | 5% |
| ***10% More Entrants*** | 48,130 | 55,990 | 7,860 | 16% |
| ***Early Retirement*** **(2 years earlier)** | 48,130 | 51,570 | 3,440 | 7% |
| ***Delayed Retirement*** **(2 years later)** | 48,130 | 54,590 | 6,460 | 13% |
| **Supply Adequacy vs. *Status Quo* Demand**[a] | | | | |
| ***Status quo*** | -6,190 | -5,790 | | |
| ***10% Fewer Entrants*** | -6,190 | -8,650 | | |
| ***10% More Entrants*** | -6,190 | -2,960 | | |
| ***Early Retirement*** **(2 years earlier)** | -6,190 | -7,380 | | |
| ***Delayed Retirement*** **(2 years later)** | -6,190 | -4,360 | | |
| **Supply Adequacy vs. *Reduced Barriers* Demand** | | | | |
| ***Status quo*** | -7,270 | -7,200 | | |
| ***10% Fewer Entrants*** | -7,270 | -10,060 | | |
| ***10% More Entrants*** | -7,270 | -4,370 | | |
| ***Early Retirement*** **(2 years earlier)** | -7,270 | -8,790 | | |
| ***Delayed Retirement*** **(2 years later)** | -7,270 | -5,770 | | |

Note: [a] FTEs required to provide a 2021 national average level of care applied to Kentucky's population in 2022 adjusting for demographics, disease prevalence, and select other determinants of care.

**Exhibit 26. Licensed Practical Nurse Supply and Demand Growth and Adequacy by Scenario**

| Scenario | 2022 | 2035 | Growth | % Growth |
|---|---|---|---|---|
| **Demand** | | | | |
| ***Status quo***[a] | 11,090 | 13,160 | 2,070 | 19% |
| ***Reduced barriers*** | 11,320 | 13,440 | 2,120 | 19% |
| **Supply** | | | | |
| ***Status quo*** | 10,330 | 9,970 | -360 | -3% |
| ***10% Fewer Entrants*** | 10,330 | 9,450 | -880 | -9% |
| ***10% More Entrants*** | 10,330 | 10,470 | 140 | 1% |
| ***Early Retirement*** **(2 years earlier)** | 10,330 | 9,710 | -620 | -6% |
| ***Delayed Retirement*** **(2 years later)** | 10,330 | 10,170 | -160 | -2% |
| **Supply Adequacy vs. *Status Quo* Demand**[a] | | | | |
| ***Status quo*** | -760 | -3,190 | | |
| ***10% Fewer Entrants*** | -760 | -3,710 | | |
| ***10% More Entrants*** | -760 | -2,690 | | |
| ***Early Retirement*** **(2 years earlier)** | -760 | -3,450 | | |
| ***Delayed Retirement*** **(2 years later)** | -760 | -2,990 | | |
| **Supply Adequacy vs. *Reduced Barriers* Demand** | | | | |
| ***Status quo*** | -990 | -3,470 | | |
| ***10% Fewer Entrants*** | -990 | -3,990 | | |
| ***10% More Entrants*** | -990 | -2,970 | | |
| ***Early Retirement*** **(2 years earlier)** | -990 | -3,730 | | |
| ***Delayed Retirement*** **(2 years later)** | -990 | -3,270 | | |

Note: [a] FTEs required to provide a 2021 national average level of care applied to Kentucky's population in 2022 adjusting for demographics, disease prevalence, and select other determinants of care.

### Exhibit 27. RN Shortfall and Supply Adequacy by Scenario, 2022-2035

| Year | SQ Demand vs SQ Supply | SQ Demand vs SQ Early Retirement Supply | SQ Demand vs SQ Delayed Retirement Supply | SQ Demand vs 10% Fewer Entrants Supply | SQ Demand vs 10% More Graduates Supply | Reduced Barriers Demand vs SQ Supply |
|---|---|---|---|---|---|---|
| | Full-Time Equivalents (shortfall) | | | | | |
| **2022** | -6,190 | | | | | -7,270 |
| **2025** | -5,950 | -6,730 | -5,200 | -6,790 | -5,110 | -7,100 |
| **2030** | -5,850 | -7,190 | -4,620 | -7,820 | -3,910 | -7,130 |
| **2035** | -5,790 | -7,380 | -4,360 | -8,650 | -2,960 | -7,200 |
| | Supply Percent Adequacy | | | | | |
| **2022** | 89% | | | | | 87% |
| **2025** | 89% | 88% | 91% | 88% | 91% | 87% |
| **2030** | 90% | 87% | 92% | 86% | 93% | 88% |
| **2035** | 90% | 87% | 93% | 85% | 95% | 88% |

Notes: SQ refers to the modeled *Status Quo* scenarios. For supply this scenario models the continuation of current numbers of new entrants and labor force participation patterns. For demand this scenario models the continuation of current patterns of care use and delivery. Additional supply scenarios model ± 10% change in annual number of new nurses entering the workforce, and ± 2 year shift in retirement patterns. An additional demand scenario models reducing barriers to accessing care.

### Exhibit 28. LPN Shortfall and Supply Adequacy by Scenario, 2022-2035

| Year | SQ Demand vs SQ Supply | SQ Demand vs SQ Early Retirement Supply | SQ Demand vs SQ Delayed Retirement Supply | SQ Demand vs 10% Fewer Entrants Supply | SQ Demand vs 10% More Graduates Supply | Reduced Barriers Demand vs SQ Supply |
|---|---|---|---|---|---|---|
| | | Full-Time Equivalents (shortfall) | | | | |
| **2022** | -760 | | | | | -990 |
| **2025** | -1,220 | -1,340 | -1,150 | -1,380 | -1,060 | -1,460 |
| **2030** | -2,130 | -2,340 | -1,990 | -2,500 | -1,780 | -2,400 |
| **2035** | -3,190 | -3,450 | -2,990 | -3,710 | -2,690 | -3,470 |
| | | Supply Percent Adequacy | | | | |
| **2022** | 93% | | | | | 91% |
| **2025** | 89% | 88% | 88% | 88% | 91% | 88% |
| **2030** | 83% | 81% | 80% | 80% | 86% | 81% |
| **2035** | 76% | 74% | 72% | 72% | 80% | 74% |

Notes: SQ refers to the modeled *Status Quo* scenarios. For supply this scenario models the continuation of current numbers of new entrants and labor force participation patterns. For demand this scenario models the continuation of current patterns of care use and delivery. Additional supply scenarios model ± 10% change in annual number of new nurses entering the workforce, and ± 2 year shift in retirement patterns. An additional demand scenario models reducing barriers to accessing care.