# Preliminary Report: UUP Health Care Study
# Ohio Department of Development

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## Part One:
## Analylsis of Trend Data--Health Care Component

### Historical Trends

The history of health issues in the state of Ohio follows national trends. There have been several dramatic changes in American health care over the course of this century. The availability of health care to different groups in the population has also changed. Again, the state of Ohio has followed the general pattern found in the United States. Characteristics of this pattern include, lower general death rates, reduced infant mortality rates, increased life expectancy, and shifts in the relative importance of the different causes of death. One of the most often-used health indicators is the principal causes of death statistic in the population. In Ohio, as in the rest of the country, we see the major shift in leading causes of death from infectious illnesses at the turn of the last century, to illness with some behavioral etiology at the turn of this century.

Looking at data for the state of Ohio since 1910, we see that in the first decade of this century tuberculosis was the major cause of death and four of the ten leading causes of death, tuberculosis, pneumonia, diarrhea and enteritis, Bright's disease/nephritis, and typhoid fever were related to infectious illness. Data from 1923 show that the three leading causes of death, heart disease, cancer, and stroke head the list for the first time. The 1923 data also show that the influenza pandemic at the close of World War I continued to have a major impact on the health of Ohioans as well. By 1940 although heart disease continued as the leading cause of death in the state, three of the top ten causes of death still were infectious illnesses. By 1960 only one of the top ten causes of death in Ohio was an infectious illness while the other nine leading causes

**Table 1: Rankings of the Principal causes of death in Ohio 1910-990**

| | 1910 | 1923 | 1930 | 1940 | 1950 | 1960 | 1970 | 1980 | 1990 | 1997 |
|---|---|---|---|---|---|---|---|---|---|---|
| Heart Disease | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Cancer | 6 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Stroke | 7 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Accidents | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 7 |
| Pneumonia and Influenza1950* | 3 | 7 | 6 | 6 | 7 | 7 | 5 | 6 | | 6 |
| Tuberculosis | 1 | 4 | 7 | 7 | 9 | | | | | |
| Influenza1923** Congenital1930+ | | 9 | | | 10 | 9 | | | | |
| Diarrhea | 4 | 10 | 10 | | | | | | | |
| Nephritis | 8 | 6 | 5 | 5 | | | | | 8 | 8 |
| Typhoid1910*** Suicide 1930+ | 10 | | | | | | | 9 | 7 | 9 |
| COPD | | | | | | | 9 | 5 | 4 | 4 |
| Diabetes | | | | 9 | 8 | 8 | 6 | 7 | 6 | 5 |
| Cirrhosis | | | | | | 10 | 10 | 10 | 10 | 10 |
| Infant disease | 9 | 8 | 8 | 8 | 5 | 5 | 7 | | | |
| Arteriosclerosis | | | 9 | 10 | 6 | 6 | 8 | 8 | 9 | |

*Influenza was added to the Pneumonia category by the State Department of Health in 1950.
** This row includes influenza deaths in 1910 and 1923, and congenital defects since 1930.
*** This row represents typhoid in 1910 and suicide since 1930.

of death were non-infectious illnesses. To varying degrees, life-style or behavioral factors have contributed significantly to nine of the top ten leading causes of death in the state since 1960. The eradication of infectious illness was due, in large measure, to the development of antibiotics and to major advances in public health. These public health practices included large-scale vaccination of the population against viral and bacterial diseases.

In addition to the rankings of the causes of death, there have been substantial changes in the rates of death per 100,000 people in the state as well as demonstrated in Figure 1. In 1910 the overall rate of death for Ohioans was 1376.2 per 100,000 people. By 1960 the overall death rate among Ohioans had dropped dramatically to 960 per 100,000 people. This drop represents the eradication of infectious illness and some significant drops in the rate of accidental deaths in the state between 1910 and 1960. By 1990 the death rate had dropped to 910 per 100,000 but today (1997) the death rate is 970 per 100,000 people. From 1960 to 1990 the death rate dropped significantly but at a much slower rate. This Ohio trend parallels national patterns. Zopf attributes the drop since 1960 to improvements in health care among the elderly population that occurred with the introduction of Medicare and decreasing poverty rates among the elderly population.[1]

The changes in the percent of all death in the state that are attributed to each of the major causes of death are presented in Figure 2. Close inspections of death rates themselves in Figure 1 and the percent of total deaths in Figure 2 demonstrate that from 1923 to 1990, coronary heart disease, cancer, and stroke have claimed the lives of most Ohioans. Since public records have been kept on causes of death, heart disease has been one of the top three leading causes of death and it has led the list of causes of death since 1920. There have been some dramatic shifts however, in the rate of deaths due to coronary heart disease over the past seventy-five years. In the 1920’s the rate of death due to heart disease was about twice the rate of death due to apoplexy (cerebral hemorrhage, or stroke). By 1930, cancer (malignant neoplasms) had replaced apoplexy

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1. Zopf, P.E. *Mortality Patterns and Trends in the United States*. Greenwood Press, Connecticut, 1992, pp.59-68.

Figure 1 Rates of death per 100,000 population in Ohio 1910-1990

Figure 2 Percentage of total deaths in Ohio 1910-1997 as the second most common cause of death behind heart disease. Death rates for heart disease remained about two times greater (227 per 100,000) that the rates for cancer (106 per 100,000), apoplexy (105 per 100,000), and accidents (101 per 100,000). The heart disease rates increased dramatically with respect to the other causes of death throughout the mid part of the century. By 1970 the death rate from heart disease was 371 per 100,000 while the cancer death rates was 167 per 100,000. A similar pattern was found in 1980. In Ohio the overall rates of heart disease deaths have decreased in the past 20 years as cancer rates have increased. In 1990 the death rate for heart disease was 319 per 100,000 while that for cancer had climbed to 223 per 100,000. Nationally, although it remains the leading cause of death in the country, there has been a dramatic decrease in the rate of death from coronary heart disease. This decrease is due to establishment of coronary care units, the provision of emergency medical services in our communities and public health campaigns to lower risk factors for coronary heart disease. This data also shows a dramatic decrease in the rate of accidental deaths in the state since 1940 although accidents remained as the fourth leading cause of death in 1990.

With respect to our neighboring states, Zopf's state-by-state comparison [2] of total age-adjusted mortality rates for men and women published in 1992 shows that Ohio is very similar to its neighboring states. For men in Ohio, death rates are similar to all of our neighboring midwestern states, Pennsylvania, Michigan, and Indiana. Kentucky and West Virginia, states on the southern border of Ohio have significantly higher mortality rates. Only the western North Central states of Wisconsin and Minnesota have significantly lower death rates for men. The picture for women in Ohio is very similar to the one for men. Death rates for women in Ohio are the same as they are in Pennsylvania and Indiana. Death rates for women in the southern border

2. Ibid. pp.55-59

states of Kentucky and West Virginia are much higher than Ohio following the same pattern as seen for men. The only difference is that women in Michigan, Ohio's northern neighbor are much higher in the same category as those for Kentucky and West Virginia. As was true for men, age-adjusted death rates for women in the western North Central States of Wisconsin and Minnesota are among the lowest in the midwestern region.

## Emerging trends

The examination of mortality data in the state of Ohio raises several key issues for health care in the state. The first has to do with demographic shifts among subgroups of the population of the state and the second with access of different groups in the population to health care providers. We know from studies of national mortality data that decreases in overall mortality are related to increases in geriatric populations. In this type of epidemiological setting, where infectious illnesses are well controlled for the most part, medical technology, and access to that technology, are significant factors in the health of the population. In Ohio we have also seen some dramatic demographic shifts in the state's urban areas. Population groups have moved from rural to central urban areas in the early part of the century. The middle of this century saw migration of different groups to first ring suburban areas. This type of outward movement has continued to second ring and third ring suburban areas - and in some areas back into the urban core - at the end of the century.

Access of people to health care services is the second key issue that affects the general state of health of Ohioans. Similar to the demographic shifts in the population, have been the shifts in financial access to health care in this century. The first half of the century saw a shift from a simple direct fee for service model to a dramatic increase in private insurance reimbursement based health care. This private insurance was usually provided to people as an employment benefit. There has been a major shift in the last part of this century from private insurance reimbursement of fees for health care services to managed care systems. We see that managed care systems provide financial access to health care for about half of employed people in the state. Financial access to health care for the elderly and for poverty groups is primarily provided through government reimbursement programs. But a rapidly increasing number of people in our state have no financial access to health care services. They have no access to either private insurance, managed care, or government reimbursement programs. These groups are the uninsured and the working poor.

This analysis of health care in Ohio in this study uses both the changing demographics and access issues in a unique way and examines health trends in Ohio with respect to spatial access of people to health care providers. The study examines changes in the number of hospital beds in different categories in the state from 1980 to 1997. Details of the methodology are found in Part Three of this report. The focus of this analysis is Ohio's urban, metropolitan areas.

## Trend data found in the current study

### A. Trends in the sixteen cities

An analysis of the distribution of hospital beds in the sixteen cities examined in this study show some interesting patterns. First, overall in the state of Ohio, the number of hospital beds has decreased from 1980 to 1997. Looking at the four major categories of types of hospital beds in the sixteen Ohio cities studied, demonstrates that despite the overall decrease in the number of hospital beds, the numbers of some types of hospital beds have increased. As Figure 3 demonstrates, the largest numbers of hospital beds in the state are in the category general medical/surgical beds. The number of general medical/surgical hospital beds has decreased dramatically from 1980 to 1997. This medical/surgical bed decrease accounts for most of the overall decline in total number of hospital beds in Ohio during this period. The sixteen cities presented in Figure 3 are ranked from highest number of general medical/surgical beds per 1000 population in 1997 to the lowest number per 1000 population. An interesting pattern is found in this data for general medical/surgical beds in the sixteen cities. The sixteen cities can be divided into three groups, high numbers of beds per 1000, middle numbers, and low numbers of beds per 1000 population. There are many more general medical /surgical beds found in Steubenville, Portsmouth, and Youngstown, the high group than in Columbus, Hamilton, and Toledo, the low group. Cincinnati, Cleveland, and Mansfield fall into the middle group of numbers of medical/surgical beds per 1000 population.

The numbers of special care beds (that is Intensive Care Unit and Coronary Care Unit beds) per 1000 population in the sixteen cities are found in Figure 4. In contrast to the pattern found in general medical/surgical beds, there has been an overall increase in the numbers of special care beds in Ohio between 1980 and 1997. In some cities the increases were more dramatic between 1980 and 1990 and other cities showed more gradual increases. Only Toledo and Lorain showed very small decreased in number of special care beds per 1000 between 1980 and 1997. It is interesting to note that Toledo has the highest rate of coronary heart disease deaths in the state while at the same time being the only major urban area to have a decrease in the number of special care beds.

The division of cities into groups of high, middle, and low number of beds that was found in the general medical/ surgical beds category is very similar to the grouping found here

Figure 3

for special care beds. Again Steubenville, Youngstown, and Portsmouth are found in the high group. Cincinnati and Cleveland are found in the middle group, and Columbus, Toledo and Hamilton in the low group of cities.

Pediatric beds per 1000 population are presented for the sixteen cities in Figure 5. Here there are much smaller differences among the sixteen cities. Although there is a slight decrease in the number of pediatric beds per 1000 children overall between 1980 and 1997, it is quite small. The number of pediatric beds during this time period is relatively flat. Again as with the first two categories of beds, general medical/surgical and special care, a similar pattern of high, middle and low groups of cities are found for pediatric beds. Again, Portsmouth and Steubenville are found near the high end of the number of pediatric beds per 1000 children scale, Cincinnati and Cleveland in the middle and Toledo and Columbus at the low end. Although Steubenville has been at the high end of the other bed categories examined, it really stands out from the other fifteen cities on Figure 5. The numbers represent hospital beds per 1000 children. An examination of the population of Steubenville shows dramatic decreases from 1980 to 1997. Steubenville has not built many new hospital beds, but it has kept the beds that it has always had despite the loss of population. Usually with a drop in population you find increased age in the population. That is why Steubenville is so far from the normal pattern seen for pediatric beds in the other cities investigated. It has a shrinking older population.

Figure 6 examining obstetrical beds per 1000 women of child bearing age, shows further evidence of the population change in Steubenville. Numbers of obstetrical beds per 1000 women were much higher in 1980 and 1990 in Steubenville than in other cities. By 1997 the numbers of obstetrical beds in Steubenville is more in line with the number found in other Ohio cities. Obstetrical beds are probably the easiest types of beds to change to more general use categories.

Figure4

Figure 5

Overall in the state there is a slight decrease in the number of obstetrical beds per 1000 women. Most of the decrease occurred between 1980 and 1990. From 1990 to 1997 there were very small changes in the number of obstetrical beds in the sixteen cities. As with all the other bed categories, the high, middle and low number cities follow the same pattern. Portsmouth, Youngstown, and Steubenville are found in the group of cities with large numbers of beds per 1000 women. Cincinnati, Cleveland, and Mansfield are found in the middle. Columbus, Toledo and Lorain are found in the low number of beds group.

B. Trends in the sixteen MSAs or wider city regions

Next we turn our attention from the sixteen cities themselves to the Metropolitan Statistical Areas (MSAs) or the wider city region in which these sixteen Ohio cities are found. As will be explained in detail in the methods section, for purposes of this analysis, the sixteen cities were divided into two categories. The first tier consists of the eight larger cities located within MSAs. They are: Akron, Canton, Cincinnati, Cleveland, Columbus, Dayton, Toledo and Youngstown. The second tier city regions are: Hamilton/Butler County, Lima, Lorain, Mansfield, Portsmouth/Scioto County, Springfield/Clark County, Steubenville/Jefferson County, and Warren/Trumball County. The same number of hospital beds per 1000 population was examined for each of the four categories of hospital beds that were used for the sixteen cities.

Looking at the first tier MSAs, Figure 7 shows the same overall decline in the number of general medical/surgical beds in the larger MSAs as was found in the individual cities. The decline was larger from 1980 to 1990 than from 1990-1997. Again similar to the pattern found in the cities, Figure 8 shows that special care beds in the eight first tier MSAs showed an overall increase in number between 1980 and 1997. The only exception to this statewide increase is in

Figure 6

Figure 7

the Toledo MSA where there was a small decrease.  In about half of these eight MSAs the major increase in number of special care beds took place between 1980 and 1990 with several cities showing a decrease from 1990 to 1997 even though the 1997 number of beds was higher than the 1980 number per 1000 population.

Figure 9 demonstrates that the number of pediatric beds per 1000 children in the eight first tier MSAs parallels the decrease found in the cities.  Most of this decrease in number took place between 1990 and 1997. In about half of these eight MSAs the number of pediatric beds increased between 1980 and 1990.

Changes in the numbers of obstetrical beds per 1000 women are presented in Figure 10 for the first tier MSAs.  The pattern again is like what was found for the cities.  There is an overall decline in the number of obstetrical beds between 1980 and 1997.  The biggest drops are found between 1980 and 1990, with 1990 to 1997 figures remaining fairly static.

Some interesting overall patterns are found in the eight MSAs presented in Figures 7 through 10.  Overall there is much more consistency among the eight first tier MSAs than was found among the sixteen cities.  The variability of numbers of hospital beds over the time period studied from 1980 to 1997 is more pronounced in the MSAs than in the cities, reflecting both changes in the actual numbers of beds and more pronounced population shifts in the MSAs between 1980 and 1997.  The MSA data picks up the big suburban growth between 1980 and 1997 in Ohio's cities.  A grouping analysis of numbers of beds in these four categories for the eight MSAs does not show the same high, middle, and low number of bed found in the sixteen cities.  The MSAs show a much less pronounced division into higher and lower categories.  In general the Cleveland and Toledo MSAs are found in the half with higher numbers of beds while

Figure 8

Figure 9

Figure 10

Columbus and Cincinnati are found in the half of the MSAs with a lower number of beds.

The second tier city regions follow some of the same patterns found in the MSAs. General medical/surgical beds presented in Figure 11 show the same overall decline in number for all areas except Steubenville. The drop in population in the wider Steubenville city region as in the city itself is responsible for what appears to be an increase in numbers of hospital beds.

Special care beds per 1000 people for the second tier city regions are found in Figure 12. The general increase in numbers of special care beds found in the sixteen cities and in the MSAs is not the rule for the eight, second tier city regions. Only about half of these city regions show an increase in number of special care beds between 1980 and 1997. Several city regions show significant drops in the numbers of special care beds from 1980 to 1997 most notably Portsmouth-Scioto County.

The pediatric beds for the second tier city regions presented in Figure 13 follows the pattern found in the sixteen cities. There is an overall decrease in the number of pediatric beds mostly occurring between 1980 and 1990. Here again the Steubenville city region stands out because of its decreasing and aging population.

The final look at the second tier city regions is found in Figure 14. Obstetrical beds per 1000 women of childbearing age have dropped fairly dramatically in these city regions. The bulk of this drop took place between 1980 and 1990 for most of the city regions. The decrease in numbers of obstetrical beds mirrors the drop found for pediatric and for general medical/surgical beds for the city regions. No consistent groups patterns are found within the eight city regions as were found in the sixteen cities or in the MSAs.

Figure 11

Figure 12

Figure 13

Figure 14

C. Trends found between cities and their surrounding suburban areas.

The next series of graphs presents a comparison in numbers of hospital beds in the different categories for each of the sixteen cities and its MSA or city region. For each city there are three sets of bars. The first bar set is the 1980-1997 data for the city alone, the second bar set is for the remainder of the MSA for 1980-1997. The remainder is the total MSA minus the city component of the MSA, or the suburban area. The third bar set for each city represents the total for the MSA (city plus suburban areas) for 1980 to 1997. The cities are presented in alphabetical order in this series. The eight first tier cities and their MSAs were examined first, followed by the eight, second tier cities and their respective city regions. In some cases the city regions are also MSAs.

In this format, the contrast between cities and suburbs is clearly seen as well as the relative contribution of the city to its MSA or region.

The information for the eight first tier cities general medical/surgical beds is found in Figure 15. The overall drop in medical/surgical beds is seen here again in all areas except the city of Canton. Like Steubenville, this apparent increase in medical/surgical beds per 1000 population is more likely a result not of more beds but of stead numbers of beds and a decline in population. One of the more interesting patterns seen in Figure 15 is the relative contributions that the city and the suburbs make to the total MSA. In Cleveland for example the city core represents about three quarters of the medical/surgical beds in the MSA while one quarter are found in the suburban areas of the Cleveland MSA. In contrast the Cincinnati city core accounts for almost all of the medical/surgical beds with very few found in the suburban area of the MSA. The opposite pattern is found in Toledo, where only about sixty percent of the medical/surgical beds are found in the city core and the suburban areas have forty percent of the medical/surgical

Figure 15

Figure 16

beds in the MSA.

The special care beds presented in Figure 16 show a very different pattern than the medical/surgical beds. Again there is an overall increase in the number of special care beds with some big increases between 1980 and 1990. Figure 16 demonstrates that changes in the MSAs are driven by changes in the city core areas. The numbers of special care beds in the cities' suburban areas show very little change between 1980 and 1997.

Pediatric beds in the cities and suburbs presented in Figure 17 show the overall decline in number found between 1980 and 1997. Like the pattern for special care beds, changes are more pronounced in the city core areas than in the suburban areas. The real drop in pediatric beds took place between 1990 and 1997. Most of these eight cities actually added pediatric beds between 1980 and 1990.

The decrease in obstetrical beds in the eight cities presented in Figure 18 shows that this decline was much more gradual than the drop in pediatric beds for the same 1980 to 1997 period. The only exception to this gradual drop in the number of obstetrical beds was found in the Toledo suburban area where there was a small increase in the number of obstetrical beds between 1980 and 1997 even though the city and total MSA showed the same decreasing number found in the other seven cities.

This examination of cities and their suburbs in Figures 15 to 18 shows similar patterns across the categories of hospital beds. The balance between Cleveland and its suburbs for medical/surgical beds noted in Figure 15 is also found for special care, pediatric and obstetrical beds. The concentration of beds in the Cincinnati city core, and the spread of beds across both the city core and suburbs in Toledo are also consistent across all bed categories.

This same type of city core and suburban contrast data is presented for the eight, second

Figure 17

Figure 18

tier cities and their respective city regions. Again the cities are presented in alphabetical order. General medical/surgical beds are presented in Figure 19. While the numbers of medical/surgical beds had consistently decreased in this study from 1980 to 1997, Figure 19 shows some increases. The increases are mainly found in Steubenville and Portsmouth and most likely are a result of overall population decreases rather than construction of new hospital beds. Of interest in this analysis on Figure 19 is the split of the cities into two groups, in the first group there is a balance between the city core and its suburbs in the city region. Hamilton, Lorain and Mansfield are examples. The other half of these cities have little or no suburban components in their regions. This is seen in Portsmouth, Springfield and Steubenville.

Special care beds presented in Figure 20 show an overall increase. The increase is gradual and is found in the city core areas and in the suburbs for those cities that have suburbs. The growth rates were somewhat higher for the 1980 to 1990 period than for the 1990 to 1997 period.

The second tier cities have few numbers of pediatric beds as demonstrated in Figure 21. Pediatric beds in particular are clustered in the city core areas of the city regions with the exception of Lorain and Hamilton. The spike of data for Steubenville again is an anomaly resulting from the population decline and age of the population in the Steubenville area. The pattern of a slight overall decrease in pediatric beds is found for the second tier cities and their suburban areas.

The final city suburban comparison for obstetrical beds is presented in Figure 22. As with the first tier cities, there has been a gradual decrease in the numbers of obstetrical beds from 1980 to 1997. In general the pattern of decrease found in the city core is mirrored in the city's respective suburban area. The exception is Mansfield where there is an increase in obstetrical

Figure 19

Figure 20

Figure 21

beds in the city core area and a decrease in the Mansfield suburban area. This could be a result of a population decline in the city of Mansfield itself with respect to the city region as a whole. The Steubenville data is interesting here. In the other areas the population decline made it look like there were increased numbers of beds in Steubenville. While the rate of obstetrical beds for Steubenville are abnormally high, from 1980 to 1997 there have been significant drops in the rates. Mostly the obstetrical beds have been converted to other use beds to match the population changes. Of the three categories of specialized beds examined, obstetrical beds are the easiest type to convert of other uses.

Of particular interest in this second tier city suburban comparison series is the split noted in the discussion of general medical/surgical beds. The second tier cities can be divided into to groups, those with and those without and suburban component to the hospital beds in the city region.

The final trends examined in this study look at different ways that geographic accessibility could be measured for different areas of the state with the data set that has been constructed. The specific details are discussed in the methodology section. The data presented here are only for 1997. Using Cleveland and its MSA, a distance model of spatial accessibility to special care beds was developed. Since time is a critical factor especially for access to coronary care services, the distance measure was used for special care beds. As Figure 23 shows, most of Cleveland central city residents live less than two miles from a hospital with special care beds. Similarly, within the Cleveland MSA, the majority of people live within five miles of a hospital that has special care beds.

Cleveland was also used to demonstrate another type of spatial accessibility measure, the concentration of obstetrical beds within an area. The concentration measure is related to the

Figure 22

amount of choice a person has in available services. For obstetrical care, survey of women of child bearing age show that having a choice of health services is particularly important. The concentration accessibility measure for obstetrical beds in the Cleveland MSA in Figure 24 shows that city core residents have forty percent to the highest accessibility value. In the Cleveland inner suburban areas residents have twenty to thirty percent of the highest accessibility value. Even in the MSA areas far from the city most all residents have up to twenty percent of the highest accessibility value. As a future step, it would be interesting to examine these types of accessibility measures for Cincinnati and Toledo. These cities represent have very different location patterns of hospitals. In Cincinnati, as we saw earlier, most all hospital beds in the MSA are concentrated in the city core area with few beds in the suburban areas. In the Toledo MSA there are nearly as many beds in the suburban areas as there are in the city core.

Overall Conclusions in the trend data

1. Mortality trends in Ohio follow national patterns
2. Death rates in Ohio dropped dramatically between 1910 and 1960. Death rates in Ohio continued to drop very gradually until 1990 and there has been a slight increase in the death rate between 1990 and 1997.
3. At the close of this century, as has been the case for almost all of the century, coronary heart disease, cancer, and strokes are the leading causes of death for Ohio's citizens. The rates of death for the number one cause, heart disease, have been slowly declining for the past twenty years. The number two cause of death, cancer, shows a steady increase in the state.

4. Behavioral components like diet and exercise and social components of health like poverty and access to medical technology will become more and more important in the health of Ohio's citizens in the next century.
5. Overall the numbers of hospital beds in the state of Ohio is declining especially general medical/surgical beds. This reflects the movement of health care services out of hospitals as primary care venues into the community.
6. Despite this overall decline in hospital beds, increasing numbers of beds in special care areas are increasing. This in part is a reflection of managed care and the increased profitability of special care beds with respect to medical/surgical beds.
7. Hospital beds in the state of Ohio are still concentrated in the core city areas. Hospitals represent a substantial capital investment. This investment is maintained and developed in the cities.
8. In addition to the capital investment, city hospitals represent the investment in the basic structure of medical care, research and training of health care providers in the state.
9. This study developed a data set to examine the spatial distribution of hospitals in the urban areas of Ohio.
10. This data set provides the tool to examine all sorts of relationships between health care providers and people who use health care services.
11. In addition to providing primary care with hospital beds, hospitals educate health care providers and are a significant component of community public health and health education efforts. This data set will provide an analysis tool to examine a variety of health issues in Ohio.

Figure 23

Figure 24

## Part Two:
## Trend Data

All trend data in the form of charts and maps are found in the *Excel* file “utpart2.xls”.

## Part Three:
## Methodology--Health Care Component

The health care component of this project focused primarily on monitoring trends in hospital service delivery to the populations of the 16 urban regions from 1980 to the present. Hospital service delivery is defined here in terms of the number of registered hospital beds available to populations residing within proximity to hospitals. Hospital beds are operationally defined using the Ohio Department of Health' extended definition of a hospital bed which takes into account different factors associated with hospital care: "'Hospital Bed' or 'Bed' means a bed in a hospital with the attendant physical space, fixtures, and equipment for use in caring primarily for inpatients. Hospital beds also may be used in caring for patients who stay for less than twenty-four hours, but their primary use shall be for care of inpatients"[3]. ODOH further classifies hospital beds with respect to hospital bed registration by defining "Conforming Hospital Bed" as one which has adequate functional space and meets minimum federal requirements for hospital construction[4].

Hospital service delivery was investigated in this study following two approaches. The first approach used ratios of hospital beds to population as a means to compare service delivery within urban regions (*e.g.*, central city vs. suburbs) and among urban regions in the years 1980, 1990 and 1997. These time periods enabled service delivery trends to be evaluated among the specializations within and among urban regions over time.

1) Hospitals were aggregated into groups associated with the city, county and metropolitan statistical area in which they are located. Four areas of specialization were targeted as representative of overall health care delivery from general hospitals within these regions:

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3. Ohio Dept. of Health. 1997. *Directory of Registered Hospitals*, Bureau of Quality Assessment and Improvement, Ohio Dept. of Health, p. II.
4. *Ibid*, pp. II-III.

1) Obstetrics, 2) Special Care in the form of intensive care (ICU) units and cardiac care units (CCU), 3) General Medical/Surgical services, and 4) Pediatrics. The number of hospital beds for each specialization were summed within each region for the years 1980, 1990 and 1997 and then standardized by population to produce ratios of hospital beds to population according to the four areas of specialization:

1) Obstetrics Beds per 1000 Women in the population (ages 15-44 years)

2) Special Care (*i.e.*, Intensive Care and Cardiac Care Units) Beds per 1000 population

3) General Medical/Surgical Beds per 1000 Population

4) Pediatric Beds per 1000 Children in the Population (under 18 years of age).

These data were aggregated and compared on an individual basis for each of the study's 16 central cities (See Figures 3-6), first tier urban regions (Figures 7-10), and second tier urban regions (Figures 11-14).

In addition, ratios for each specialization in their respective time periods were reaggregated to permit comparisons in hospital service delivery between each urban region (MSA or county), its central city and the non-city remainder of the region. This approach enabled basic urban/suburban/exurban comparisons over time and space (Figures 15-22). The explicit comparisons that were made are as follows:

First Tier Cities (Figures 15-18):

Akron City vs. Remainder Akron MSA

Cleveland City vs. Remainder Cleveland-Lorain-Elyria MSA

Canton City vs. Remainder Canton-Massillon MSA

Columbus City vs. Remainder Columbus MSA

Toledo City vs. Remainder Toledo MSA

Youngstown City vs. Remainder Youngstown-Warren MSA

Dayton City vs. Remainder Dayton-Springfield MSA

Cincinnati City vs. Remainder MSA

Second Tier Cities (Figures 19-22):

Springfield City vs. Remainder Clark County

Lorain City vs. Remainder Lorain County

Portsmouth City vs. Remainder Scioto County

Steubenville City vs. Remainder Jefferson County

Mansfield City vs. Remainder Mansfield MSA (Richland and Crawford Counties)

Lima City vs. Remainder Lima MSA (Allen and Auglaize Counties)

Warren City vs. Remainder Trumbull County

Hamilton City vs. Remainder Butler County.

A comprehensive set of graphs were prepared for all comparisons among all years and all specializations. The information provided in these graphs provided a means to draw the link between aggregate hospital service delivery trends on the county level and vital statistics and health trends over time. These county-level vital statistics were obtained from both the Statistical Analysis Unit, Office of Policy and Planning, Ohio Department of Health, and from the *Ohio Department of Health Data Warehouse*.

This initial approach to evaluating hospital service delivery certainly provides a useful yardstick to compare overall delivery among regions or to monitor changes over time in the same region. However, this approach lacks the sensitivity to measure variations in health care delivery within specific regions. As a result, a second approach was adopted which measures geographic accessibility to hospital services within urban regions. Geographic accessibility is operationally defined here as a measure of geographic proximity of hospital services to the surrounding populations that they serve; regions with large numbers of hospitals (and beds) which are centrally located in close proximity to regional populations will provide a high degree of accessibility in contrast to regions with a small number of hospitals that are located further from populations.

In order to measure variations in the relative accessibility to hospital services, each urban region was subdivided into individual block groups. Over 8,000 block groups were included in the study among the 16 city regions. Block group centroids were extracted from a digital database and superimposed over hospital point locations in a geographic information system (GIS). Point-to-point distance relationships (block group centroid to hospital point) were used in combination with the number of beds at hospitals.

This phase of the study focused on two particularly geographically sensitive medical services: Obstetrics and Special Care (ICU, CCU). These services were chosen because quick access to hospitals for these patients is a critical factor. Several accessibility indices were used to measure the relative "concentration" of hospital beds (by date and by specialization) to each block group within the 16 urban regions. All accessibility measures have been computed, but we have yet to fully evaluate their effectiveness in measuring accessibility and providing useful insight into the formulation of health care policy. Two of the more effective measures of accessibility are presented here. The first of these indices is the "minimum distance" measure, which is particularly useful in evaluating accessibility to Special Care services. This index is characterized as a "minimum level of service" measure which records the distance between each block group and its closest hospital with an ICU or CCU unit.

Accessibility is measured for each block group simply in terms of the linear distance to the nearest hospital having an ICU or CCU Unit; those block groups with low minimum distance accessibility indices are in close proximity to special care units and are therefore at a locational advantage with respect to these services. The map in Figure 23 shows the distribution of minimum distance accessibility indices to Special Care Services for block groups in the Cleveland, Akron and Canton areas in 1997. By themselves, these measures don't reveal a significant amount of information in the map. However, we intend to compute the 80th percentile minimum distance for each region by generating a cumulative frequency distribution within each region relating block group populations over distance to their closest hospital and recording the minimum distance associated with 80 percent of the population. The 80th percentile distance can then be used as a comparative measure between urban regions, between urban and suburban locations within regions, and between time periods within the same region. These statistics have yet to be completed in the study.

The second accessibility index presented here is the "concentration" measure, which was used as a means to evaluate accessibility to Obstetrics services. This index is computed by taking the entire set of hospitals in the study and summing ratios of hospital beds over linear distance to hospitals for each block group in the study. These computations yield an index of concentration expressed in "beds per mile" for all hospitals relative to each block group. Those block groups in close proximity to many hospitals with Obstetrics beds will have higher accessibility than those in more peripheral locations. This "concentration" measure will allow us to compare not only the number of beds available within a region, but also a basic measure of choice between hospitals for women in the population. Again, we can use this value to make comparisons within and among urban regions, as well as trends in accessibility over time within regions. The map in Figure 24 shows the distribution of concentration-based accessibility indices to Obstetrics for block groups in the Cleveland, Akron and Canton areas in 1997.

This accessibility approach enables health care policy makers to evaluate which areas may be considered to be “well-served” by hospitals and which areas may be considered “under-served”. The variability in geographic accessibility to hospital services can be more readily studied using this technique.

Given the strong locational orientation of this study, the tremendous volume of data assembled, and the spatial relationships that are examined between hospitals and surrounding populations, a geographic information system (GIS) was used as a means to assemble, store, manage, and analyze the data in the study. One of the major outcomes of this project was the development of a comprehensive GIS database that contains all of the registered hospitals in the State of Ohio along with the number of registered beds for each medical specialization within those hospitals.

Hospital data were manually encoded from the Ohio Department of Health’s *Directory of Registered Hospitals* (1980, 1990, 1997). A comprehensive database was prepared including hospital name, address, zip code, county, operation (*e.g*., Church, County, *etc*.), classification (general, psychiatric, rehabilitation, *etc*.), and specializations according to the number of beds. These data were imported into a GIS database using ESRI *ArcView* software. All hospitals were *geocoded* to their respective locations (*i.e.*, they have a location built into the database).

All block groups within the urban regions were retrieved and stored in the form of boundaries and centroids. Census data were also assigned to block groups with respect to age structure, sex, and selected socioeconomic characteristics for 1990 and 1997. Socioeconomic data for block groups were not available for 1980; instead, tract data were acquired and stored in the GIS.  In addition, city boundaries, county boundaries,  and MSA boundaries were also stored in the GIS along with their respective census data for the years 1980, 1990 and 1997.

This GIS-based approached enabled the quick assignment of hospital points and block groups to their respective city, county and metro region, which in turn permitted quick aggregation of data by these larger areal units.  Accessibility index computations were made using software developed by Peter Lindquist at the University of Toledo; output from these computations were easily imported back into the GIS for display as seen in the maps in Figures 23 and 24.

It should be emphasized at this point that the study reported here remains a work in progress. Additional measures of accessibility are currently being modified and evaluated.  Summary statistics from accessibility measures are currently being computed to provide a more efficient means of comparing service delivery within and among urban regions over time for the areas of specialization used in the study.  Additional data, statistics, maps and figures will be produced to document the results of these analysis in greater detail in later drafts of this report.

## Part Four:
## Supporting Data--Health Care Component

Given the large volumes of geographic and census data in the database compiled for this study, presentation of supporting data in this section would be very difficult to provide. For example, the data displayed on the maps in Part Two comes from a database consisting of over 8,000 block groups and nearly 200 hospitals. These data were inputted into software prepared by the author to compute accessibility indices for the 8000 block groups in the urban regions of this study. The maps of Cleveland are only a small subset of the total digital map produced.

**Part Five:**
**Data Sources--Health Care Component**

1. Vital statistics data were obtained from the Statistical Analysis Unit, Office of Policy and Planning, Ohio Department of Health, February, 1999.

2. 1997 vital statistics data were obtained from the *Ohio Department of Health Data Warehouse* at the following web address: http://www.odh.state.oh.us/data/data-f.htm

3. Hospital data were obtained from three documents distributed by the Ohio Department of Health:

   *1980 Directory of Registered Hospitals*, Office of Resources Development, Ohio Department of Health, July, 1980.

   *1990 Directory of Registered Hospitals*, Office of Resources Development, Ohio Department of Health, October, 1990.

   *1997 Ohio Directory of Registered Hospitals,* Bureau of Quality Assessment and Improvement, Ohio Department of Health, November, 1997.

   Hospital locations geocoded in the database were obtained from two sources:

   *ArcView StreetMap* hospital point data base, Environmental Systems Research Institute, Redlands, California, 1997.

   Hospitals not in ESRI's hospital point data base were geocoded by address matching in *ArcView* 3.1 using the *StreetMap* extension. Addresses were obtained from the ODOH Directory of Registered Hospitals.

4. Geographic data and census data were obtained using software and data sets from GeoLytics, Inc.:

   1990 MSA boundaries, county boundaries, city boundaries and block groups were obtained from GeoLytics' *Census CD+Maps*.

   1990 and 1997 census data for MSAs, counties, cities and block groups were also obtained from GeoLytics' *Census CD+Maps.* Original 1990 census data were taken from the Census of Population and Housing, U.S. Bureau of the Census; 1997 Estimates and Projections used in the study were produced for GeoLytics by Third Wave Research Group, Ltd.

   1980 census data for MSAs, counties, cities and tracts were obtained from GeoLytics' Census CD 1980.