7-1-2003

Cluster Analysis for Medical Technologies and Health Services for El Paso County and the Upper Rio Grande Region

Carlos Olmedo
University of Texas at El Paso, colmedo@utep.edu

Daniel Carrasco-Terrazas

Comments:
IPED Technical Report: 2003-13

Cluster Analysis for Medical Technologies and Health Services for El Paso County and the Upper Rio Grande Region

by

Carlos Olmedo, MS
with Daniel Carrasco-Terrazas

July 2003
IPED Report 2003-13

Institute for Policy and Economic Development
The University of Texas at El Paso
El Paso, Texas 79968-0703
iped@utep.edu
http://iped.utep.edu

EXECUTIVE SUMMARY

The competitiveness of firms in today's economy is becoming more dependent on complementary knowledge acquired from other firms and institutions. As a result, cluster analysis is increasingly becoming a popular concept in the domain of regional policy-making. A cluster can be characterized as interdependent firms and institutions (including specialized suppliers) linked to each other in a value-added production and service chain. Its competitive advantage rests on making more productive use of inputs, which requires continual innovation. A cluster's innovation is not the activity of a single firm, rather, collaboration between firms with complementary assets that understand the value of networking to reduce the increasing complexity and the costs and risks of innovation. The role of non-business institutions, such as universities, can not only contribute but be critical to the cluster's competitive success.

This study analyzes the medical technologies and health services clusters in El Paso County and the West Texas Upper Rio Grande (URG) region, which includes the counties of Brewster, Culberson, El Paso, Hudspeth, Jeff Davis, and Presidio. Medical technologies encompass high paying pharmaceutical and medical devices manufacturing and biotech research and testing services. The latter is an important and fast-growing sector of the U.S. economy, and has become a focal point of many economic development strategies. Health services include offices of health care practitioners, nursing and personal care facilities, and hospitals. Some of the highest paying occupational categories fall into health-related specializations based on the educational degree held by the practitioners. The direct linkages between primary industries in medical technologies and health services and the consequent indirect linkages with supplier chains can produce substantial economic activity within a local economy in the form of employment, output, and personal income.

The principal method of economic assessment for this cluster analysis is performed through an economic base theory technique, the *location quotient*, which compares an industrial activity in the local economy (El Paso or the URG region) against the same industrial activity of a reference economy. Employment is used as the basic unit of analysis. Twelve reference economies are used in this empirical exercise – the United States, Texas, nine surrounding counties with populations of over 500,000, and Lubbock.

Exporting clusters are the primary source of an area's economic growth and prosperity over time. The demand for local industries is inherently limited by the size of the local markets, however, exporting clusters can grow far beyond that limit. Location quotients allow the analyst to determine whether primary industries within the pre-defined clusters have some level of regional export (*basic sector*) or meet only local demand (*non-basic sector*). Basic sector employment is identified as the driver the local economy and the means of strengthening the local economy is to develop basic sectors. Results from this exercise provide several important insights that have emerged over time in the El Paso region with respect to medical technologies and health services.

The medical technologies cluster in El Paso and the URG region has witnessed significant employment and wage contraction over time. Employment and wages in the health services cluster have increased, but at a rate that has been outpaced by regional demographic trends, which are the primary demand factor. Location quotients indicate that the clusters are non-basic sectors, meeting local demand at best with little or no regional exports. For medical technologies, El Paso medical industries lack direct linkages with surrounding reference areas with sizeable medical manufacturing and service economic activity, such as the Albuquerque, Houston, and Dallas areas. For health services, it is apparent that El Paso's association with the Lubbock area is not sufficient to offset the regional (and international) health care deficiency.

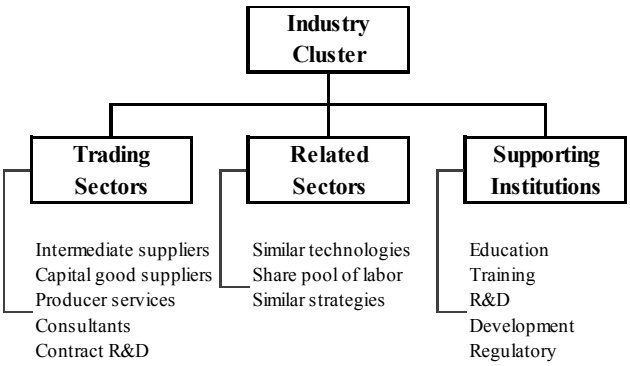
INTRODUCTION

The purpose of this study is to analyze employment in the medical technologies and health services clusters for El Paso County and the Upper Rio Grande (URG) region using location quotients as the principal economic assessment tool. The following section offers a brief background summary of cluster analysis, its terminology and as a tool for levels of economic activity. The next part clarifies the validity and limitations of the Standard Industrial Classification (SIC) system used for this exercise, as well as the public and special request sources for employment and wages data. This is followed by the methodology section, which provides an explanation of economic base theory and the location quotient, including how to interpret the location quotient, and provides a list of the reference economies chosen for this study. The subsequent section defines the industries or industry groups selected for the medical technologies and health services clusters. A correspondence crosswalk between the former SIC and successor North American Industry Classification System industry codes is also provided. The empirical results follow, as well as an analysis of the economic activity and contribution each cluster has on the local economy.

CLUSTER BACKGROUND

Clusters of innovative firms are driving growth and employment in many regions. As a result, industry clusters have become one of the most popular concepts in local and regional development research and practice. The greatest value in the industry cluster concept is its capacity to help both the analyst and the policymaker understand not only regional theory or methods, but comprehensive regional economic conditions and trends, as well as the policy challenges and opportunities those conditions and trends signify. Industry cluster analysis can help exploit the growing wealth of regional economic data, provide a means of thinking effectively about industrial interdependence, and generate unique pictures of a regional economy that reveal more effective policy options.[1]

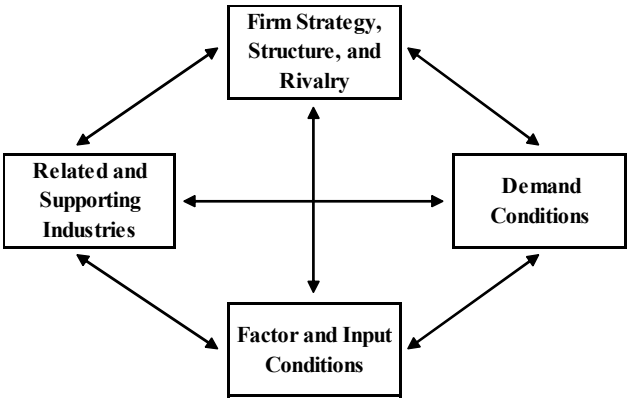
An industry cluster can be defined as a network of strongly interdependent business firms and non-business organizations linked to each other in a value-added production and service chain. Together they determine individual competitiveness and are faced with common opportunities and threats.[2] Non-business organizations include industry associations, technical, vocational, and community colleges with specialized industry programs, universities and research institutions, government industry programs, industry trade associations, and the like, and through strategic alliances are often a critical element in the success of the cluster. Clusters are bound together by buyer-supplier relationships, common technologies or production and service sharing, common distribution channels, labor pools, or markets and services, or share specialized infrastructure (see diagram below). Ultimately, productive and innovative firms and economic self-interest make the cluster competitive.



Industry Cluster: Interdependent firms and institutions
Source: Bergman and Feser

Policy interest in regional industry clusters dates back to Michael Porter's *The Competitive Advantage of Nations*, published in 1990.[3] Porter argues that regional specialization is good for the growth of both the specialized industries and the city in which they reside. Local competition is good because it fosters imitation and innovation.[4] His model is largely consistent with the growing body of literature on how interdependence between firms,

industries, and public and quasi-public institutions affect innovation and growth in regional agglomeration. Porter's "diamond" demonstrates the underlying and inter-related factors that affect a cluster's competitiveness, as well as all aspects that are external to individual companies, but that influence companies' profitability, productivity, and growth. It is important to note that while Porter's work advanced the field of cluster analysis, his concepts in most literature are taken only as a point of departure, and more developed ideas are used to explain the advantages of using clusters as a basis for regional policy.



Porter's (1990) model of competitive advantage

Some clusters already exist and their roots can often be traced to historical circumstances, or from unusual, sophisticated, or stringent local demand. Other clusters, experts agree, may be emerging, such as biotechnology in a limited number of regions worldwide. New clusters may also arise from one or two innovative firms that stimulate growth of many others. Sometimes a chance event creates some advantageous factor that, in turn, fosters cluster development. Making more productive use of inputs is key, which requires continual innovation.[5]

From a policy point of view, knowing what could become a cluster (perhaps with proper policy stimulation) is frequently more critical than knowing what composes a cluster. Defining an industry cluster, geographically concentrated or not, can be difficult.[6] On one hand, both space and time are relevant dimensions. On the other hand, data and methodological constraints also dictate cluster definitions.[7] The latter is not necessarily a limitation if recognized explicitly by the analyst and policy conclusions are determined accordingly. However, if clusters are defined one way and measured another, resulting policy conclusions will clearly be unsubstantiated.

To undertake this study we begin by defining the medical technologies and health services clusters. Clusters are defined by examining primary industries generally associated with medical product and service and health service activity. *Medical technologies* are used as a blanket category to describe companies in medical manufacturing of devices and instruments, pharmaceutical and clinical research and development, biotechnology and biological products, and where appropriate bioinformatics and genomics. In this study *the medical technologies cluster is recognized as three broad segments*:

1) the pharmaceutical manufacturing segment;
2) the medical devices manufacturing segment; and,
3) the biotech service segment.

Medical technologies are used in this analysis over "biomedical" or "biotechnology" because the area has only a small number of "biotech-related" firms. However, biotech, which is heavily concentrated in nine U.S. regions, is perceived to be an industry of the future with high-paying jobs.[8] In order for the El Paso area to capture part of this fast-growing new sector of the U.S. economy it must first possess two key ingredients that the Brookings Institute finds necessary for biotech growth: strong research and the ability to convert that research into commercial activity. The Brookings Institute further concludes that clustering provides decisive competitive advantage, but requires a considerable amount of time and investment, and that although growing rapidly, the sector is risky and still a small portion of most metropolitan economies (no biotech firm is among the 25 largest private employers in a

metro). Nonetheless, there exist indirect linkages and positive spillovers from biotech firms to other industries that can only be measured via input-output tables (i.e., biomedical services in corporate law, accounting, specialized real estate, and risk insurance). It is important to note that biotech is part of but not synonymous with medical technologies since the latter is generally unconnected to the genetic and cellular techniques that are the hallmark of biotech.

Health services comprise establishments providing health care and social assistance for individuals. The industries in this sector share a commonality of process, namely, labor inputs of health practitioners or social workers with the requisite expertise. Many of the industries in this sector are defined based on the educational degree held by the practitioners included in the industry.

The health cluster was included in this research primarily because of the principal demand consideration to demographics (in accordance with Porter's diamond "demand conditions"). The border region's changing demographic make up has resulted in a critical need to address healthcare concerns. While health services currently account for a substantial number of jobs, there is a growing demand for more services. Consequently, a larger health care provider and patient base encourages local development of new medical products, services, and techniques. In other words, medical technologies can complement health services. Furthermore, beyond the direct linkages between primary industries within these two clusters, supplier chains, or indirect industries, can also be stimulated. The "magnitude of clustering" from non-trade based linkages can have a substantial economic contribution in the form of employment, output, and personal income when primary industries create a ripple, or secondary effect throughout the regional economy.

DATA SOURCES

The United States has begun converting employment and wage classifications from the 4-digit Standard Industrial Classification (SIC) coding system to the 6-digit North American Industry Classification System (NAICS; see Exhibit 2 in the Appendix for more detail). The respective 4- and 6-digits represent the greatest level of industry detail. Exhibit 1 shows the industry placement in this hierarchical structure for both systems as reference:

Exibibit 1. SIC and NAICS Hierarchical Structure

SIC Level	**NAICS Level**
1-digit (Industry Division)	2-digit (Industry Sector)
2-digit (Major Industry Group)	3-digit (Industry Subsector)
3-digit (Detailed Industry Group)	4-digit (Industry Group)
4-digit (Industry)	5-digit (NAICS Industry)
	6-digit (National Industry)
SIC Example	**NAICS Example**
Manufacturing	**33** Manufacturing
38 Measuring, Analyzing, & Controlling Instruments	**339** Miscellaneous Manufacturing
384 Surgical, Medical, & Dental Instruments & Supplies	**3391** Medical Equipment & Supplies
3841 Surgical & Medicl Instruments	**33911** Medical Equipment & Supplies
	339111 Laboratory Apparatus & Furniture

The change in employment classification poses significant data retrieval problems for industry analysis nationwide since historical SIC statistics do not have a complete transition into NAICS. Data for more than two-thirds of all 4-digit SICs will be derivable from the NAICS, either because the industry definition has not changed or because the new industries are subdivisions of old SIC industries and can be recombined. For the remaining industries, however, there will be breaks in time series. As a result, some broad sectors like manufacturing and retailing will lose some of their historical comparability.[9] The problem of data comparability across time was recognized early in the development of the NAICS, but was nonetheless preferred because it was deemed unproductive to collect and maintain time series data that have questionable value. A onetime break in historical continuity was accepted seeing as the benefits of conversion to a new classification structure are apparent.[10]

A historical time series for El Paso, the URG region, and for the reference economies is needed to undertake this study, therefore, *analysis is performed using historical SIC statistics*. Two sources for SICs are used. The first source is the Bureau of Labor Statistics (BLS) *Covered Employment and Wages (ES-202)* historical data set for counties, states, and the United States. The second source is the equivalent Texas Workforce Commission (TWC) *ES-202* data for El Paso County. The ES-202 series is derived from tabulations of monthly employment and quarterly total wages of workers covered by state Unemployment Insurance (UI) legislation and of federal workers covered by the Unemployment Compensation for Federal Employees (UCFE) program. More precisely, ES-202 data is gathered from the information sent to a state or federal agency by firms that employ "covered workers."

For this study, annual ES-202 data between 1990 and 2000 are used. The latter is the last available year for analysis since BLS SIC detailed industry coverage terminates that year. This limitation, however, is unavoidable. For medical technologies a special request to the TWC Information Release Department was necessary for 1990 to 2000 El Paso employment and wages since these are unreported by the BLS due to nondisclosure for confidentiality purposes.[11] BLS data are used for all other employment and wages analysis.[12]

METHODOLOGY

The *Location Quotient (LQ)* is used to assess the competitive position over time of the region's industrial activity in medical technologies and health services. The *LQ* is the most commonly utilized economic base analysis method, developed in part to offer a slightly more complex model of the variety of analytical tools available to economic base analysts. This technique compares the share of jobs in a local economy for some industry to the share of jobs in a reference economy for the same industry to identify areas of specialization/deficiency generally resulting from geographic location, competitive advantage, or from the labor force. For example, for *n* medical industries, such that $i = 1, \ldots, n$ and using the United States as the reference economy, El Paso *LQs* are calculated by:

$$LQ_i = \frac{E_{ep}^i / E_{ep}}{E_{us}^i / E_{us}} = \frac{\text{El Paso industry } i \text{ jobs / total El Paso jobs}}{\text{U.S. industry } i \text{ jobs / total U.S. jobs}}$$

The *LQ* is one of several economic base analysis techniques that are grounded in the assumption that the local economy can be divided into two very general sectors, a *basic* (non-local) and a *non-basic* (local) sector. The basic sector produces for export outside the region and is made up of local firms whose sales are entirely dependent upon external factors. For example, an airplane manufacturer builds and sells its product for export throughout the world and so its clientele is non-locally based. The non-basic sector by contrast produces for consumption inside the region and is population dependent. It is made up of firms that depend largely upon local business conditions. For example, a local grocery store sells its goods for local consumption and so its clientele is locally based. Many firms or industries are classified as both basic and non-basic – they meet local demand and also produce regional exports.

Economic base theory asserts that the means of strengthening and growing the local economy is to develop and enhance the basic sector. The basic sector is therefore identified as the driver or the economic base of the local economy.[13] By developing those economic sectors that rely on external demand not closely tied to local conditions, the local economy can better insulate itself from economic downturns when external markets remain strong even when the local economy contracts.

The *LQ* provides a means of assigning firms to basic and non-basic sectors. Interpreting *LQs* is very simple. Only three general outcomes can result:

- $LQ < 1$ All Non-Basic Sector Employment:
  The industry employs a smaller share of the local workforce than it does of the reference economy. This suggests that local employment is less than is expected and the industry does not meet local demand for a given good or service. Therefore this employment is considered non-basic by definition.

- *LQ = 1* All Non-Basic Sector Employment
  The industry's share of local employees is the same as the industry's share of the reference economy. This suggests that local employment is exactly sufficient to meet local demand for a given good or service. Therefore, this employment is also considered non-basic because none of these goods or services are exported from the local area.

- *LQ > 1* Some Basic Sector Employment
  The industry employs a greater share of the local workforce than it does of the reference economy. This suggests that local employment is greater than expected and the industry exceeds local demand for a given good or service. Therefore, this "extra" employment is basic because these extra jobs must export their goods or services to non-local areas.

When the *LQ* is calculated to be greater than 1, it can be assumed that some of that industry's employment is basic. However, it must be emphasized that a *LQ > 1* does not mean that all of that industry's employment is basic in nature. Only those jobs over and above what is expected for the region can be identified as basic sector jobs. A second formula must be applied to apportion the industry's employment to each sector when the *LQ > 1*, but this is beyond this Scope of Work and its relevance is not applicable to the actual results.

As with any economic base method, the choice of data and, more importantly, the comparison area can greatly affect the results. As mentioned, annual BLS and TWC employment data are employed for this study to calculate *LQs*. In addition, total (private plus government) employment is used in this analysis. While some studies calculate *LQs* using private sector jobs only, it makes little practical sense to exclude the second largest employer in the El Paso area after the services sector. Public sector jobs are integral to the area's economy, and relative to other regional economies, El Paso has a greater share of public sector jobs as a percent of total employment. Furthermore, because government plays a major role in health services and because it is known as fact that health services, regardless of the *LQ* outcomes, are exported to Mexican nationals, public employment is also utilized.

The selected reference economies for this study are Texas, the United States, nine surrounding (applying the term loosely) counties that, similar to El Paso, had 2000 Census populations of over 500,000, and Lubbock County, chosen for its close linkages with the El Paso region in health services. The ten counties are listed below – the Metropolitan Statistical Area or Primary Metropolitan Statistical Area within the respective county and the 2000 Census county population are in parenthesis:

In Texas
Bexar (San Antonio MSA; 1,392,931)
Dallas (Dallas PMSA; 2,218,899)
Harris (Houston PMSA; 3,400,578)
Hidalgo (McAllen-Edinburg-Mission MSA; 569,463)
Lubbock (Lubbock MSA; 242,628)
Tarrant (Fort Worth-Arlington PMSA; 1,446,219)
Travis (Austin-San Marcos MSA; 812,280)
In New Mexico
Bernalillo (Albuquerque MSA; 556,678)
In Arizona
Maricopa (Phoenix-Mesa MSA; 3,072,149)
Pima (Tucson MSA; 843,746)

For the health services cluster analysis, a slight modification to the LQ method is performed. Health services are a necessary for the entire population, from birth to death, and not just to the working labor force. Hence, a more appropriate measure is health services to population; population replaces total employment in the denominator of the percentiles (see the *LQ* equation). The results of this approach are similar to calculating a specific number of health care providers to a number of persons within a geographic area – i.e., one nurse to a certain number of people in El Paso – and comparing this ratio to a reference geographic area. The lower of the two ratios may tell the story of a field where a deficiency exists. Similarly, LQs less than 1 under this modified

technique suggest that the industry is a non-basic driver of the economy that fails to meet local demand or is a critical field where a deficiency exists.

CLUSTER SELECTION

Medical Technologies Cluster

Medical product and service firms are not separately classified as such in either the SIC system or in its successor, the NAICS. Instead, this study uses as a starting basis a pre-defined set of nineteen SIC 4-digit primary medical industries established by the University of South Florida's Center for Economic Development Research (CEDR) cluster linkage and impact report, "*Medical Product Industries Cluster in Tampa Bay*."[14] These medical firms encompass industrial categories from drug and medical-related manufacturing to research and testing services. They can be categorized by segment: 1) pharmaceutical, 2) medical devices, and 3) biotech. Four of the nineteen pre-defined industries are pharmaceutical, fourteen are medical devices, and one is biotech (see Appendix 1a). The SIC classifies the first two segments as manufacturing industries and the third segment is the sole service industry.

Of the nineteen pre-defined industries used in the Florida study, only nine are current employers or were recent employers in El Paso. One of the nine industries is in pharmaceuticals, one is in biotech, and the remaining seven are in medical devices. Also, six of the industries are in the major industry group SIC 38 (Measuring, Analyzing and Controlling Instruments). The nine SIC medical technologies available for analysis are:

Pharmaceutical (Manufacturing) Segment

- **SIC 2834** Pharmaceutical Preparations

Medical Devices (Manufacturing) Segment

- **SIC 3069** Fabricated Rubber Products, Not Elsewhere Classified
- **SIC 3823** Industrial Instruments for Measurement, Display, and Control of Process Variables, and Related Products
- **SIC 3827** Optical Instruments and Lenses
- **SIC 3829** Measuring and Controlling Devices, Not Elsewhere Classified
- **SIC 3841** Surgical and Medical Instruments and Apparatus
- **SIC 3842** Orthopedic, Prosthetic, and Surgical Appliances and Supplies
- **SIC 3851** Ophthalmic Goods

Biotechnology (Service) Segment

- **SIC 8731** Commercial Physical and Biological Research

Health Services Cluster

Clusters rarely conform to classification systems since they fail to capture many important industrial associations in competition. However, health care provider industries are easy to categorize since they all fall within the broader SIC 2-digit major industry group SIC 80 Health Services. Hence, this study uses the nine SIC 3-digit detailed industry groups (SICs 801-809) that make up SIC 80 to define health providers since industries at the SIC 4-digit level are fully categorized in these broader SIC 3-digit levels. For example, all types of hospitals or offices of doctors can be found in one of these nine SIC 3-digit codes, and nowhere else. By comparison, for medical, the SIC 4-digit industry "Commercial Physical and Biological Research (SIC 8731)" falls under the broader SIC 3-digit detailed industry group "Research, Development, and Testing Services (SIC 873)." But using this SIC 3-digit level would also include non-medical technologies such as SIC 8732 "Commercial, Economic, Sociological, and Educational Research." Consequently, while it makes sense to use the 3-digit level for health providers since it captures the entire field, the 4-digit level must be used for medical technologies since components can be found elsewhere throughout the SIC codes. The health services cluster includes the following SIC industry groups:

- **SIC 801** Offices and Clinics of Doctors of Medicine
- **SIC 802** Offices and Clinics of Dentists
- **SIC 803** Offices and Clinics of Doctors of Osteopathy
- **SIC 804** Offices and Clinics of Other Health Practitioners
- **SIC 805** Nursing and Personal Care Facilities
- **SIC 806** Hospitals
- **SIC 807** Medical and Dental Laboratories
- **SIC 808** Home Health Care Services
- **SIC 809** Miscellaneous Health and Allied Services, Not Elsewhere Classified

For health care providers availability of data is not a problem, although some BLS nondisclosure statistics do affect the completeness. However, the suppressed employment figures are minor and do not affect the overall efficiency of the analysis since both the region and the reference economies appear to have similar suppressions. In particular, SICs 806 and 809 throughout have nondisclosure data that can be designated to the government sector. In El Paso this nondisclosure data can mainly be traced to local government as the employer, such as Thomason Hospital. In mathematical terms, the percentages used to calculate the *LQs* are affected by only fractions of a percent, changing the *LQs* themselves by similar insignificant amounts (i.e., an *LQ* from 0.8634 to 0.8636 is still an *LQ* of 0.86 rounded and does not change the outcome). Hence, the calculations of the *LQs* are not affected by nondisclosure data in health services.

Correspondence

Correspondence tables between the SIC industries and their corresponding NAICS industry counterparts are provided in the Appendix. The first two tables (Appendices 1a and 1b) are created for this study using the 1997 North American Industry Classification System booklet (see Endnote 9) and provide a bridge between the selected SIC 4-digit industries and the respective NAICS 6-digit industries. The full nineteen pre-defined medical industries by the Florida study are provided rather than only the nine available for analysis. The second two tables (Appendices 2a and 2b) are obtained from the Texas Workforce Commission SOCRATES industrial crosswalk tables and provide a bridge between SIC 3-digit and NAICS 4-digit industry groups.[15] The first two tables provide greater detail while the latter two tables offer the percent of correspondence.

Statistical correlates are provided to ensure some level of consistency with similar future studies for the El Paso area using NAICS data. As mentioned, in many cases only partial correspondence is possible and it becomes the responsibility of users to understand the degree of validity when cross-referencing between systems; otherwise, efficiency is lost.

EMPIRICAL RESULTS

Medical Technologies Economic Activity

El Paso County comprises the entire medical technologies employment field within the URG region.[16] Consequently, the following analysis applies equally for El Paso as it does to the six county West Texas Upper Rio Grande region. *(Since medical industries data were obtained through a special request from the TWC Information Release Department, specific data cannot be published per contractual agreement to protect the competitive or confidential privacy of the few reporting firms. Hence, only cluster totals and general information as to the particular industrial activity and contribution can be provided.)*

TWC data indicate that employment in medical technologies decreased by 79 percent between 1995 and 2000, from 2,274 to 469 (Figure 1). Overall, the number of these high paying jobs fell in 1996 and 1997, rebounded in 1998, and fell substantially in 1999 from apparent relocations, shutdowns, or cutbacks. Roughly $61.4 million in nominal wages were lost during this five year period, a contraction of 78 percent from $79.0 million to $17.6 million (Figure 2). Adjusted for the effects of the multiplier that decreases income in the area by an amount greater than the wages drop, the actual loss was more.

Figure 1. El Paso Average Annual Employment for Medical Technologies Cluster

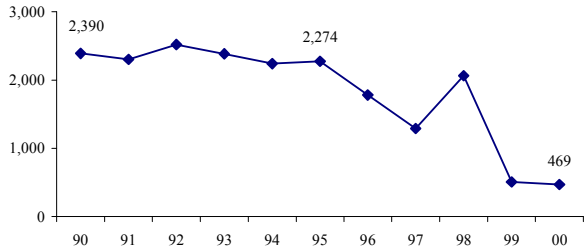
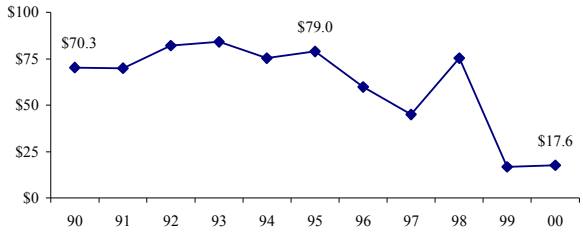


Figure 2. El Paso Total Annual Wages for Medical Technologies Cluster (in millions)



Individually in 2000, SICs 2834 (Pharmaceutical), 3823 (Industrial Instruments), 3842 (Orthopedic & Surgical Supplies), and 8731 (Physical & Biological Research) exhibited some level of stability (small job gains or declines), while the remaining five medical industries were small or no longer employed workers (Table 1). The healthiest of these industries in 2000 was SIC 8731, employing above 200 people. The other three stable industries employed between 25 and 150 workers. The worst performing industry SIC 3841 (Surgical & Medical Instruments), which, according to the TWC Information Release Department, once employed nearly 2,000 workers and as of 2000 was approaching single digits.

Computing average employee hourly wages shows that seven of the nine medical industries paid medium to high wages in 2000 (Table 1). SICs 2834 (Pharmaceutical), 3829 (Measuring & Controlling Devices), and 3841 (Surgical & Medical Instruments) paid between $12 and $13 per hour, SICs 3823 (Industrial Instruments) and 3827 (Optical Instruments) paid close to $15 per hour, SIC 3842 (Orthopedic & Surgical Supplies) paid above $18 per hour, and SIC 8731 (Physical & Biological Research) paid roughly $22 per hour. By segment, biotech pays the highest while pharmaceutical and the majority of medical devices pay above a living wage. It should be noted that the two industries (SICs 3069 Rubber Products and 3851 Ophthalmic Goods) paying substandard wages are visible outliers whose pay may be skewed; that is, the calculations to obtain hourly wages need not necessarily apply since production could have resulted from contract work at a point in time rather than from a 40 hour work week for the entire year. The wage contribution indicates that medical technologies add value to the economy per unit of labor.

Table 1. El Paso 2000 Industry Outlook

SIC Code	SIC Industry	Employee Level	Hourly Wages *
SIC 2834	Pharmaceutical Preparations	100-150	$12-$13
SIC 3069	Fabricated Rubber Products, NEC	0-25	non-living
SIC 3823	Industrial Instruments for Measurement, Display, & Control	25-50	$14-$15
SIC 3827	Optical Instruments & Lenses	0-25	$14-$15
SIC 3829	Measuring & Controlling Devices, NEC	none	$12-$13 ***
SIC 3841	Surgical & Medical Instruments & Apparatus	0-25 **	$12-$13
SIC 3842	Orthopedic, Prosthetic, & Surgical Supplies	50-100	$18-$19
SIC 3851	Ophthalmic Goods	none	non-living ***
SIC 8731	Commercial Physical & Biological Research	200-250	$21-$22

Shaded areas indicate the industry exhibited some level of stability (small job gains or declines)

* Assuming 40 hour workweeks for the year period.

** SIC 3841 was a large employer up to 1998, as reported by the TWC.

*** Hourly wages calculated for 1999.

Medical Technologies Location Quotients

LQs for nine medical industries – one pharmaceutical, seven medical devices, and one biotech – are performed for El Paso County and the URG region. Three years are selected for output, 1990, 1995, and 2000, to see how employment changed over time. In many cases the *LQ* cannot be calculated either due to no reported employment in El Paso or due to no reported employment or nondisclosure data in the reference economies.

Table 2 shows that between 1990 and 2000, SICs 2834 (Pharmaceutical), 3823 (Industrial Instruments), 3841 (Surgical & Medical Instruments), 3842 (Orthopedic & Surgical Supplies), and 8731 (Physical & Biological Research) reported employment throughout the entire period. In 2000, SICs 3069 (Rubber Products) and 3827 (Optical Instruments) reported employment, while SICs 3829 (Measuring & Controlling Devices) and 3851 (Ophthalmic Goods) reported no employment. Only five of the nine industries have the data available to calculate *LQs* for 1990, 1995, and 2000.

Table 2. El Paso Years of Reported Employment

SIC Code	SIC Industry	Years Available
SIC 2834	Pharmaceutical Preparations	90-00
SIC 3069	Fabricated Rubber Products, NEC	92, 97-00
SIC 3823	Industrial Instruments for Measurement, Display, & Control	90-00
SIC 3827	Optical Instruments & Lenses	98-00
SIC 3829	Measuring & Controlling Devices, NEC	92-99
SIC 3841	Surgical & Medical Instruments & Apparatus	90-00
SIC 3842	Orthopedic, Prosthetic, & Surgical Supplies	90-00
SIC 3851	Ophthalmic Goods	90-99
SIC 8731	Commercial Physical & Biological Research	90-00

LQ results for El Paso are shown in Table 3. The highlighted *LQs* are the *LQs* greater than 1, which is an indication of basic sector employment and a level of regional exports as discussed. To facilitate the understanding the tables, the following two symbols are used: ***(ND)*** denotes nondisclosure data and ***(-)*** denotes no reported employment. The URG *LQs* for medical technologies are in Appendix 3 since all but one of the outcomes remains the same; hence, the El Paso analysis is applicable to the URG regional analysis. The only *LQ* that changes outcome is SIC 8731 (Physical & Biological Research) against the Pima County reference economy for 1990 (Appendix 3); it changes from greater than 1 for El Paso to less than 1 for the URG. The reader should also note that *LQs* are slightly lower, as they should be, for the URG region because total employment increases with the addition of Brewster, Culberson, Hidalgo, Jeff Davis, and Presidio (this decreases the local industry share).

LQs in Table 3 show that the El Paso medical technologies cluster is predominantly a non-basic sector whose employment is below what is expected.[17] In 2000, only three *LQs*, data permitting, were greater than 1 – against the reference counties of Harris in SIC 2834 (Pharmaceutical) and Maricopa in SICs 3842 (Orthopedic & Surgical Supplies) and 8731 (Physical & Biological Research). Unfortunately, the only border reference county of Hidalgo had no reported or nondisclosure data so comparison of medical industries between border counties with populations of over 500,000 is not possible.

Using the definitions of basic and non-basic, the medical cluster chiefly meets only local demand and is not identified as a driver of the local economy. *LQs* indicate that medical technologies have changed for the worse over time in El Paso, and in particular, SIC 3841 (Surgical & Medical Instruments; see only the reference economies of Texas and the United States in Table 3 to observe the sharp drop in *LQs* between 1995 and 2000 – the outcomes change from above one to below one). Developing and enhancing this high paying sector to strengthen and grow the local economic base through regional exports appears not to have been a priority over this past decade.

Table 3. Medical Technologies Cluster Location Quotients for El Paso County

		LQ with Texas as Reference Economy			LQ with United States as Reference Economy			LQ with Bexar as Reference Economy		
		1990	1995	2000	1990	1995	2000	1990	1995	2000
Manufacturing										
2834	Pharmaceutical Preparations	0.49	0.59	0.55	0.18	0.21	0.21	0.56	0.47	0.32
3069	Fabricated Rubber Products, NEC	-	-	0.13	-	-	0.06	-	-	ND
3823	Industrial Instruments for Measurement Display & Control of Process Variables, & Related Products	0.14	0.57	0.27	0.13	0.64	0.31	ND	ND	-
3827	Optical Instruments & Lenses	-	-	0.22	-	-	0.07	-	-	-
3829	Measuring & Controlling Devices, NEC	-	0.42	-	-	0.24	-	-	0.70	-
3841	Surgical & Medical Instruments & Apparatus	18.14	15.27	0.13	9.85	9.41	0.05	8.22	ND	ND
3842	Orthopedic, Prosthetic, & Surgical Appliances & Supplies	0.16	0.19	0.42	0.15	0.21	0.43	ND	1.47	1.57
3851	Ophthalmic Goods	1.12	0.02	-	1.15	0.02	-	ND	0.01	-
Services										
8731	Commercial Physical & Biological Research	0.99	0.45	0.72	0.78	0.32	0.48	0.28	0.11	ND

		LQ with Dallas as Reference Economy			LQ with Harris as Reference Economy			LQ with Hidalgo as Reference Economy		
		1990	1995	2000	1990	1995	2000	1990	1995	2000
Manufacturing										
2834	Pharmaceutical Preparations	1.80	3.59	ND	9.04	ND	1.29	ND	-	-
3069	Fabricated Rubber Products, NEC	-	-	0.12	-	-	0.16	-	-	ND
3823	Industrial Instruments for Measurement Display & Control of Process Variables, & Related Products	0.09	0.37	0.17	0.15	0.52	0.24	-	-	-
3827	Optical Instruments & Lenses	-	-	ND	-	-	ND	-	-	-
3829	Measuring & Controlling Devices, NEC	-	0.47	-	-	0.30	-	-	-	-
3841	Surgical & Medical Instruments & Apparatus	65.20	15.60	0.26	18.73	18.75	ND	ND	ND	ND
3842	Orthopedic, Prosthetic, & Surgical Appliances & Supplies	0.32	ND	0.65	1.52	0.39	0.78	ND	-	-
3851	Ophthalmic Goods	0.30	0.01	-	ND	0.21	-	-	-	-
Services										
8731	Commercial Physical & Biological Research	2.07	1.86	0.98	0.72	0.38	0.61	ND	ND	ND

		LQ with Lubbock as Reference Economy			LQ with Tarrant as Reference Economy			LQ with Travis as Reference Economy		
		1990	1995	2000	1990	1995	2000	1990	1995	2000
Manufacturing										
2834	Pharmaceutical Preparations	-	-	ND	0.09	0.10	ND	ND	ND	ND
3069	Fabricated Rubber Products, NEC	-	-	-	-	-	0.03	-	-	ND
3823	Industrial Instruments for Measurement Display & Control of Process Variables, & Related Products	-	ND	ND	0.16	1.80	0.81	0.02	0.20	ND
3827	Optical Instruments & Lenses	-	-	-	-	-	ND	-	-	ND
3829	Measuring & Controlling Devices, NEC	-	-	-	-	5.06	-	-	0.11	-
3841	Surgical & Medical Instruments & Apparatus	ND	ND	-	13.87	8.27	0.05	ND	ND	ND
3842	Orthopedic, Prosthetic, & Surgical Appliances & Supplies	ND	ND	0.23	0.08	0.08	0.21	0.05	0.06	0.13
3851	Ophthalmic Goods	2.12	ND	-	11.82	0.15	-	ND	ND	-
Services										
8731	Commercial Physical & Biological Research	3.36	0.46	ND	4.85	3.39	ND	0.18	0.09	0.19

		LQ with Bernalillo as Reference Economy			LQ with Maricopa as Reference Economy			LQ with Pima as Reference Economy		
		1990	1995	2000	1990	1995	2000	1990	1995	2000
Manufacturing										
2834	Pharmaceutical Preparations	ND	ND	ND	0.75	0.58	0.79	-	-	-
3069	Fabricated Rubber Products, NEC	-	-	ND	-	-	ND	-	-	ND
3823	Industrial Instruments for Measurement Display & Control of Process Variables, & Related Products	-	ND	ND	0.20	1.24	0.62	ND	ND	ND
3827	Optical Instruments & Lenses	-	-	0.02	-	-	ND	-	-	0.22
3829	Measuring & Controlling Devices, NEC	-	1.29	-	-	ND	-	-	0.03	-
3841	Surgical & Medical Instruments & Apparatus	-	ND	ND	ND	131.73	ND	ND	7.67	ND
3842	Orthopedic, Prosthetic, & Surgical Appliances & Supplies	0.04	0.08	0.96	2.06	1.91	2.68	0.18	0.15	0.46
3851	Ophthalmic Goods	ND	ND	-	4.34	ND	-	ND	0.15	-
Services										
8731	Commercial Physical & Biological Research	0.04	0.02	0.03	5.00	1.16	1.60	1.02	0.28	0.42

Table 4 ranks the reference counties plus El Paso with respect to the number of firms, employees, and total wages for 2000. While some data are suppressed by the BLS for confidentiality purposes for the reference counties, El Paso still ranks very low in all three comparisons. Bernalillo County, home to Albuquerque and Sandia National Laboratories and closest in distance to El Paso than any of the reference economies, employs the most workers and pays the most wages in medical technologies. This underscores that *key cluster linkages between Bernalillo and El Paso do not exist*. One obvious policy consideration if El Paso wishes to pursue medical technologies is to create synergy with this area.

Table 4. 2000 Medical Technologies Rankings

Counties	Firms
1. Harris	196
2. Dallas	141
3. Maricopa	121
4. Bernalillo	89
5. Travis	83
6. Tarrant	46
7. Pima	43
8. El Paso	19
9. Bexar	18
10. Lubbock	4
11. Hidalgo	-

Counties	Employees
1. Bernalillo	9,593
2. Harris	6,407
3. Dallas	5,660
4. Travis	4,197
5. Tarrant	2,405
6. Maricopa	2,336
7. Bexar	950
8. Pima	934
9. El Paso	469
10. Lubbock	163
11. Hidalgo	-

Counties	Wages
1. Bernalillo	$608.9
2. Harris	$371.2
3. Dallas	$297.2
4. Travis	$246.9
5. Maricopa	$122.5
6. Tarrant	$83.6
7. Pima	$48.3
8. Bexar	$43.1
9. El Paso	$17.6
10. Lubbock	$3.5
11. Hidalgo	-

Health Services Economic Activity

El Paso County accounts for almost all employment and wages in the health field in West Texas.[18] Consequently, El Paso and the URG region are practically synonymous for this subsection. *(Health services data are not subject to non-disclosure confidentiality rules as medical technologies, so detailed statistics can be given.)*

Public and private employment by URG health care providers increased an average of 211 per year (1.2 percent per annum) between 1995 to 2000, from 17,393 to 18,448 (Figure 3). All of these gains were experienced by El Paso County alone in the BLS data. Individually, Home Health Care (SIC 808) had the greatest employment gains (Table 5). Unfortunately, this detailed industry group within health services paid substandard wages (Table 7). Three of the nine groups did not experience employment growth during this period; these are SICs 803 (Offices of Doctors of Osteopathy), 806 (Hospitals), and 807 (Medical & Dental Labs). Also from 1995 to 2000, nominal wages for the cluster as a whole increased 3.4 percent annually and directly injected $558.1 million into the regional economy in 2000 (Figure 4). This represented 4.4 percent of El Paso's personal income in 2000.[19]

Figure 3. El Paso Average Annual Employment for Health Services Cluster

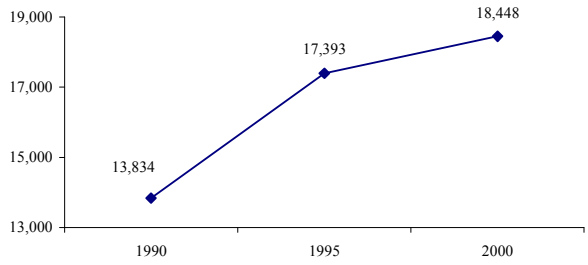


Figure 4. El Paso Total Annual Wages for Health Services Cluster (in millions)

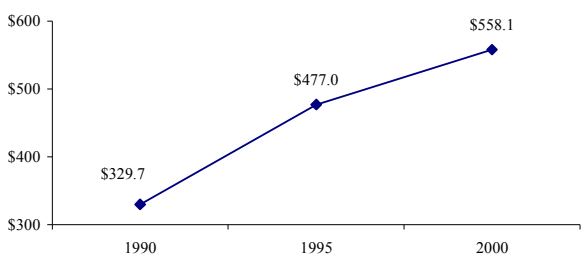


Table 5. El Paso Average Annual Employment for Healthcare Services Industry Groups

PERIOD	801 Offices & Clinics of Doctors of Medicine	802 Offices & Clinics of Dentists	803 Offices & Clinics of Doctors of Osteopathy	804 Offices & Clinics of Other Health Practitioners	805 Nursing and Personal Care Facilities	806 Hospitals	807 Medical & Dental Laboratories	808 Home Health Care Services	809 Miscellaneous Health & Allied Services, NEC
1990	2,489	621	33	531	880	6,673	474	1,506	627
1995	2,787	720	79	697	1,072	8,039	372	2,914	713
2000	3,137	794	25	785	1,311	6,731	329	4,402	934
95-00 Change	350	74	-54	88	239	-1,308	-43	1,488	221
95-00 % Change	12.6%	10.3%	-68.4%	12.6%	22.3%	-16.3%	-11.6%	51.1%	31.0%

Table 6. El Paso Average Annual Wages (in millions) for Healthcare Services Industry Groups

PERIOD	801 Offices & Clinics of Doctors of Medicine	802 Offices & Clinics of Dentists	803 Offices & Clinics of Doctors of Osteopathy	804 Offices & Clinics of Other Health Practitioners	805 Nursing and Personal Care Facilities	806 Hospitals	807 Medical & Dental Laboratories	808 Home Health Care Services	809 Miscellaneous Health & Allied Services, NEC
1990	$114.0	$12.3	$0.5	$12.9	$9.0	$147.0	$9.1	$12.3	$12.6
1995	$145.9	$17.9	$2.0	$13.0	$15.4	$211.1	$10.2	$42.0	$19.5
2000	$176.4	$24.0	$0.8	$22.3	$22.4	$216.4	$13.6	$48.3	$33.9
95-00 Change	$30.5	$6.1	-$1.2	$9.3	$7.0	$5.3	$3.4	$6.3	$14.5
95-00 % Change	20.9%	34.2%	-61.9%	71.7%	45.5%	2.5%	32.8%	14.9%	74.3%

Seven of the nine detailed industry groups paid medium to high wages (Table 7) in 2000. SICs 802 (Offices of Dentists), 803 (Offices of Doctors of Osteopathy), and 804 (Offices of Other Health Practitioners) paid between $13 and $15 per hour, SICs 806 (Hospitals), 807 (Medical & Dental Labs), and 809 (Misc. Health) paid between $15 and $20 per hour, and SIC 801 (Offices of Doctors of Medicine) paid the highest at over $27 per hour. The two remaining SICs paying non-living wages are 805 (Nursing & Personal Care) and 808 (Home Health Care), most likely due to a low level of specialization needed for personal and home health care. The result is that many of these workers are paid minimum wage levels with little or no insurance and compensation packages.

Table 7. El Paso Average Hourly Wages for Healthcare Services Industry Groups

PERIOD	801 Offices & Clinics of Doctors of Medicine	802 Offices & Clinics of Dentists	803 Offices & Clinics of Doctors of Osteopathy	804 Offices & Clinics of Other Health Practitioners	805 Nursing and Personal Care Facilities	806 Hospitals	807 Medical & Dental Laboratories	808 Home Health Care Services	809 Miscellaneous Health & Allied Services, NEC
2000	$27.04	$14.56	$14.70	$13.65	$8.22	$15.46	$19.82	$5.28	$17.46

Assuming 40 hour workweeks for the year period.

As an exercise, an hourly wage comparison is performed for two selected SICs, 801 (Offices of Doctors of Medicine) and 806 (Hospitals), to determine competitive pay by industrial grouping; that is, to see how El Paso fares in hourly wages versus other reference economies (Figures 5 and 6). SIC 801 is El Paso's highest paying health classification at $27.04 in 2000. By comparison, SIC 801 paid $29.58 in Texas, $27.24 in the United States, $28.83 in Travis, $36.44 in Dallas, and $30.46 in Harris. SIC 806 is a critical employment area and paid $15.46 in El Paso in 2000. By comparison, SIC 806 paid $16.13 in Texas, $16.75 in the United States, $15.49 in Travis, $17.84 in

Dallas, and $18.09 in Harris. In this example, for a doctor of medicine the Dallas area pays the highest, while for hospital employees, the Houston area pays the most (assuming comparable workweeks).[20] Central-East Texas offers greater pay than El Paso (this is a simple comparison and does not take into account an area's cost of living).

Figure 5. 2000 Hourly Wages for SIC 801 Offices of Doctors of Medicine

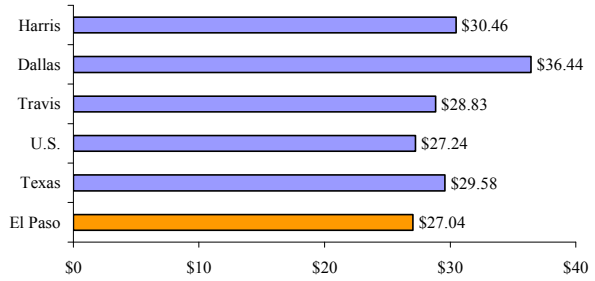
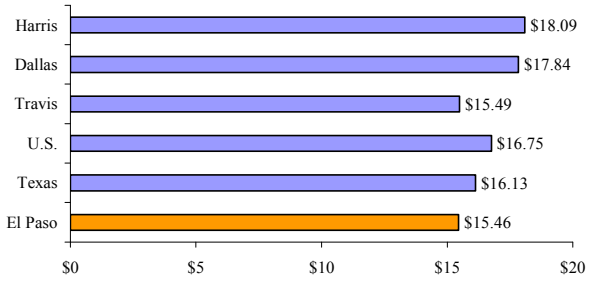


Figure 6. 2000 Hourly Wages for SIC 806 Hospitals



A recent Scope of Work performed by the Institute for Policy and Economic Development (IPED) for the Upper Rio Grande Workforce Development Board estimates that the SIC 80 major industry group (Health Services) will be the seventh fastest growing sector between 2003 and 2008 at about three percent per annum.[21] However, in absolute employment gains, this El Paso sector is expected to be the second largest behind Business Services. Individually, all but one of the nine SIC 3-digit detailed industry groups within the health cluster are expected to perform well in employment growth (osteopathy shows few gains but historically has had low employment). Wages are also estimated to perform well in the medium to high wages groups discussed above. Furthermore, individual health occupations are also estimated to do well. This suggests that specific, well-paying health services are a viable training cluster, especially given that with increases in regional population demand will inherently rise as well.

Health Services Location Quotients

LQs for nine health detailed industry groups are calculated for the region. The El Paso *LQs* are provided in Table 8 and when compared to the URG *LQs*, all but three of the outcomes remain the same. The latter can be found in Appendix 4. The three outcome changes in the URG *LQs* are in SICs 804 (Offices of Other Health Practitioners) and 806 (Hospitals) in 1995 and 2000, respectively, against Hidalgo (Appendix 4), and in SIC 807 (Medical & Dental Labs) in 1990 against Tarrant. Otherwise, all analyses remain the same. The reader should note that health *LQs* for the URG region are slightly lower than those for El Paso because the local industry ratio declines with the additional populations of the five other URG counties.

In general, modified *LQs* using population indicate that the El Paso health services cluster is a non-basic sector with the exceptions of SICs 808 (Home Health Care) and 809 (Misc. Health). For all reference economies excluding Hidalgo County, SICS 801-807 remained or became non-basic over time, signifying that local employment in these health industry groups is less than is expected (Table 8, non-shaded *LQs*). Since these *LQs* are less than 1 in 2000, by definition, these industry groups did not even meet local demand for these given services. That is, employment in health services SICs 801-807 was not sufficient relative to the regional population. The troublesome shortages relate to specialized industrial fields, those falling under "Offices and Clinics of Health Practitioners (SICs 801-804)."

LQs for SICs 808 (Home Health Care) and 809 (Misc. Health) reveal that one or both of these industry groups have some level of basic employment against all twelve reference areas in 2000 (recall that SIC 808 pays non-living wages in El Paso). In other words, El Paso appeared to have some excess employment in home and miscellaneous health care. To be more precise, *LQs* for SIC 808 are greater than 1 in 2000 relative to Texas, the United States, Dallas, Harris, Tarrant, Travis, Bernalillo, Maricopa, and Pima. *LQs* for SIC 809 are greater than 1 in 2000 against Texas, Bexar, Dallas, Harris, Hidalgo, Lubbock, Tarrant, and Travis.

Comparing El Paso with the only border reference county, Hidalgo, Table 8 shows that over time El Paso had *LQs > 1* in SICs 802 (Offices of Dentists), 806 (Hospitals), and 809 (Misc. Health). Also, *LQs* are not possible

for 2000 in SICs 803 (Offices of Osteopathy) and 807 (Medical and Dental Labs) due to nondisclosure data for Hidalgo. It is likely, though, comparing employment trends in El Paso in these two industry groups and looking at the 1995 *LQs*, that in SICs 803 and 807 El Paso has some level of basic employment relative to Hidalgo. Hence, against the border county of Hidalgo, the results are mixed, with both areas showing employment strengths and weaknesses. However, Hidalgo does show better job performance relative to the population in the highest paying industry group in health services – Offices of Doctors of Medicine.[22]

Table 8. Health Services Cluster Location Quotients for El Paso County

		LQ with Texas as Reference Economy			LQ with United States as Reference Economy			LQ with Bexar as Reference Economy		
		1990	1995	2000	1990	1995	2000	1990	1995	2000
Services										
801	Offices & Clinics of Doctors of Medicine	0.86	0.82	0.74	0.76	0.70	0.66	0.76	0.65	0.57
802	Offices & Clinics of Dentists	0.67	0.64	0.62	0.50	0.49	0.48	0.69	0.61	0.58
803	Offices & Clinics of Doctors of Osteopathy	ND	0.64	0.21	0.39	0.65	0.21	0.52	0.59	0.14
804	Offices & Clinics of Other Health Practitioners	0.90	0.78	0.76	0.81	0.71	0.74	0.89	0.79	0.58
805	Nursing and Personal Care Facilities	0.31	0.31	0.39	0.25	0.24	0.28	0.33	0.35	0.42
806	Hospitals	0.76	0.81	0.64	0.59	0.65	0.54	0.72	0.72	0.62
807	Medical & Dental Laboratories	ND	0.88	0.68	1.19	0.79	0.65	0.76	0.44	0.29
808	Home Health Care Services	0.81	0.81	1.12	2.24	1.89	2.84	0.97	0.56	0.90
809	Miscellaneous Health & Allied Services, NEC	1.67	1.34	1.29	1.05	0.83	0.94	1.25	1.08	1.07

		LQ with Dallas as Reference Economy			LQ with Harris as Reference Economy			LQ with Hidalgo as Reference Economy		
		1990	1995	2000	1990	1995	2000	1990	1995	2000
Services										
801	Offices & Clinics of Doctors of Medicine	0.64	0.56	0.49	0.63	0.62	0.61	1.06	1.03	0.73
802	Offices & Clinics of Dentists	0.48	0.47	0.44	0.53	0.50	0.49	1.42	1.42	1.26
803	Offices & Clinics of Doctors of Osteopathy	ND	0.33	0.12	0.76	1.26	0.44	ND	2.03	ND
804	Offices & Clinics of Other Health Practitioners	0.63	0.49	0.48	0.74	0.68	0.63	1.65	1.00	0.87
805	Nursing and Personal Care Facilities	0.39	0.40	0.48	0.63	0.65	0.76	0.57	0.72	0.84
806	Hospitals	0.69	0.83	0.65	0.68	0.71	0.60	1.49	1.40	1.03
807	Medical & Dental Laboratories	0.57	0.35	0.29	1.11	0.64	0.48	ND	2.13	ND
808	Home Health Care Services	0.88	0.84	1.48	0.86	0.88	1.28	1.19	0.73	0.47
809	Miscellaneous Health & Allied Services, NEC	ND	0.89	1.50	1.75	1.79	1.53	1.69	1.62	1.53

		LQ with Lubbock as Reference Economy			LQ with Tarrant as Reference Economy			LQ with Travis as Reference Economy		
		1990	1995	2000	1990	1995	2000	1990	1995	2000
Services										
801	Offices & Clinics of Doctors of Medicine	0.64	0.59	0.52	0.85	0.80	0.74	0.53	0.52	0.49
802	Offices & Clinics of Dentists	0.61	0.59	0.53	0.51	0.50	0.53	0.46	0.48	0.40
803	Offices & Clinics of Doctors of Osteopathy	0.24	0.67	ND	0.14	0.20	0.06	2.48	2.80	0.58
804	Offices & Clinics of Other Health Practitioners	0.71	0.70	0.62	0.65	0.54	0.72	0.67	0.64	0.52
805	Nursing and Personal Care Facilities	0.39	0.32	0.30	0.34	0.34	0.39	0.41	0.51	0.69
806	Hospitals	0.52	0.51	ND	0.82	0.82	0.72	1.07	1.13	0.72
807	Medical & Dental Laboratories	0.64	0.63	0.49	1.03	0.88	0.78	0.83	0.45	0.36
808	Home Health Care Services	0.45	0.47	0.67	1.72	1.61	2.02	0.71	0.96	1.46
809	Miscellaneous Health & Allied Services, NEC	0.79	1.22	1.09	1.67	1.12	1.26	1.53	1.35	1.23

		LQ with Bernalillo as Reference Economy			LQ with Maricopa as Reference Economy			LQ with Pima as Reference Economy		
		1990	1995	2000	1990	1995	2000	1990	1995	2000
Services										
801	Offices & Clinics of Doctors of Medicine	0.57	0.43	0.44	0.69	0.65	0.54	0.64	0.80	0.68
802	Offices & Clinics of Dentists	0.40	0.42	0.36	0.49	0.50	0.50	0.53	0.47	0.48
803	Offices & Clinics of Doctors of Osteopathy	0.18	0.66	0.26	ND	0.22	0.09	ND	0.34	0.10
804	Offices & Clinics of Other Health Practitioners	0.62	0.52	0.53	0.65	0.57	0.75	0.82	0.76	0.96
805	Nursing and Personal Care Facilities	0.45	0.29	0.33	0.34	0.35	0.59	0.40	0.51	0.42
806	Hospitals	0.57	0.60	0.38	0.75	0.94	0.85	0.61	0.66	0.60
807	Medical & Dental Laboratories	0.55	0.36	0.19	0.89	0.62	0.42	ND	0.87	0.91
808	Home Health Care Services	3.18	1.54	3.16	ND	3.28	4.44	3.42	5.20	10.02
809	Miscellaneous Health & Allied Services, NEC	0.49	0.64	0.85	0.92	0.60	0.94	0.63	0.59	0.63

El Paso County provides health services to the entire URG region. It is for this reason that URG *LQs* are provided in Appendix 4 since it makes practical sense to analyze how El Paso's health services are impacted by regional demand from the West Texas counties. While the general outcomes do not change, the lower URG *LQs* do tell us that when taking the region as a whole, the health deficiency problems that have plagued the border region are more serious. Moreover, it should be noted that El Paso, like other border communities, exports health services to Mexican nationals. This interaction is bi-directional, as El Pasoans also take advantage of Mexican health providers such as dentists, although it is safe to assume that more Mexican nationals make use of El Paso's health services. This interaction between nations is currently immeasurable due to lack of data, but it should be recognized that the "regional economy" is incomplete without encompassing the areas between Ciudad Juárez and Chihuahua city. With additional demand from the unknown but significant millions of annual border crossings that are health related, the relevance of El Paso's health industries becomes more apparent.

The poor empirical performance of El Paso's health services using the *LQ* economic base technique is not surprising. Occupational shortages of health care personnel are well documented along the border area. A disproportionate number of border counties are designated Medically Underserved Areas (MUA) and Health Professional Shortage Areas (HPSA), with some of the most severe deficiencies in mental health and primary care services, and acute care facilities.[23] As Amaya points out,

> …demographic and social factors on both sides of the border interact to create health conditions distinct from other areas in the United States, including a higher risk for certain health problems and reduced access to healthcare service. Health care delivery on the border can be typified by its inadequate infrastructure, insufficient work force, and limited international collaboration.

Exhibit 2. Conversion from SIC to NAICS

Standard Industrial Classification

The Standard Industrial Classification (SIC – U.S. Office of Management and Budget, last revision 1987) was a 4-digit product-by-industry classification system unique to the United States since the 1930s and revised periodically over the past 50 years. The SIC was developed as an industry system that classified single physical location establishments by *type* of activity in which they were primarily engaged. It allowed for comparison of U.S. import and export statistics with data related to domestic production and other U.S. economic statistics. It was developed during a period when the nation's economy was more predominately manufacturing based than today. Present day it was limited in that it lacked correspondence to the systems of Canada and Mexico and failed to take into account the burgeoning service-based economy. The SIC has direct and partial correspondence to the NAICS.

North American Industry Classification System

The North American Industry Classification System (NAICS – U.S. Office of Management and Budget (OMB), 1997 and 2002) is the first-ever North American industry 6-digit classification system that replaced the 1987 U.S. SIC and the classification systems of Canada (1980 SIC) and Mexico (1994 Mexican Classification of Activities and Products (CMAP)). The NAICS was developed in cooperation with the Economic Classification Policy Committee (ECPC), on behalf of OMB, Statistics Canada, and Mexico's Instituto Nacional de Estadística, Geografía e Informática (INEGI) and classifies establishments into industries based on the *activities* in which they are primarily engaged.

It is erected on a production-oriented or supply-based conceptual framework in that establishments are grouped into industries according to similarity in the processes used to produce goods or services. A production-oriented industry classification system ensures that statistical agencies in the three countries can produce information on inputs and outputs, industrial performance, productivity, unit labor costs, employment, and other statistics and structural changes occurring in each of the three economies. An establishment is classified to an industry when its primary activity meets the definition for that industry. Because establishments may perform more than one activity, it is necessary to determine procedures for identifying the primary activity of the establishment.

Recognizing the changing and growing services-based economy(ies), there are 21 sectors (1 unclassified) in the NAICS, of which 16 are services related (the SIC had 11 divisions, of which 5 were services related). It

provides comparability among the 3 nations at the 5-digit level – industrial production (first 4 digits) and employment statistics (5^{th} digit) – with the 6^{th} digit reserved for the respective nations in recognition of nationally important activities. When the 6^{th} digits in the respective countries do not match then it generally indicates that the U.S. national industry is not comparable to 6-digit national industries of Mexico and/or Canada.

Appendix 1a. SIC Correspondence to NAICS for Medical Technologies

SIC Code	SIC Description	NAICS Code	NAICS Description		
2833	Medicinal Chemicals and Botanical Products	325411	Medicinal & Botanical	Pharmaceuticals	SIC Manufacturing
2834	Pharmaceutical Preparations	325412	Pharmaceutical Preparation (p)		
2835	In Vitro and In Vivo Diagnostic Substances	325412	Pharmaceutical Preparation (p)		
		325413	In-Vitro Diagnostic Substance		
2836	Biological Products, Except Diagnostic Substances	325414	Biological Product (except Diagnostic)		
3053	Gaskets, Packing, and Sealing Devices	339991	Gasket. Packing, & Sealing Device	Medical Devices	
3061	Molded, Extruded, and Lathe-Cut Mechanical Rubber Goods	326291	Rubber Product for Mechanical Use		
3069	Fabricated Rubber Products, NEC	31332	Fabric Coating Mills (p)		
		315299	All Other Cut/Sew Apparel (p)		
		315999	Other Apparel Accessories/Other Apparel (p)		
		339113	Surgical Appliance/Supplies (p)		
3823	Industrial Instruments for Measurement, Display, & Control of Process Variables; & Related Products	334513	Instruments & Related Product for Measuring, Displaying, & Controlling Industrial Process Variables		
3824	Totalizing Fluid Meters and Counting Devices	334514	Totalizing Fluid Meter and Counting Device (p)		
3826	Laboratory Analytical Instruments	334516	Analytical Laboratory Instrument		
3827	Optical Instruments and Lenses	333314	Optical Instrument and Lens		
3829	Measuring and Controlling Devices, NEC	334514	Totalizing Fluid Meter & Counting Device (p)		
		339112	Surgical & Medical Instrument (p)		
		334519	Other Measuring & Controlling Device		
3841	Surgical and Medical Instruments and Apparatus	339111	Laboratory Apparatus & Furniture (p)		
		339112	Surgical & Medical Instrument (p)		
3842	Orthopedic, Prosthetic, and Surgical Appliances and Supplies	322291	Sanitary Paper Product (p)		
		339113	Surgical Appliance & Supplies		
		334510	Electromedical & Electrotherapeutic Apparatus (p)		
3843	Dental Equipment and Supplies	339114	Dental Equipment & Supplies		
3844	X-Ray Apparatus and Tubes and Related Irradiation Apparatus	334517	Irradiation Apparatus (p)		
3845	Electromedical and Electrotherapeutic Apparatus	334517	Irradiation Apparatus (p)		
		334510	Electromedical & Electrotherapeutic Apparatus (p)		
3851	Ophthalmic Goods	339113	Surgical & Medical Instrument (p)		
		339115	Ophthalmic Goods (p)		
8731	Commercial Physical and Biological Research	54171	Research and Development in the Physical, Engineering, & Life Sciences (p)	Biotech	SIC Service

NEC - Not Elsewhere Classified

p - partial correspondence

Appendix 1b. SIC Correspondence to NAICS for Health Services

SIC Code	SIC Description	NAICS Code	NAICS Description	
8011	Offices & Clinics of Doctors of Medicine	621493	Freestanding Ambulatory Surgical & Emergency Centers	SIC Services
		621491	HMO Medical Centers	
		621112	Offices of Physicians, Mental Health Specialists (p)	
		621111	Offices of Physicians, (except Mental Health Specialists) (p)	
8021	Offices & Clinics of Dentists	62121	Offices of Dentists	
8031	Offices & Clinics of Doctors of Osteopathy	621111	Offices of Physicians (except Mental Health Specialists) (p)	
		621112	Offices of Physicians, Mental Health Specialists (p)	
8041	Offices & Clinics of Chirpractors	62131	Offices of Chiropractors	
8042	Offices & Clinics of Optometrists	62132	Offices of Optometrists	
8043	Offices & Clinics of Podiatrists	621391	Offices of Podiatrists	
8049	Offices & Clinics of Health Practitioners, NEC	62133	Offices of Mental Health Practitioners (except Physicians)	
		62134	Offices of Physical, Occupational, & Speech Therapists & Audiologists	
		621399	Offices of All Other Miscellaneous Health Practitioners	
8051	Skilled Nursing Care Facilities	623311	Continuing Care Retirement Communities (p)	
		62311	Nursing Care Facilities (p)	
8052	Intermediate Care Facilities	623311	Continuing Care Retirement Communities (p)	
		62321	Residential Mental Retardation Facilities	
		62311	Nursing Care Facilities (p)	
8059	Nursing & Personal Care Facilities, NEC	623311	Continuing Care Retirement Communities (p)	
		62311	Nursing Care Facilities (p)	
8062	General Medical & Surgical Hospitals	62211	General Medical and Surgical Hospitals (p)	
8063	Psychiatric Hospitals	62221	Psychiatric & Substance Abuse Hospitals (p)	
8069	Specialty Hospitals, Except Psychiatric	62211	General Medical and Surgical Hospitals (p)	
		62221	Psychiatric & Substance Abuse Hospitals (p)	
		62231	Specialty (except Psychiatric & Substance Abuse) Hospitals	
8071	Medical Laboratories	621512	Diagnostic Imaging Centers	
		621511	Medical Laboratories	
8072	Dental Laboratories	339116	Dental Laboratories	
8082	Home Health Care Services	62161	Home Health Care Services	
8092	Kidney Dialysis Centers	621492	Kidney Dialysis Centers	
8093	Specialty Outpatient Facilities, NEC	62141	Family Planning Centers (p)	
		62142	Outpatient Mental Health & Substance Abuse Centers	
		621498	All Other Outpatient Care Facilities	
8099	Health & Allied Services, NEC	621991	Blood & Organ Banks	
		54143	Graphic Design Services (p)	
		541922	Commercial Photography (p)	
		62141	Family Planning Centers (p)	
		621999	All Other Miscellaneous Ambulatory Health Care Services	

NEC - Not Elsewhere Classified

p - partial correspondence

Appendix 2a. SIC Correspondence to NAICS for Medical Technologies

SIC Code	SIC Description	Percent Correspondence	Accumulated Correspondence	NAICS	NAICS Description
801	Offices and clinics of medical doctors	92.5	92.5	6211	Offices of physicians
801	Offices and clinics of medical doctors	5.8	98.3	6214	Outpatient care centers
802	Offices and clinics of dentists	99.8	99.8	6212	Offices of dentists
803	Offices and clinics of osteopathic physician	99.8	99.8	6211	Offices of physicians
804	Offices and clinics of other health practitioners	99.3	99.3	6213	Offices of other health practitioners
805	Nursing and personal care facilities	83.7	83.7	6231	Nursing care facilities
805	Nursing and personal care facilities	11.9	95.6	6233	Community care facilities for the elderly
805	Nursing and personal care facilities	3.7	99.3	6232	Residential mental health facilities
806	Hospitals	93.6	93.6	6221	General medical and surgical hospitals
806	Hospitals	3.2	96.8	6223	Other hospitals
806	Hospitals	2.1	98.9	6222	Psychiatric and substance abuse hospitals
807	Medical and dental laboratories	75.8	75.8	6215	Medical and diagnostic laboratories
807	Medical and dental laboratories	21.5	97.3	3391	Medical equipment and supplies mfg.
808	Home health care services	98.7	98.7	6216	Home health care services
809	Health and allied services, nec	76.2	76.2	6214	Outpatient care centers
809	Health and allied services, nec	20.4	96.6	6219	Other ambulatory health care services

Appendix 2b. SIC Correspondence to NAICS for Health Services

SIC Code	SIC Description	Percent Correspondence	Accumulated Correspondence	NAICS	NAICS Description
283	Drugs	87.8	87.8	3254	Pharmaceutical and medicine manufacturing
305	Hose, belting, gaskets, and packing	57.5	57.5	3399	Other misc. manufacturing
306	Fabricated rubber products, nec	88.9	88.9	3262	Rubber product manufacturing
306	Fabricated rubber products, nec	3.2	92.1	3133	Textile and fabric finishing mills
306	Fabricated rubber products, nec	2.6	94.7	3391	Medical equipment and supplies mfg.
382	Measuring and controlling devices	84.4	84.4	3345	Electronic instrument manufacturing
382	Measuring and controlling devices	9.4	93.8	3333	Commercial and service industry mfg.
382	Measuring and controlling devices	4.0	97.8	3391	Medical equipment and supplies mfg.
384	Medical instruments and supplies	70.6	70.6	3391	Medical equipment and supplies mfg.
384	Medical instruments and supplies	22.9	93.5	3345	Electronic instrument manufacturing
384	Medical instruments and supplies	1.9	95.4	3222	Converted paper product manufacturing
385	Ophthalmic goods	96.7	96.7	3391	Medical equipment and supplies mfg.
873	Research and testing services	65.7	65.7	5417	Scientific research and development services

Appendix 3. Medical Technologies Cluster Location Quotients for the Upper Rio Grande Region

		LQ with Texas as Reference Economy			LQ with United States as Reference Economy			LQ with Bexar as Reference Economy		
		1990	1995	2000	1990	1995	2000	1990	1995	2000
Manufacturing										
2834	Pharmaceutical Preparations	0.47	0.58	0.53	0.18	0.20	0.21	0.54	0.46	0.31
3069	Fabricated Rubber Products, NEC	-	-	0.12	-	-	0.06	-	-	ND
3823	Industrial Instruments for Measurement Display & Control of Process Variables, & Related Products	0.13	0.56	0.26	0.13	0.62	0.30	ND	ND	-
3827	Optical Instruments & Lenses	-	-	0.21	-	-	0.06	-	-	-
3829	Measuring & Controlling Devices, NEC	-	0.40	-	-	0.24	-	-	0.68	-
3841	Surgical & Medical Instruments & Apparatus	17.51	14.81	0.13	9.51	9.12	0.05	7.94	ND	ND
3842	Orthopedic, Prosthetic, & Surgical Appliances & Supplies	0.15	0.18	0.41	0.14	0.20	0.41	ND	1.43	1.52
3851	Ophthalmic Goods	1.09	0.02	-	1.11	0.02	-	ND	0.01	-
Services										
8731	Commercial Physical & Biological Research	0.95	0.44	0.70	0.75	0.31	0.46	0.27	0.11	ND

		LQ with Dallas as Reference Economy			LQ with Harris as Reference Economy			LQ with Hidalgo as Reference Economy		
		1990	1995	2000	1990	1995	2000	1990	1995	2000
Manufacturing										
2834	Pharmaceutical Preparations	1.74	3.48	ND	8.73	ND	1.25	ND	-	-
3069	Fabricated Rubber Products, NEC	-	-	0.11	-	-	0.16	-	-	ND
3823	Industrial Instruments for Measurement Display & Control of Process Variables, & Related Products	0.09	0.36	0.17	0.14	0.51	0.23	-	-	-
3827	Optical Instruments & Lenses	-	-	ND	-	-	ND	-	-	-
3829	Measuring & Controlling Devices, NEC	-	0.45	-	-	0.29	-	-	-	-
3841	Surgical & Medical Instruments & Apparatus	62.94	15.12	0.25	18.08	18.18	ND	ND	ND	ND
3842	Orthopedic, Prosthetic, & Surgical Appliances & Supplies	0.31	ND	0.62	1.47	0.37	0.75	ND	-	-
3851	Ophthalmic Goods	0.29	0.01	-	ND	0.20	-	-	-	-
Services										
8731	Commercial Physical & Biological Research	1.99	1.80	0.95	0.69	0.37	0.59	ND	ND	ND

		LQ with Lubbock as Reference Economy			LQ with Tarrant as Reference Economy			LQ with Travis as Reference Economy		
		1990	1995	2000	1990	1995	2000	1990	1995	2000
Manufacturing										
2834	Pharmaceutical Preparations	-	-	ND	0.09	0.10	ND	ND	ND	ND
3069	Fabricated Rubber Products, NEC	-	-	-	-	-	0.03	-	-	ND
3823	Industrial Instruments for Measurement Display & Control of Process Variables, & Related Products	-	ND	ND	0.16	1.75	0.78	0.02	0.20	ND
3827	Optical Instruments & Lenses	-	-	-	-	-	ND	-	-	ND
3829	Measuring & Controlling Devices, NEC	-	-	-	-	4.91	-	-	0.11	-
3841	Surgical & Medical Instruments & Apparatus	ND	ND	-	13.39	8.02	0.05	ND	ND	ND
3842	Orthopedic, Prosthetic, & Surgical Appliances & Supplies	ND	ND	0.22	0.07	0.08	0.21	0.05	0.05	0.13
3851	Ophthalmic Goods	2.04	ND	-	11.41	0.15	-	ND	ND	-
Services										
8731	Commercial Physical & Biological Research	3.25	0.45	ND	4.68	3.28	ND	0.17	0.09	0.18

		LQ with Bernalillo as Reference Economy			LQ with Maricopa as Reference Economy			LQ with Pima as Reference Economy		
		1990	1995	2000	1990	1995	2000	1990	1995	2000
Manufacturing										
2834	Pharmaceutical Preparations	ND	ND	ND	0.73	0.56	0.76	-	-	-
3069	Fabricated Rubber Products, NEC	-	-	ND	-	-	ND	-	-	ND
3823	Industrial Instruments for Measurement Display & Control of Process Variables, & Related Products	-	ND	ND	0.19	1.20	0.60	ND	ND	ND
3827	Optical Instruments & Lenses	-	-	0.02	-	-	ND	-	-	0.21
3829	Measuring & Controlling Devices, NEC	-	1.25	-	-	ND	-	-	0.03	-
3841	Surgical & Medical Instruments & Apparatus	-	ND	ND	ND	127.70	ND	ND	7.43	ND
3842	Orthopedic, Prosthetic, & Surgical Appliances & Supplies	0.04	0.07	0.93	1.99	1.85	2.59	0.17	0.15	0.45
3851	Ophthalmic Goods	ND	ND	-	4.19	ND	-	ND	0.15	-
Services										
8731	Commercial Physical & Biological Research	0.04	0.02	0.03	4.83	1.13	1.54	0.98	0.27	0.41

Appendix 4. Health Services Cluster Location Quotients for the Upper Rio Grande Region

		LQ with Texas as Reference Economy			LQ with United States as Reference Economy			LQ with Bexar as Reference Economy		
		1990	1995	2000	1990	1995	2000	1990	1995	2000
Services										
801	Offices & Clinics of Doctors of Medicine	0.84	0.79	0.72	0.74	0.68	0.64	0.74	0.63	0.56
802	Offices & Clinics of Dentists	0.65	0.62	0.60	0.48	0.48	0.46	0.66	0.59	0.56
803	Offices & Clinics of Doctors of Osteopathy	ND	0.62	0.20	0.37	0.62	0.20	0.50	0.57	0.14
804	Offices & Clinics of Other Health Practitioners	0.86	0.76	0.73	0.77	0.68	0.71	0.85	0.76	0.56
805	Nursing and Personal Care Facilities	0.29	0.30	0.38	0.24	0.23	0.27	0.31	0.33	0.40
806	Hospitals	0.73	0.78	0.62	0.56	0.63	0.53	0.69	0.70	0.60
807	Medical & Dental Laboratories	ND	0.84	0.66	1.14	0.77	0.62	0.73	0.43	0.28
808	Home Health Care Services	0.78	0.78	1.08	2.15	1.82	2.74	0.93	0.54	0.87
809	Miscellaneous Health & Allied Services, NEC	1.61	1.29	1.24	1.01	0.80	0.91	1.20	1.05	1.03

		LQ with Dallas as Reference Economy			LQ with Harris as Reference Economy			LQ with Hidalgo as Reference Economy		
		1990	1995	2000	1990	1995	2000	1990	1995	2000
Services										
801	Offices & Clinics of Doctors of Medicine	0.62	0.55	0.48	0.62	0.60	0.59	1.04	1.00	0.71
802	Offices & Clinics of Dentists	0.46	0.46	0.43	0.51	0.48	0.47	1.37	1.37	1.22
803	Offices & Clinics of Doctors of Osteopathy	ND	0.32	0.12	0.73	1.22	0.43	ND	1.96	ND
804	Offices & Clinics of Other Health Practitioners	0.61	0.47	0.47	0.71	0.66	0.61	1.59	0.97	0.84
805	Nursing and Personal Care Facilities	0.37	0.38	0.46	0.61	0.62	0.74	0.55	0.69	0.81
806	Hospitals	0.66	0.80	0.63	0.65	0.68	0.58	1.44	1.35	0.99
807	Medical & Dental Laboratories	0.55	0.33	0.28	1.07	0.61	0.46	ND	2.06	ND
808	Home Health Care Services	0.85	0.81	1.43	0.83	0.85	1.24	1.14	0.70	0.46
809	Miscellaneous Health & Allied Services, NEC	ND	0.86	1.45	1.68	1.73	1.48	1.62	1.56	1.48

		LQ with Lubbock as Reference Economy			LQ with Tarrant as Reference Economy			LQ with Travis as Reference Economy		
		1990	1995	2000	1990	1995	2000	1990	1995	2000
Services										
801	Offices & Clinics of Doctors of Medicine	0.63	0.57	0.51	0.83	0.78	0.73	0.51	0.50	0.47
802	Offices & Clinics of Dentists	0.59	0.56	0.51	0.49	0.48	0.51	0.45	0.46	0.39
803	Offices & Clinics of Doctors of Osteopathy	0.23	0.65	ND	0.14	0.20	0.06	2.38	2.70	0.56
804	Offices & Clinics of Other Health Practitioners	0.68	0.67	0.60	0.63	0.52	0.69	0.65	0.62	0.50
805	Nursing and Personal Care Facilities	0.37	0.31	0.29	0.33	0.33	0.38	0.39	0.49	0.67
806	Hospitals	0.50	0.49	ND	0.79	0.79	0.69	1.03	1.09	0.69
807	Medical & Dental Laboratories	0.61	0.61	0.47	0.99	0.85	0.76	0.80	0.43	0.34
808	Home Health Care Services	0.43	0.45	0.65	1.65	1.55	1.95	0.68	0.92	1.41
809	Miscellaneous Health & Allied Services, NEC	0.76	1.18	1.05	1.61	1.08	1.21	1.48	1.30	1.19

		LQ with Bernalillo as Reference Economy			LQ with Maricopa as Reference Economy			LQ with Pima as Reference Economy		
		1990	1995	2000	1990	1995	2000	1990	1995	2000
Services										
801	Offices & Clinics of Doctors of Medicine	0.56	0.42	0.43	0.67	0.64	0.53	0.62	0.78	0.66
802	Offices & Clinics of Dentists	0.39	0.41	0.35	0.47	0.49	0.48	0.51	0.45	0.46
803	Offices & Clinics of Doctors of Osteopathy	0.18	0.64	0.25	ND	0.21	0.09	ND	0.33	0.10
804	Offices & Clinics of Other Health Practitioners	0.60	0.50	0.51	0.63	0.55	0.73	0.79	0.74	0.92
805	Nursing and Personal Care Facilities	0.43	0.28	0.32	0.33	0.33	0.57	0.39	0.49	0.41
806	Hospitals	0.55	0.58	0.36	0.72	0.91	0.82	0.59	0.64	0.58
807	Medical & Dental Laboratories	0.53	0.35	0.19	0.86	0.59	0.40	ND	0.84	0.88
808	Home Health Care Services	3.06	1.48	3.05	ND	3.17	4.29	3.29	5.01	9.67
809	Miscellaneous Health & Allied Services, NEC	0.47	0.62	0.82	0.89	0.58	0.91	0.61	0.56	0.61

In addition, specialized fields along the border are negatively affected by such factors as high malpractice insurance premiums and low government funded medical reimbursements (Medicare, Medicaid, and CHIP). The lack of general health care personnel can also be attributed to the lack of a 4-year medical school, and a low local supply of qualified persons – many jobs within health services require some level of specialization including college degrees, so the low level of educational attainment along the border is problematic.

Table 9 shows that out of the eleven counties analyzed in this study, El Paso ranks ninth in the number of firms and wages in 2000 and tenth in the number of workers employed in health services. The Houston area dominates the rankings, followed by the Phoenix, Dallas, San Antonio, Fort Worth, and Austin areas. The

Albuquerque area, with a population base lower than that of the El Paso region's, also performs better in the rankings. Between the two border counties, El Paso fares better than Hidalgo in the average number of firms and total wages, while Hidalgo employs more workers. Lubbock has lower rankings than El Paso, as should be expected since its population base is roughly one-third that of the El Paso region's.

Table 9. 2000 Health Services Rankings

Counties	Firms
1. Harris	6,251
2. Maricopa	4,835
3. Dallas	4,472
4. Bexar	2,485
5. Tarrant	2,425
6. Travis	1,465
7. Pima	1,263
8. Bernalillo	1,041
9. El Paso	843
10. Hidalgo	683
11. Lubbock	486

Counties	Employees
1. Harris	128,963
2. Maricopa	97,846
3. Dallas	90,593
4. Bexar	59,994
5. Tarrant	49,589
6. Travis	31,169
7. Pima	29,777
8. Bernalillo	30,144
9. Hidalgo	20,023
10. El Paso	18,413
11. Lubbock	7,547

Counties	Wages
1. Harris	$4,929.4
2. Maricopa	$3,911.8
3. Dallas	$3,876.3
4. Bexar	$1,968.8
5. Tarrant	$1,855.4
6. Travis	$1,147.0
7. Bernalillo	$1,078.7
8. Pima	$1,072.3
9. El Paso	$557.2
10. Hidalgo	$465.3
11. Lubbock	$274.7

Growth within health services is ultimately related to demographics, so growth within the cluster is inevitiable. The real question is whether policymakers can stimulate, develop, and enhance this high paying sector through proposed investments such as the 4-year medical school and the Border Health Institute and followed by proper workforce and educational training. The benefits for El Paso are two-fold: first, it helps narrow the gap between regional (and international) demand for health services and the supply of health care providers; and second, it helps the region's economic base through multiplying income, social spillovers, and possibly, further employment and output through linkages with medical technologies by encouraging local development of new medical products, services, and techniques (indirect linkages with supplier chains could also result).

CONCLUSION

Empirical results using *Location Quotients* show that the El Paso region is a non-basic employer in the medical technologies and health services clusters. Hence, at best only local demand is being met with little or no regional exports. While health services grew between 1990 and 2000, relative to the reference economies they grew at a slower rate and failed to keep up with demographic trends, the principal demand factor. However, there were two exceptions, Home Health Care Services and Miscellaneous Health and Allied Services, the first of which pays non-living wages. The medical devices manufacturing segment of medical technologies contracted during this period to one-fifth the 1990 employment level, while the pharmaceutical segment realized employment gains and the high-paying biotechnology segment contracted by one-third. Clearly both clusters are not economic drivers of the region and employment in medical technologies does not complement employment in health services. That is, health services do not encourage local development of new medical products, services, and techniques. Overall, primary medical and health industries provide medium to high paying employment that requires some level of job specialization. The analysis shows that the first has not been treated as a source for resource allocation or policy stimulation and the latter continues to plague the border region as a source of employment deficiency.

This study should be regarded as a point of departure for developing the role of medical technologies and health services clusters in the local economy. Input-output tables, such as *IMPLAN* and the IPED's *Regional Impact Forecast Model*, are necessary to identifying a set of industries that constitute the most likely candidates for non-trade based or cross-industry linkages. Understanding supplier chains (indirect industries) of the primary industries allows analysts to derive a measure of the "magnitude of clustering" by estimating the economic contribution for each segment – employment, output, and personal income – of the primary industries on the secondary effects throughout the region. By identifying substantial economic activity between an indirect industry and the primary

industries, one can better organize the inter-industry relationships for public policy and economic development workforce training. From this basis, business recruitment and vendor opportunities can better be targeted, as well as identification of critical industries related to local area enhanced economic growth.

ENDNOTES

[1] Bergman and Feser, 1999. "Industrial and Regional Clusters: Concepts and Comparative Applications," Web Book of Regional Science (rri.wvu.edu/regscweb.htm), edited by Loveridge, Morgantown, WV: Regional Research Institute, West Virginia University. See Chapter 2.

[2] Enright, 1996. "Regional Clusters and Economic Development: A Research Agenda," *Business Networks: Prospects for Regional Development*, edited by U.H. Staber et al., Berlin, Walter de Gruyter, pg. 191.

[3] Porter, 1990. "The Competitive Advantage of Nations," New York: Free Press.

[4] Glaeser, Kallal, Scheinkman, and Shleifer, 1992. "Growth in Cities," *Journal of Political Economy*, vol. 100, no. 6, pgs. 1126-1152.

[5] Porter, 1998. "Clusters and the New Economics of Competition," *Harvard Business Review*, reprint no. 98609, pgs. 77-90.

[6] An example of distant linkages is the sizable number of maquiladora automotive components manufacturers that sell to final market assemblers in the U.S. Northeast and Midwest. Development officials in Chihuahua and El Paso cannot afford to ignore key linkages of twin plants and logistics to firms in the United States if they truly want to understand what drives the competitiveness of their local industries.

[7] Bergman and Feser, 1999.

[8] These nine areas account for three-fourths of the nation's largest biotechnology firms and for three-fourths of the biotech firms formed in the past decade. Two of the nine metropolitan areas, Boston and San Francisco, established themselves as the research leaders in biotechnology in the early days after the industry's founding in the 1970s and continue today to be the dominant centers of the biotech industry. Two other metropolitan areas, Philadelphia and New York, have substantial concentrations of biotech activity, related chiefly to the historical presence of the headquarters of the nation's largest pharmaceutical manufacturers. Since the 1970s, three other metropolitan areas have emerged as significant centers of biotech industry – San Diego, Seattle, and Raleigh-Durham – each of which has built upon a well-recognized and well-funded medical research establishment. Two additional metropolitan areas, Washington/Baltimore and Los Angeles, also have a concentration of biotech activity. Washington D.C. has a significant biomedical research establishment and is home to the National Institutes of Health (NIH). In addition, several firms related to the exploration and mapping of the human genome are located in the Washington/Baltimore area. Los Angeles houses the nation's largest biotech firm, Amgen, located in Thousand Oaks.
See Cortright and Mayer, June 2002. "Signs of Life: The Growth of Biotechnology Centers in the U.S.," The Brookings Institution Center on Urban and Metropolitan Policy (brook.edu/es/urban/publications/biotech.htm).

[9] North American Industry Classification System – United States, 1997. Executive Office of the President, Office of Management and Budget.

[10] U.S. Economic Policy Classification Committee, Issue Paper No. 5, July 1993. "The Impact of Classification Revisions on Time Series."

[11] Data qualifies for nondisclosure when there are two or less employers that make up the respective employment field or when one employer accounts for 80 percent or more of total employment within the field. Nondisclosure ensures that a degree of competitive privacy is maintained to the reporting firms.

[12] The Bureau of Economic Analysis (BEA) provides better employment and wage estimates at the aggregate level than the BLS since the BEA adjusts the estimates to account for employment and wages not covered, or not fully covered, by the state unemployment and federal compensation programs. While BEA statistics provide the greatest accuracy, they are reported only at the SIC 1-digit division level for counties, and so the BLS must be used for the more detailed industry data. Hence, readers should note that some data may in fact be underreported.

[13] Klosterman, 1990. "Community and Analysis Planning Techniques," Rowmand and Littlefield Publishers, Inc., Savage, Maryland. See Chapters 9-13.

[14] Center for Economic Development Research (cedr.coba.usf.edu/), College of Business Administration, University of South Florida, 2002. "Medical Product Industries Cluster in Tampa Bay." See also, "Florida's Medical Technology Clusters," 2003. Sponsored by the Florida High Tech Corridor, Inc., the Tampa Bay Partnership, and the University of South Florida (innovationinsight.com).

[15] See socrates.cdr.state.tx.us/iSocrates/Files/onLineDocs.asp

[16] BLS reported no employment for the other URG counties.
[17] As an exercise, *LQs* were also calculated using private employment rather than total (private plus public) employment. The overall outcomes did not change.
[18] Of the nine SIC industry groups under analysis (SICs 801-809), SIC 801 (Offices and Clinics of Doctors of Medicine) for Brewster County is the only industry group that adds a noticeable amount of employees to this study (an average of 33 workers from 1990 to 2000).
[19] Personal income retrieved from Regional Economic Information System (REIS), Bureau of Economic Analysis.
[20] Note that this relates to employment by industry, which is not the same as occupational employment. Therefore, results by occupational pay may be very different.
[21] Olmedo, McCune, and McElroy, 2003, Institute for Policy and Economic Development (iped.utep.edu), University of Texas at El Paso, 2003. "Employment Growth Industry Groups and Living Wage Occupations," *Special Report 2003-04* for the Upper Rio Grande Workforce Development Board.
[22] As an exercise not reported here, *LQs* were also performed using private employment only rather than private plus public. For the most part the *LQ* outcomes did not change. The only variances took place in SICs 806 (Hospitals) and 809 (Misc. Health Services). By adding the government aspect, the industry share for El Paso's SIC 809 was pushed up, thereby increasing the *LQs*, sometimes above 1 but not all the time. This means that in some cases this industry group changes from basic to non-basic if only private employment is used. For SIC 806 the results of using private employment were mixed. Against the 12 reference areas, the *LQs* increased six of the times, decreased five times, and once remained unchanged, but only once did the actual outcome change from non-basic ($LQ < 1$) using private employment only to basic ($LQ > 1$) using private plus public employment (against Hidalgo County).
[23] Amaya, 2003. "Health Issues on the United States-Mexico Border," *Dígame Policy and Politics on the Texas Border*, Chapter 14, edited by Brenner, Coronado, and Soden, Dubuque, IA: Kendall Hunt Publishing.