

**RESPONDING TO RURAL HEALTH DISPARITIES IN THE
UNITED STATES: THE GEOGRAPHY OF EMERGENCY CARE
AND TELEMEDICAL TECHNOLOGY**

**REPONDRE AUX DISPARITES DANS L'OFFRE DE SOINS AUX
ETATS-UNIS : GEOGRAPHIE DE L'URGENCE ET DE LA
TELEMEDECINE**

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Abstract – *The paper focuses on the need to address territorial inequalities in American healthcare services. It shows how much the situation has become critical in the United States. It discusses to what extent telemedicine is a sustainable option to reduce the negative consequences of the economic, professional and physical barriers to care in rural areas. As far as healthcare is concerned, rural and urban environments in the United States do not have to face the same barriers and challenges. The article first details what specific health issues have to be dealt with in rural areas. The case of emergency care in Vermont is then developed to illustrate what could be the benefits of using ICTs to improve access to care.*

Key-words – *rural, spatial disparities and inequalities, telemedicine, “trauma systems”*

Résumé – *Cet article traite de l'urgence qu'il y a, aux Etats-Unis, à réduire les inégalités territoriales en matière de santé. Il montre combien la situation est devenue critique pour le pays. En ce sens, la « télémedecine » pourrait être le moyen le plus durable et optimal de réduire l'effet négatif des barrières économiques, professionnelles et physiques sur l'offre de soin en milieu rural. Aux Etats-Unis, les problématiques de santé rencontrées dans les espaces urbains ne sont pas les mêmes que celles touchant les espaces ruraux ce qui justifie qu'une réflexion spécifique soit menée sur le sujet. L'article détaille dans un premier temps les défis à relever pour les territoires ruraux. Le cas des urgences médicales dans le Vermont est ensuite mobilisé pour démontrer l'intérêt qu'il pourrait y avoir à recourir aux nouvelles technologies pour améliorer l'accès aux soins.*

Mots-clés – *développement rural, disparités et inégalités spatiales, « télémedecine », système de soins*

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INTRODUCTION

Humankind is undergoing a demographic and epidemiological evolution, changes in basic patterns of life- how many children we have, when and by what means we die, where we live and work. Specifically in the developed world (and most of the developing world), fertility has been declining, mortality is delayed to increasing ages as death results more from degenerative conditions than infection or injury, and migration is progressing from rural agrarian environments to urban ones. The rapid urbanization experienced by populations worldwide over the last two centuries has been accompanied by massive changes in governance, economic structure, health, and education. With mass movement of people to specific areas, infrastructure, such as clean water supply, sanitation, education and health facilities, can be over-burdened to the point of ineffectiveness, especially in the early period of expansion. Before urban public health forces adjust, rising density often cause infectious disease rates to increase as well. We see evidence for these impacts of rapid urbanization in the US, Britain, and the Netherlands in the mid 1800's, where studies of the average height of male skeletons (an indicator of level of nutrition in a population) show a decline during the period of most rapid urban growth. After the period of growth, health infrastructure, nutrition and economic resource distributions stabilize, and urban residents begin to take advantage of economies of scale for many resources, resulting in higher levels of health for more people- (the shared expense to construct large reservoir projects for clean water, the construction of large health centers which offer specialty care, for example).

While much of the urban areas of the developing world are still adjusting to rapid urbanization, and struggling to meet the needs of this growth, the United States' level of urbanization has been relatively stable for decades, with approximately 80% of the total population living in urban or suburban environments, and 20% in rural settings (Van Dis 2002). These environments support dramatically different ways of life, different socialization among inhabitants, and different expectations in terms of social services and self-reliance.

In particular, a great deal of inequity in health and the availability of health-related services can be found between rural and urban environments. The uneven distribution of healthcare resources ranges from fewer and farther service locations, reduced funding, discontinuous education, and inadequate mobility in rural areas. Also called spatial inequality, disparity exists in the unequal distribution of resources in space, and also the consideration for individuals to reach these locations (Hanson and Guiliano 1986; Carr 2005). Access to health care overall is a challenge to rural residents, who have a lower proportion of the population insured, a greater difficulty in traveling to primary, preventative, prenatal, and emergency care providers, and less

diversity in health care resources to choose from. Rural residents are left without these services, increasing the physical barriers to quality and timely healthcare.

These geographic variances in access lead to the conclusion that different strategies to address health disparities will have to be considered for rural regions. In this paper, I will discuss how rural and urban environments in the United States face different barriers and different challenges in improving healthcare. Focusing on rural access to care, I will examine how advances in information communications technologies (ICTs) have the potential to collapse some of the disparities between urban and rural healthcare in the case of emergency medicine by reducing barriers in access. The role for ICTs in healthcare is to combat some of the deficiencies in the quality and availability of services, ranging from a lack of expertise among providers, outdated training, and long travel times to service locations.

RURAL AREAS AND ACCESS TO CARE

The study of variation in resources between rural and urban areas reveals disparities in several types of opportunity access at many geographic scales. Early studies in the U.S. showed a spatial mismatch of lower-income jobs and residences, prompting federal programs like Welfare-to-Work connecting workers with employment opportunities (Kain 1992; Sanchez and Wolf 2005). More recent findings show an uneven distribution in grocery stores, also called food deserts, in lower-income urban areas (Apparicio *et al.* 2007). The prevalence of crime is examined in urban and suburban areas, near hotspots like casinos and bars (Brown, 1982; Barthe and Stitt, 2009). Research suggests differences in the distribution of opportunities, including health care, can greatly impact levels of quality of life. The examination of equity of healthcare access is partly described as a variation in resources, examining and comparing the spread of benefits and costs to rural or urban communities.

The US Department of Health and Human Services states: “Communities at different urbanization levels differ in their demographic, environmental, economic, and social characteristics. These characteristics influence the magnitude and types of health problems communities face” (US Govt. Health 2002). In general, the many differences in rural, suburban, and urban life, including the differences in healthcare delivery, can create different life outcomes for residents in these areas. For example, the age-adjusted death rate for young people age 1 to 24 is 31% higher in rural areas than urban areas, and 65% higher than suburban areas. Likewise, the age-adjusted death rate for people age 25-64 is 32% higher rurally than the suburban areas (Eberhardt and Pamuk 2004). Taking rural areas for example, we see greater levels of non-active leisure time compared to more urban areas, while the increases in industrial agriculture have decreased the physicality of much rural work. Rural residents are more likely to be obese or overweight compared to suburban residents. Rates for tobacco use are higher in rural areas, and access to behavior change support services

less. Although homicide rates are higher in inner city settings, the survival rates for those suffering trauma is lower in rural settings, and the deaths from injuries on the whole is higher in rural areas (especially for motor vehicle accidents). On average, levels of pollution are lower, although some rural sites, such as the San Joaquin valley of California, have very high levels of airborne pollutants due to topography and exposure to interstates (Morello-Frosch *et al.* 2002). Childbirth is more likely to take place without medical supervision in rural environments, affecting infant mortality (Eberhardt and Pamuk, 2004). Mental health issues are affected by the difficulty in access and perhaps education around depression and other mental health topics in rural areas, and these areas have higher rates of suicide than either urban or suburban settings (Singh and Siahpush 2003). The US government has set health goals for a variety of indicators in a publication "Healthy People 2010." These indicators are measures which directly affect the mortality and morbidity of the population and access to healthcare, with the goal of demonstrating improvement in the indicators over time with interventions in areas showing marked disparities for any indicator (US Dept HHS 2004). These indicators tend to vary across levels of urbanization, and may in part explain the differences in death rates.

While urban areas in the United States have primarily financial barriers to care for uninsured and underinsured residents, rural areas experience economic, professional, and physical barriers to care. Economically, the high rates of the uninsured among rural residents stem from high rural unemployment, as well as high levels of low-wage and self-employment. Although US government guidelines would appear to support the expansion of emergency services in rural locales, the current state of healthcare economics supports an entirely different trend. In 1997, the New York Times noted: "The nation has lost 400 emergency departments in 5 years, mostly in inner cities and rural communities, partly as a result of the harsh new economics of the health system. Hospitals are caught between their mission to serve patients and the shrinking resources to meet those needs" (Kilborn 1997). A study looking at the finances behind rural hospitals and emergency rooms noted that only when affiliated with larger, profitable healthcare networks were rural emergency departments financially sustainable (Avery 1999). Even when rural hospitals are funded, they encounter problems in staffing and training independent of economics. At the low patient volumes common to rural facilities, the abilities of physicians, nurses, and EMT's to respond appropriately to a rare emergency decreases. Given disuse, medical knowledge and memory diminishes, leaving rural facilities lopsided in terms of competency (Williams *et al.* 2001).

The economic and professional barriers are coupled with physical barriers, both barriers to access and barriers of communication. In terms of barriers to physical access, the lower density of rural populations and less developed transportation networks results in fewer health care providers and locations within a certain distance or time (Hansen 1959). Perhaps most concerning to rural residents is the general lack of physicians in rural areas. Although 20% of US residents live in rural

areas, only 9% of physicians practice there. Among recent medical school graduates, this figure is skewed farther, with only 3% planning to open a rural practice (Rabinowitz *et al.* 2002). In comparison to urban and especially the relatively affluent suburban population, rural residents are being left behind in terms of health access issues. Indeed, central urban areas can have 5-6 times as many physicians per capita as rural areas. This leads to rural residents having to travel long distances to obtain care, depending on the local distribution of providers. The scarcity of physicians has implications beyond solely travel-time to reach a qualified provider. In urban areas, residents take for granted a level of competition and comparison-shopping available given the large number of doctors. This competition and variety results in greater access to services often deemed controversial, such as reproductive health services or HIV counseling. In rural areas, if the only hospital in a two-hour radius does not provide abortions or restricts access to “morning-after” treatments or birth control, the residents will have to travel further a field to find appropriate care (Bennett 2002). As a result, lowered accessibility can increase travel time between patients and providers, (Ramsbottom-Lucier *et al.* 1996), and the time for emergency staff to respond and deliver accident victims (see Appendix, Figure 1).

While many service industries, such as marketing or information technology, for example, lend themselves to an increasingly decentralized and mobile workforce, other industries are beholden to infrastructure, long-term investment, and economies of scale not easily translatable from urban to rural settings. Modern healthcare in particular, requiring expensive equipment, highly specialized personnel, and a large patient base to sustain it, is a largely urban and suburban resource. Without adequate funding or a large population, modern healthcare services are spread thinly over rural areas. The lack of available health care physicians and services ultimately lead to differences in when and for what a rural versus urban resident will seek medical care (for example, women in the most rural settings are far more likely to opt for mastectomies than ongoing radiation treatment for breast cancer- preferring a one stop solution to multiple visits and hospital stays) (Meden *et al.* 2002). These rural-urban differences in health system access are compounded by the age structure of rural areas in the US, which tend to have a higher proportion of elderly residents and thus carry more of a burden from chronic conditions (See Appendix Figure “3”), and the higher levels of poverty in rural areas (See Appendix Figure “5”). In a survey of rural health experts conducted in 2001, 73% noted rural access to healthcare as a priority for improvement, the highest of any priority (Gamm *et al.* 2003). Access to healthcare can be further categorized into access to insurance, access to primary care and preventative services, and access to emergency services. In terms of this last access issue: “The following Healthy People 2010 objectives are among those addressed in the discussion of emergency medical services: Reduce the proportion of persons who delay or have difficulty in getting emergency medical care, increase the proportion of persons who have access to rapidly responding pre-hospital emergency services, increase the number of [States] with trauma care systems that maximize survival and functional outcomes of trauma patients and help prevent injuries from

occurring, and increase the number of states that have implemented guidelines for pre-hospital and hospital pediatric care” (Rawlinson and Crews 2003).

THE CASE OF EMERGENCY TELEMEDECINE

While it may not be possible to alter the spatial distribution of healthcare services, information communications technologies (ICTs) can reduce the need for physical access by providing virtual access to services. In particular, the Internet enables individuals to participate in activities and receive services without physical travel, alleviating barriers due to lowered physical accessibility (Kenyon *et al.* 2002). Studies from around the world show ICT applications for improving access to financial services and employment opportunities, as well as promoting rural entrepreneurship and government participation such as voting (Kenyon *et al.* 2002; Bandias and Vemuri 2005). Similar to health care, educational attainment in rural areas is significantly lower than urban areas, and is often attributed to the lack of enough schools and adequate transportation (Dalal and Goulias 2010; Beatty and Geiger 2010). Also called distance learning, one study finds almost 46% of rural students engaging in high levels of academic classes (NSF 2000; Sloan and Olive 2006).

In rural areas, ICTs, specifically telemedicine, show promise as a sustainable option in improving the availability and quality of healthcare without requiring a large infrastructure investment. Telemedicine can be defined as any provision of medical care over distance, typically utilizing information communications technologies (phone, internet, audio/video transmission) to coordinate patients with physicians, or physicians with consultants. Telemedicine can improve access to healthcare and services by reducing or eliminating the physical barriers to quality rural healthcare, such as inadequate training or too few service locations (Kenyon *et al.* 2002). A vital implementation discussed here is the role of communications in reducing the need for travel, and thereby reducing the inequality in available services and level of expertise in rural outskirts.

Certain sectors of the medical field have been able to adopt telemedical approaches in their services, such as in health education materials offered by health insurers online, or radiologists communicating interpretations of scans via email or networked databases. These innovations allow clinics and hospitals that may have low volume still access specialty resources, without funding in-house specialty staff (Wootton 2001). By allowing providers to conduct more services remotely and cheaply, telemedicine in theory may be able to change how rural residents obtain healthcare. Given the physician scarcity noted earlier in the report, technologies which allow urban physicians to effectively aid rural residents will help address some of the disparity in quality between rural and urban health access. A review of telemedical use notes: “Telemedicine may be an attractive option when a conventional referral to a

hospital involves much travel on the part of the patient or doctors concerned. A wide range of teleconsulting applications have been trialed... these experiments have shown technical feasibility, but obviously it is too early to know whether such applications will come into widespread use” (Wootton 2001).

One implementation of teleconsulting technologies to emergency care studied has been the collaboration between rural hospitals/clinics and the level 1 trauma center in Vermont (Ricci 2003). Vermont is an excellent model for rural-urban health studies, as 68% of the population lives in rural areas, with emergency response provided by volunteer EMT’s (as a 2nd or often 3rd job), and ½ of ambulance services respond to less than 100 calls per year. The physicians available in Vermont’s rural settings are often general or family practitioners rather than specialists like most of rural America. The state also has a large academic training hospital with Level I trauma services in Burlington, which serves the surrounding rural areas of northern Vermont and New York.

The U.S. trauma system, as it has been adopted by a majority of states, consists of a network of referring hospitals and clinics. Any given region of the country will have many rural and small city clinics and hospitals, a few regional health centers, and even fewer advanced, specialized academic facilities. The categories of facility are summarized below:

Trauma Level I	Full range of services provided, the facility also serves an academic function of education and research
Trauma Level II	Full range of services, without academic functions
Trauma Level III	A trauma facility with 24 hour on-call availability of at least one surgeon, orthopedist, and emergency specialist
Trauma Level IV	A facility with an on-call general surgeon
Trauma Level V	A clinic staffed by non-physicians

A patient experiencing an emergent condition can anticipate being brought to the nearest emergency facility, and transferred to the next level facility as needed. The implementation of this type of referral system has been shown to reduce preventable deaths from traumatic events from 21-30% to 5%. Implementation also increases the level of care that a resident will access on average, as states without an organized trauma system tend to have larger numbers of under-treated emergencies resulting from a failure to refer to more advanced care when necessary (Trunkey 2003).

In the Vermont case, to improve the outcomes of patients experiencing emergent conditions far away from the central hospital, small rural clinics and

hospitals were equipped with remotely operated video equipment and computers, which were networked with the central hospital and the homes of trauma surgeons and emergency specialists. In this way, a patient arriving at a rural health center could receive care from the rural physician as directed by the urban specialist, including early interventions to stabilize or improve survival which would have earlier been undertaken after the patient had been transferred, often a difference of many minutes to hours, depending of transport conditions (weather, road access, ambulance availability and arrival time). Thus, telemedicine was used to collapse some of the advantages of scale the urban hospital enjoys, bringing the benefits to the rural areas, and expanding the reach of the already establish trauma system.

The results Ricci et al. observed in the Vermont case were positive. The telemedicine system, whereby specialized trauma surgeons collaborated with rural physicians in the field resulted in 41 consultations over 30 months for major traumas. "The system was judged to be life saving in three instances, and both rural and trauma center providers felt the system enhanced clinical care." In those 3 cases, the trauma surgeons remotely walked the rural physicians through surgical procedures or insisted on procedures that would have been neglected (for instance, opening the abdomen to drain internal bleeding before transport to the urban hospital). In 67% of cases, consulted trauma surgeons judged that their recommendations would not have been as affective over the phone (Ricci *et al.* 2003) (See Appendix Table 1 to review list of surgeon recommendations). Another indirect benefit of the teleconsulting equipment was that it served as a continuing education and organization tool. Rural physicians and emergency medical staff could attend virtual seminars on new treatments and procedures or meetings to work out protocols for how to transfer patients to the Burlington hospital, without having to take time away from their practice areas, where they are most needed. It also served to train the volunteer staff without their needing to commute, thus saving precious volunteer time. In rural areas where travel distances can be long, telemedical equipment can be greatly beneficial in improving healthcare training and thereby quality.

CONCLUSION

"Rural urbanization" has been occurring within the United States since the 1970's, as more affluent residents of cities and suburbs seek to exchange "push" factors of racial tension, struggling educational systems, pollution, and economic blight in inner cities or urban sprawl, traffic congestion, and loss of open space in suburban areas for the "pull" factors of bucolic, relaxed, unpaved landscapes and move to rural areas (Peters and Larkin 2002). In some ways this trend is self-limiting, as an over migration of suburbanites to rural locations transforms those areas into denser, more urban locals and mitigates the original pull factors. Some factors are accelerating this ex-urbanization flight, such as the increasing economic importance and employment opportunities in the urban fringe areas as opposed to central cities, and the ability of many workers to "telecommute." While the observed disparity in

healthcare can be seen as a negative characteristic of the rural environment, mitigating its “pull,” the telecommuting of healthcare may decrease this disparity.

Spatial analysis on the distribution of goods and opportunities indicates many differences between rural and urban areas, specifically the ability to access necessary resources. Given the interplay of poverty, physical isolation, and physician shortages are at the root of barriers to access care in rural areas; it is also unclear how the recent trend of affluent suburbanite/urbanite migrants will change the healthcare landscape of rural areas. Perhaps the locating of wealth in rural areas will increase the payoff for physicians, prompting an increasing rural physician population. Regardless of the effect of any new wealth in rural areas, physical barriers will always remain in areas of low population density. The emphasis here is the ability of information communications technologies, i.e. ICTs, as a sustainable option to reduce the negative consequences of physical barriers to access to rural healthcare standards and quality of life.

Telemedicine technologies show particular promise in mitigating the distance-related issues, such as the scarcity of healthcare resources in rural locals, both by impacting the efficacy of first responder activities during transport (for example, if an ambulance has the capability to look up medical records remotely, a person found unconscious who was diabetic may be treated early during transport to the hospital, improving the outcome), and through maintaining rural providers' access to the knowledge and resources of urban specialists and academic centers. However, given the aging infrastructure, expensive equipment, and current lack of resources that characterize most rural healthcare facilities, funding for the expansion of telemedical activities will require the financing of large organizations- such as statewide HMO's and state and federal governments (Gamm *et al.* 2003 and Avery 1999). If telemedicine is embraced in rural settings, an indirect result may also be to improve emergency outcomes by improving the ongoing access of patients to providers, meaning patients spend less time delaying consultations with their doctors which can lead to more serious conditions over time (as with diabetes, where complications of blindness, amputation, and heart disease are common with poor self-management- but rare if the diabetes is carefully followed and kept in check through efforts of the doctor and patient). As improving clinical outcomes often entails avoiding expensive end-of-life care and long-term hospitalizations, such results also mean a potential for great cost savings as well (Cummings *et al.* 2001).

More study is needed to determine the cost-benefits of individual telemedicine applications, the efficiency of different technologies and equipment, and optimal reimbursement and regulatory framework for telemedical practices. In particular but limited situations (for example, managing prison healthcare via offsite staff), the benefits of telemedicine have been demonstrated to far outweigh the costs (Ellis and Mayrose 2003). The authors note telemedicine cannot substitute for health care, and while ICT may increase communications it does not improve existing physical access. However, in theory and the limited practice thus far, telemedicine can

help improve specific health indicators in rural areas as related to access to emergency care- by reducing delays in receipt of emergency care (for example, physician directed pre-hospital care by EMS, or lifesaving surgery conducted as early as necessary as instructed by remote supervising specialists), by helping expand and strengthen the statewide trauma networks (both by expanding the sites and facilities where specialized trauma procedures are possible using remote supervision and strengthening the coordination between the different tiers of the trauma system), and by improving the quality of care received through expanded adoption of guidelines (teleconferencing and continuing education facilitating the transfer of up-to-date standards of care and recent advances from academic centers to remote rural clinics).

FURTHER THOUGHTS

On a note regarding the design of future studies on this topic, one concern with the study of rural area access to care is the categorization of urban and rural areas solely on the basis of density. Rural areas can differ a great deal in terms of distance and difficulty in travel to and from more urban (and hence serviced areas). Factors including road quality and quantity, area size, terrain, and mass transit systems can all alter how integrated a rural population is into health and trauma systems. The federal government separates urbanization into 5 levels, by county. A county can contain a large central city, be on the fringe of a large city, contain a smaller metropolitan area, contain a town of 10,000 or more, or without a town of 10,000 (Eberhardt 2001). Clearly these 5 categories contain areas very different from each other, some counties being surrounded by other rural areas, while others may abut and interact with a metropolitan area. Any future work should make effort to distinguish between not only rural and urban areas, but suburban, and should also note variances in urban accessibility of rural areas studied.

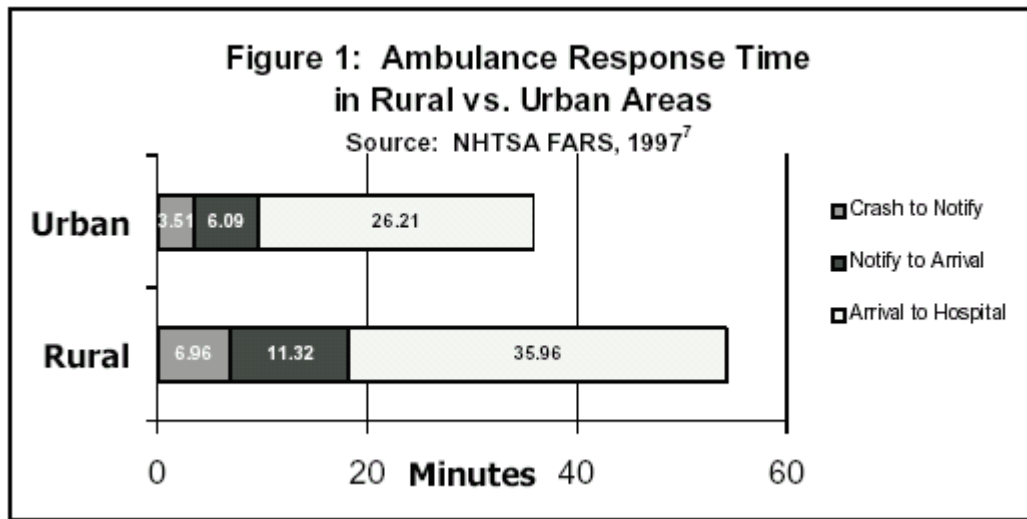
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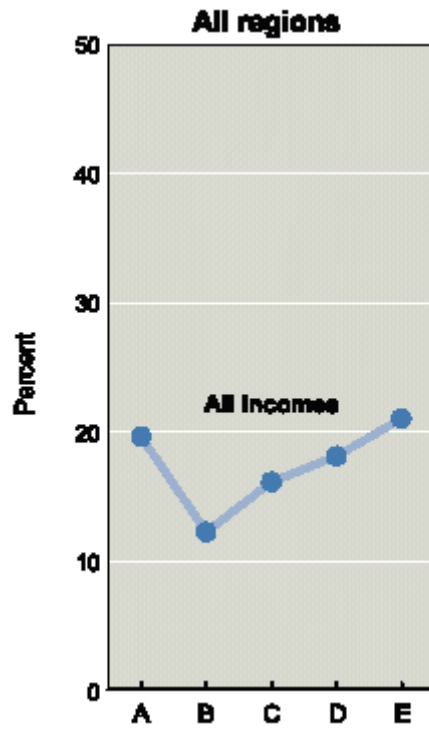
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APPENDIX



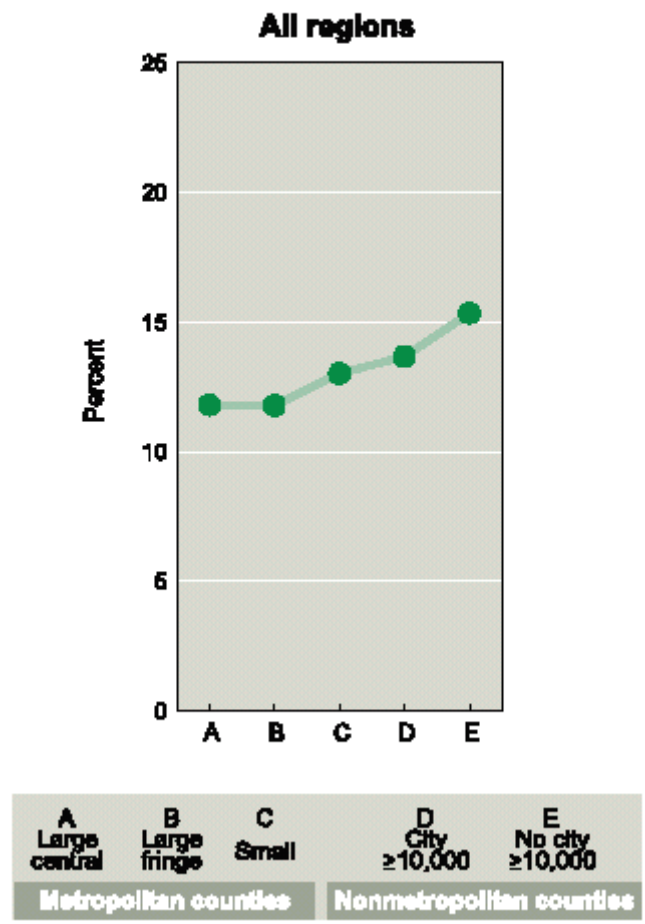
(Rawlinson and Crews, 2004)

Figure 2: Levels of Uninsured by Urbanization level



(Eberhardt, 2001)

Figure 3. Population 65 years of age and over by region and urbanization level: United States, 1998



(Eberhardt, 2001)

Figure 5. Population in poverty by region and urbanization level: United States, 1997

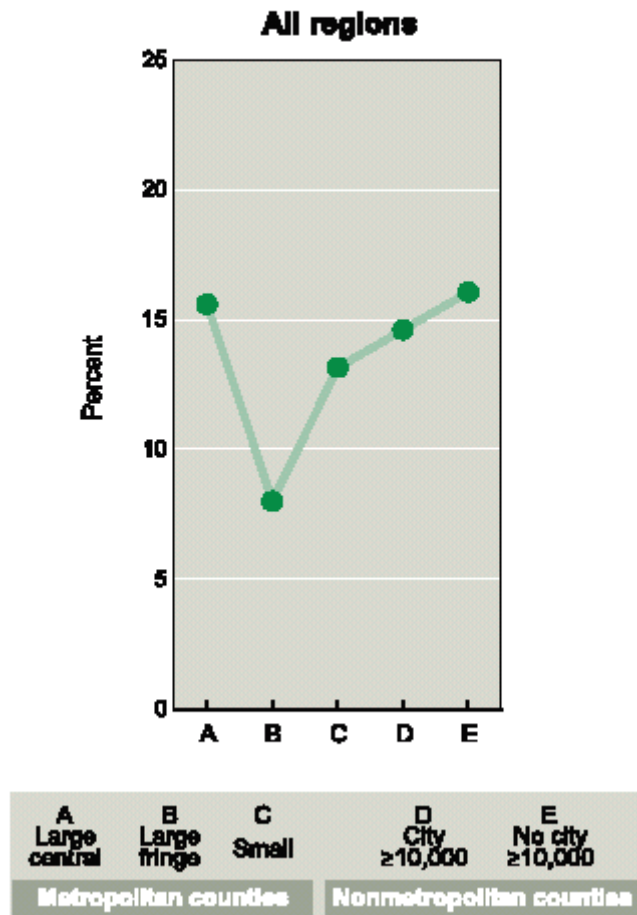


TABLE 1. RECOMMENDATIONS GIVEN TO RURAL HOSPITAL DURING TELE-TRAUMA CONSULTATIONS

<i>Recommendation</i>	<i>No. (percentage)</i>
Transfer—routine	5 (12%)
Transfer—ASAP	24 (59%)
Keep at referring facility	6 (15%)
Place nasogastric tube	9 (22%)
Intubate	5 (12%)
Place chest tube	3 (7%)
Do CT scan	5 (12%)
Do not do CT scan	3 (7%)
Give blood	6 (15%)
Explore abdomen prior to transfer	2 (5%)
Do diagnostic peritoneal lavage	3 (7%)
Start dopamine	1 (2%)
Give fluids	1 (2%)
Give mannitol	4 (11%)
Place hard collar	3 (7%)
Do not intubate	1 (2%)
Give steroids	1 (2%)
Put nasogastric tube in mouth, not nose	1 (2%)
Open pericardium	1 (2%)
Stop resuscitation efforts	1 (2%)

Percentages add up to more than 100% because, in most cases, multiple recommendations were made.

