COST-EFFECTIVENESS ANALYSIS PROPOSAL:

Southeast Health District Teledentistry Program

A Cost-Effectiveness Analysis: Traditional Dental Care versus Teledentistry for Children Enrolled in Brantley County, Georgia Elementary Schools for the 2010-2011 School Year

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What is Important?

Research indicates that adult oral health is dependent on the dental care individuals receive when they are children. According to the CDC more than one quarter of children ages two to five are affected by tooth decay and one-half of children ages twelve to nineteen (Centers for Disease Control and Prevention [CDC], 2010). If left untreated, the bacteria associated with dental caries have been linked to Myocardial Infarctions (Kimmo *et al.,* 1989). Untreated dental caries which lead to periodontal disease have also been linked to adverse outcomes in pregnancy (Babalola & Omole, 2010). There are social determinants associated with tooth decay. Children from lower income families and from certain racial and ethnic backgrounds, including African-American and Hispanic, are disproportionately affected by tooth decay (CDC, 2010). The risk of tooth decay is increased by certain behavioral risk factors. Children, who do not engage in adult supervised, regular brushing of teeth after meals, don't floss, receive fluoride treatments and have prolonged tooth exposure to simple sugars, are at an increased risk for developing dental caries (American Academy of Pediatrics, 2003). The economic burden of poor dental health is tremendous. Children miss approximately 51 million hours per year of school due to dental-related illness which equals on average 3.1 days per 100 students in a school calendar year (National Maternal and Child Health Resource Center, 2008). In United States approximately $91.5 billion dollars were spent on dental procedures (Caitlin, Cowan, Hartman, & Heffler, 2008). Of that $40.6 billion was paid out of pocket, $45.3 billion was billed through private insurance and $5.5 billion was paid through public programs; $0.1 billion from Medicare and $5.3 billion from Medicaid and state Child Health Insurance Programs (Caitlin *et al.,* 2008).

What Works?

The Community Guide to Preventive Services published by the CDC recommends school-based sealant programs as an evidence-based strategy for reducing dental caries in school-aged children (The Community Guide to Preventive Services, 2002a). In addition, the CDC states that sealants are an effective way to prevent dental caries but only one-third of children ages six to nineteen have undergone this dental procedure (CDC, 2010).

The USPSTF Community Guide recommendations are developed through a systematic review of available scientific data which starts with identifying all relevant studies of basic research, assessing their quality and providing a summary of the evidence (The Community Guide to Preventive Services, 2002b). Interventions that are recommended in "The Community Guide to Preventive Services" have undergone effectiveness testing and most importantly, have been implemented and tested in the communities in which they will take place. Inclusion in the guide implies that these interventions are economically advantageous and should be adopted as best practices (The Community Guide to Preventive Services, 2002b).

What Offers the Best Value?

Children traditionally receive sealant treatment at a dental office. To determine which intervention - traditional or school-based sealant programs - has the greatest return on investment, it is imperative to perform an economic evaluation (EE) (Haddix, Teutsch & Corso, 2003).Traditional and school-based dental services reduce dental caries in children; both interventions produce a common effect. Because the goal is to compare the costs of providing dental sealants in these two settings a CEA is the most appropriate Cost Analysis to perform.

Problem & Objective

The Southeast Health District (SEHD) has received Health Resources and Services Administration (HRSA), Office of the Advancement of Telehealth (OAT) funding to conduct a school-based teledentistry program. For funding reporting purposes and to improve the district's chances of obtaining additional HRSA funding, an economic study will be conducted. The evaluator will perform a Cost-Effectiveness Analysis of traditional dental care versus teledentistry for children enrolled in Brantley County, Georgia elementary schools for the 2010-2011 school year.

Key questions to be answered include the following:

- How much does it cost to provide routine dental services for children in a dental office?
- How much does it cost to provide routine dental services for children in at school via teledentistry?
- Is it more cost-effective to provide routine dental services in dental offices versus schools?

Routine dental services are X-rays, cleaning, fluoride treatment and sealants.

Audience

The study results will be shared with HRSA as part of the required evaluation of the teledentistry program. HRSA can potentially use the economic evaluation to justify the funding they receive to Congress. Results will also be utilized by the SEHD in future funding applications and for justification for expansion of the existing program. The state Division of Public Health will receive study results for consideration of the transferability of the program to additional public health districts.

Perspective

A societal perspective is the most appropriate for this economic analysis. Because the researcher is attempting to analyze the allocation of societal resources, funding which is first allocated from legislature to HRSA and then from HRSA to successful applicants, it is most suitable to take a societal perspective, especially in light of a limited and competitive government resource base.

The research base for telehealth evaluation is limited for several reasons: people think improved technology is always better, excitement surrounding an innovative idea makes rigid evaluation hard to apply, uncertain research questions and methods, associated with innovations and technological glitches can sabotage the best evaluation plans (Garshnek & Hassell, 1999). In 1995 the Clinton administration recognized the need for cost-effective, innovative healthcare solutions and the Joint Working Group on Telemedicine (JWGT) was formed (Garshnek & Hassell, 1999). One of the group's tasks was to develop a transferable evaluation framework for telehealth with a goal of, "strengthening evaluation designs and promoting comparable evaluations" (Garshnek & Hassell, 1999). One of the critical questions identified by the JWGT was the costs and benefits of the telehealth operations (Garshnek & Hassell, 1999). This type of assessment provides a truer picture as a society and is not biased toward one perspective in any way.

Health Outcome

The health outcome for the cost-effectiveness study will be the number of children seen by the teledentistry program in Brantley County schools for the 2010-2011 school year and the number of children seen in a local dental office during the same time frame.

Timeframe & Analytic Horizon

Teledentistry program applications are included in parent packets that were distributed in July 2010. The timeframe for the Cost-Effectiveness Analysis is technically the school year which began in August 2010 and ended in May 2011. But because teledentistry services include referrals for extensive dental services which may include a referral to a local dentist for minimal procedures, referral to a pediatric dentist for more involved procedures or those children that need sedation and finally, referral to the Medical College of Georgia for extensive procedures therefore the timeframe must include the referral process. Based on the limited number of providers in the area, distance to providers and socioeconomic barriers, the evaluator estimates the program timeframe to be the application month, nine-month school year plus one-year for referral and treatment which equals: one-year and ten months.

A child starts losing their primary teeth around age six and this process is usually completed by age twelve, with all permanent teeth in place, on average, by age fourteen (WebMD, 2009). The services provided by teledentistry will last through the time period that the child has the primary teeth that were treated in the program through the period in which they gain all of their permanent teeth. There is much research that indicates the relationship between child oral health and its influence on adult dental health, especially as it relates to gum disease (U.S. Department of Health and Human Services [DHHS], 2000). Emerging research is also showing the relationship between oral and many chronic diseases such as diabetes and cardiovascular disease (U.S. DHHS, 2000).

As stated by Haddix, "the analytic-horizon of a prevention—effectiveness study should extend over the time period during which the costs, harms, and benefits of the intervention are incurred" (Haddix *et al.*, 2003). Based on the local barriers mentioned previously, the evaluator has chosen to take a more conservative approach to estimating the time horizon.

Because the program targets children ages four to ten years of age the time horizon can vary depending on the age when the child first received services at the teledentistry clinic. Based on the WebMD data the following chart illustrates the time horizon for the different age groups.

Age of Child	Time Horizon
Four	Ten years
Five	Nine years
Six	Eight years
Seven	Seven years
Eight	Six years

Nine	Five years
Ten	Four years

To accommodate all possible ages of entry into the Teledentistry Program, the Analytic Horizon chosen is ten years.

Study Format

A retrospective study is being conducted because the costs are being indentified after the 2009 start of the Teledentistry Program (TD). A disadvantage of the format is that the data collected may not be as precise as it would be if the researcher was involved at the start of the process. The main advantage of this type of study is time and resource savings. In addition, through a working relationship, the evaluator has personal access to the Telehealth Coordinator and her data and vendor and community contacts. The cost of traditional dental services (TdD) will be obtained by access to the Local Dental Supervisor dental records. Additional and comparison dental service cost information will be accessed from electronic, aggregate sources such as The Medical Expenditure Panel Survey and The Centers for Medicare and Medicaid Services.

Cost Analysis

Type of Cost	Description	Data Source
Direct Cost-Non-Medical (TD)	Telehealth Equipment (General)	Invoices from Vendor, Telehealth Coor.
Direct Cost-Medical (TD)	Telehealth Equipment-Dental (inter-oral cameral, X-ray)	Invoices from Vendor, Telehealth Coor.
Direct Cost-Non-Medical (TD)	T1 lines for data transmission	Monthly Invoice to SEHD, reimbursed 90% through Universal Service Funds program
Direct Cost-Medical (TD)	Dental Equipment (chairs, suction/cleaning)	Invoices from Vendor, Telehealth Coor.
Direct Cost-Medical (TD)	Dental Software-allows electronic transmission of X-rays to MCG	Invoice from Vendor, Telehealth Coor.
Direct Cost-Medical (TD)	Dental Supplies (disposable exam supplies, education materials)	Invoices from Vendor, Telehealth Coor.
Direct Cost-Non-Medical (TD)	Clinic space donated by school (in-kind)	School superintendent for info on facility cost/funding
Direct Cost-Medical (TD)	Dental Staff Time: -Local Dental Supervisor (Annual Contract) - MCG (Annual Contract) - Dental Hygienist (Hourly)	Contracts will be obtained from Telehealth Coor.
Direct Cost-Non-Medical (TD)	Administrative Staff Time: -Telehealth Coordinator (30% of time, in-kind)	Southeast Health District HR
Direct Cost-Non-Medical (TdD)	Dental clinic space (cost for same time period)	Will attempt to obtain from Local Dental Supervisor, if unable will utilize an on-line resource for area commercial real estate

		http://www.loopnet.com/Georgia/Waycross-Commercial-Real-Estate/
Direct Cost-Medical (TdD)	Dental office employee wages/salaries: - Dentist - Dental Hygienist -Dental Assistant -Office Manager	Will attempt to obtain from Local Dental Supervisor, if unable will utilize an on-line resource for are dental salaries http://www.indeed.com/salary/q-Dental-Assistant-l-Savannah,-GA.html
Direct Cost-Medical (TdD)	Dental Equipment (chairs, suction/cleaning, X-ray)	Will attempt to obtain from Dental Program Supervisor, if unable will utilize an on-line resource http://www.bplans.com/dental_office_business_plan/strategy_and_implementation_summary_fc.cfm
Direct Cost-Medical (TdD)	Dental Supplies	Will attempt to obtain from Dental Program Supervisor and can get an estimate from Telehealth Coor. if unable will utilize an on-line resource http://www.1stmedicalsupplies.com/
Direct Cost-Medical (TdD)	Dental visit charge for same services provided at Teledentistry dental clinic	Local Practice Dental Records Medical Expenditure Panel Survey http://www.meps.ahrq.gov/mepsweb/data_stats/data_overview.jsp Centers for Medicare and Medicaid Services http://www.cms.gov/home/medicaid.asp
Indirect Cost-Prod. Losses	Travel costs for parents associated with a dental visit.	Will be calculated based on travel distance from Brantley county to closest Medicaid accepting dentist at the state mileage reimbursement rate of .51 cents
Indirect Cost-Prod. Losses	Parent wages lost as a result of child's dental visit	Due to lack of dental providers and rural status wages for an eight hour day will be calculated. Ga Dept. of Labor will be utilized to ascertain the average hourly wage in Brantley County http://www.dol.state.ga.us/ Additional documentation may be obtained from U.S. Bureau of Labor Statistics http://www.stats.bls.gov/

Parent Survey

Although Haddix indicates intangible costs, such as pain and suffering, are not traditionally include in CEA analysis, the researcher attempted to quantify the costs associated with lack of self-esteem as it relates to children and dental problems. A parent survey was part of the Teledentistry Program application packet. A two-part question from the "Early Childhood Oral Health Impact Scale" was modified and included in the survey. Survey question:

- How often has your child, because of dental problems (pain in teeth, mouth or jaws), experienced the following:
  a) Avoided smiling or laughing when around other children
  ___Never ___Hardly ever ___Sometimes ___Often ___Very Often
  b) Avoided talking with other children
  ___Never ___Hardly ever ___Sometimes ___Often ___Very Often

Self esteem will be quantified as the average wage for an individual with a high school diploma (or equivalent).For caregivers who respond to the top two tiers of the Likert scale (Often/Very Often), their child's self-esteem will be valued as the average wage for an individual *without* a high school diploma (or equivalent). Caregivers who respond to the lower two tiers (Never/Hardly Ever) will have their child's self-esteem valued as the average wage for an individual *with* a high school diploma (or equivalent).

Cost Adjustment

The main reason to adjust costs for this evaluation is the majority of the expenses are associated with the cost of equipment; both telehealth and dental, which were realized at the start of the program. These cost must be annuitized, if not, the costs per child seen in the Brantley County School Teledentistry Program for the 2010-2011 school year would be inflated. From the research available the average life, without need of technology upgrade, of the telehealth equipment is approximately five years (Scuffman & Steed, 2002).

Evaluation

An intermediate health outcome will be used for both the Teledentistry Program and traditional dentistry. For teledentistry, the health outcome is the number of children seen in the Teledentistry Program during the 2010-2011 school year. The source of the outcome data is primary data collection through a work-based partnership with the Telehealth Coordinator who manages the Teledentistry Program. For traditional dental services the health outcome will be the number of children seen at a dental office during the same time frame. This data will be specific to the Teledentistry Program's Dental Supervisor's dental practice, who is located in a neighboring county (Brantley County has no dentists). The data will be obtained through an established community partnership and will also utilize the dental offices electronic dental record software.

To evaluate the comparison of traditional dental services with the next most effective intervention, teledentistry services, the researcher will utilize an Incremental Cost Effectiveness Ratio (ICER). The following is the ICER formula:

$$\text{ICER} = \frac{\text{Cost of Teledentistry Program} - \text{Cost of traditional dental services}}{\text{\# of children seen during 2010-2011 school year} \quad \text{\#of children seen at the Teledentistry Dental Supervisor's practice during the 2010-2011 school year}}$$

Calculation results will be interpreted as the additional costs (or savings) realized for every child seen by the Teledentistry Program compared to children seen in dental offices. If the results of the ICER are positive then the Teledentistry Program provide an additional benefit of cost-effectiveness but is not cost saving. If negative results are obtained then the Teledentistry Program is both cost-effective and cost-saving. The results of the ICER can be used to advocate for additional or continued funding of the Teledentistry Program and perhaps expansion of the program to other Georgia Public Health Districts that have medically underserved areas. The results can also be used to influence policy. For example, Georgia Dental Association's continued support of teledentistry services or Georgia Medicaid reimbursement.

Because there is such a large initial capital outlay associated with the Teledentistry Program a discussion on Marginal Cost Effectiveness Ratio (MCER) is warranted. With any type

of telehealth service once the initial equipment and data lines have been installed, these costs remain constant regardless of how many clients are seen. Therefore the more people seen via telehealth reduce the capital costs. The following is the MCER formula:

$$\text{MCER} = \frac{\text{Cost of Teledentistry Program Expansion}}{\text{\# of children seen at expanded Teledentistry Program}} - \frac{\text{Cost of Teledentistry Program}}{\text{\#of children seen at original Teledentistry Program}}$$

Results of the MCER calculation will be interpreted as the cost per additional child seen via the Teledentistry Program. The researcher suspects the MCER to be low since the capital costs will not change and the clinic space is donated. The only costs that will increase will be those for human capital, disposable dental supplies and educational items given to children. The MCER outcome can be used as a program promotion tool. Basically, those who refer to the program can be encouraged to send as many children as they would like because costs stay virtually the same whether 5 or 50 children receive services. MCER results are also good to share with local politicians who may question the program, its costs and efficacy. Additionally, the MCER outcome should be shared with stakeholders, such as the funders and state public health officials because it illustrates why this program can be expanded at a minimal cost.

Sensitivity Analysis

A sensitivity analysis of the SEHD Teledentistry Program CEA needs to be conducted for several reasons. The sample is comprised of Brantley County school children who participated in the Teledentistry Program and therefore is a convenience sample. This type of sample may lead to bias because the results of the analysis may not be transferrable to all elementary school children. The traditional dental charges reported by the program's dental supervisor may not be accurate. In fact he may choose to report a lower value to improve his community standing. Because the researcher is attempting to quantify intangible costs it imperative to conduct a sensitivity analysis of the valuation of self-esteem. Additionally, average wage data is not as accurate as getting the wages of the caregivers of each program participant and telehealth technology is improving at a rapid rate so future equipment will perform better and cost less, so the sensitivity analysis should include both of these variables. The analytic horizon was determined based on average age of primary tooth loss and subsequent permanent tooth growth and therefore may not be accurate for the individual children participating in the Teledentistry Program.

A one-way sensitivity analysis focusing on the cost of future telehealth equipment could be conducted by following these steps. First the result to be observed for changes will be the cost of the Teledentistry Program services per child seen. Second, the variable to be included in the analysis is the cost of the teledentistry equipment. Third, a focused approach will be used and based on the Consumer Price Index the cost of the equipment will be reduced by 25% (Consumer Price Index, 2011). With all other variables held constant, reducing the cost of the equipment should reduce the cost of the Teledentistry Program per child.

A separate sensitivity analysis discussion will be included as a supplement to the final CEA report. The supplement will be in narrative form and will discuss the types of inputs, the rates by which they were changed and the sensitivity of the results. Since the costs associated with this CEA are obtained from valid sources (invoices, payroll etc.) the model can be considered fairly robust. In addition, the results of the CEA will be used as an evaluation tool for

the program grant, reducing the need for sensitivity analysis intensity. Therefore the evaluator could choose to simply state in the final report that a sensitivity analysis was conducted using a reasonable range for inputs and the results did not change.

Strengths and Limitations of CEA

The Cost-Effectiveness Analysis (CEA) is easier to conduct than other economic analyses because there is no dollar value placed on the health outcome. It is also easier to obtain health outcome effectiveness data. The CEA can identify the most cost-effective prevention strategy from options that produces the same effect and can determine if a more expensive program is worth its additional cost. Although the CEA has strengths it is not without limitations. The CEA requires a common health outcome for the interventions being compared without considering the multiple health outcomes of the intervention. This method also ignores many variables that are important when making resource allocation decisions, such as social justice, fair access to care and equitable distribution of limited resources.

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