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# Cost effectiveness, efficiency and equity of inspection services throughout Connecticut's local public health system

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Connecticut Association  
of Directors of Health

Strengthening local public health.

# Connecticut Practice-Based Research Network

- The Connecticut Association of Directors of Health established the Connecticut Practice-Based Research Network (PBRN) one of a growing number of such networks nationally, to advance public health systems and service research that will support evidence-based practice and policy.
- The PBRN's leadership team includes research champions from Yale University, the University of Connecticut, Southern Connecticut State University, the Institute for Community Research, and local health directors.

# Project Components

- The proposed project has two components.
  - Component 1 aims to describe and analyze the scope and cost of four environmental health services provided in Connecticut and the differences in associated costs incurred by local health jurisdictions that may arise from differences in the size and structure of local health departments.
    - These services include: food protection, public water wells, subsurface sewage disposal and lead poisoning prevention and control.
  - Component 2 will evaluate the impact of size and organizational structure relative to a number of hypotheses about the efficiency, effectiveness and equity of food protection services.

# Some Key Questions That Our Cost Functions Can Address

- What are the unit costs of services?
- Are providers “too small” or “too large” ?
- To answer: estimate scale economies
- Is it less costly to “produce” different types of services separately or together? (Some don’t do all inspections due to small district size)
- To answer: estimate scope economies
- Can more inspections lower the incremental cost of outcomes?
- To answer: estimate scope economies where outcomes are outputs

# Outputs and Outcomes for Unit Costs

- Drinking Water:
  - **Output:** number of permits and/or inspections (of all types);
  - **Outcome:** maximum contaminant level– (MCL) water test

# Outputs and Outcomes for Unit Costs (continued)

- Food Services:
  - **Output:** # of inspections  
(in different “classes”, including temporary events);
  - **Outcomes:**
    - # of cases of salmonella and/or food borne outbreaks related to food service establishments
    - Ratio of number of actual inspections to the # of mandated inspections (regulation compliance outcome)

# Outputs and Outcomes for Unit Costs (continued)

- Sewage:
  - **Outputs:** # of permits  
(how many new homes, how many with failing septic)  
B100's– makes sure have space for a workable septic
  - **Outcome:** Outbreaks of Cholera?



# Outputs and Outcomes for Unit Costs (continued)

- Lead: 2 Possibilities
  - **Output:** # of epi, environmental investigations, & orders written
  - **Outcome:** ??? Suggestions?

OR,

Surveillance data drives the action/outcome for lead

- **Output:** # of kids below age 6 with blood lead  $\geq 20$   $\mu\text{g}/\text{dl}$ ;
- **Outcome:** # of epi, environmental investigations, & orders written

**Either way, control for:** Do you provide educational follow-up?

(only required when blood lead  $\geq 10$   $\mu\text{g}/\text{dl}$  )

# Cost Function Variables

- Q: Outputs and/or Outcomes
- P: Price of inputs (average wage for sanitarian, nurses, other; contract workers; volunteers' value of effort)
- X: Capital stock (sq ft); rent; and/or other inputs (materials, contractors, etc); population
- D: fixed effects for departments or districts
- t: year fixed effects, or a time trend

# Estimating Equation

$$TC = VC(Q, P, X, t, D) + FC$$

Generalized Leontief Variable Cost Function:

$$VC_{it} = VC_{it}(Q_{it}, P_{it}, X_{it}, t, D_i) = \sum_n \sum_q \alpha_{nq} P_{nit}^{.5} P_{qit}^{.5} + \sum_n \sum_l \delta_{nl} P_{nit} Q_{lit}$$

$$+ \sum_n P_{nit} (\sum_l \sum_k \delta_{lk} Q_{lit} Q_{kit}) + \sum_n P_{nit} (\sum_i \delta_i D_i) + \sum_n P_{nit} \sum_m \delta_m X_{mit}$$

$$+ \sum_n P_{nit} (\sum_k \delta_{tk} t Q_{kit}) + u_{VCit}, t = 2001, 2002, \dots, 2010; i = 1, 2, \dots, 74$$

# Total, Variable, and Unit Cost

- Use parameter estimates and average of all years' data for each variable in each district to obtain  $\underline{VC}$  for each district
- Unit Costs for  $Q_i$  (given level of other outputs) =  $\underline{VC}/Q_i + FC/Q_i$
- Can still easily compute scale economies:

With only one output,

$$\begin{aligned}\varepsilon &= [\partial TC/\partial Q][Q/TC] \\ &= \partial \ln TC / \partial \ln Q \\ &= MC/AC\end{aligned}$$

If  $\varepsilon > 1$ ,  $MC > AC$ , so AC rising (decreasing returns to scale)

If  $0 < \varepsilon < 1$ ,  $MC < AC$ , so AC falling (increasing returns to scale)

If  $\varepsilon = 1$ ,  $MC = AC$  (constant returns to scale, or minimum efficient scale)

# Total (or Variable) Cost

Scale Economies with 2 Outputs (Baumol et al, 1982):

$$\varepsilon = \partial C / \partial Q_1 \cdot (Q_1 / C) + \partial C / \partial Q_2 \cdot (Q_2 / C)$$

Scope Economies with 2 Outputs:

$\partial^2 C / \partial Q_1 \partial Q_2 < 0$  is a sufficient condition:

MC curve for one output drops when more of the other output is produced (weak complementarity, Vita, 1990)  
(In reverse, could have economies of specialization)

# Quality (Outcomes) and Quantity: How are they inter-related?

- If  $\partial^2 C / \partial Q_1 \partial Q_2 < 0$ , where  
     $Q_1$  = quality of output (outcomes),  
     $Q_2$  = quantity of output,

This implies more output (such as food inspections) lowers the MC of better outcomes (such as number of cases of salmonella)

# Other Activities We Need to Control For

- Immunizations/community health:

Do you provide immunization clinics?

Flu clinics?

Do you provide vaccines other than flu?

(If so, probably have a nurse on-staff).

What about school health and nurses?

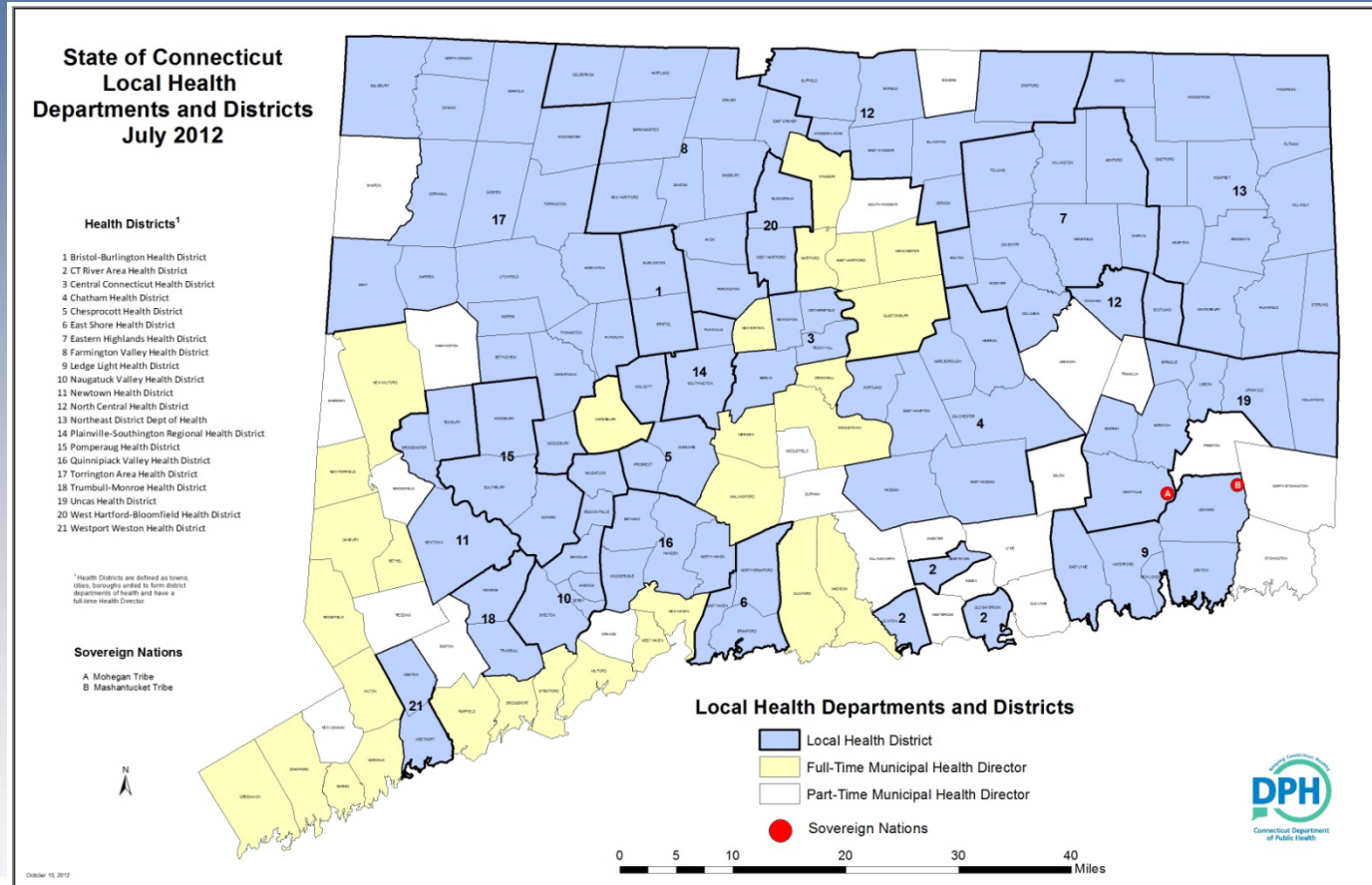
Dental clinics (different staff and operational costs)?

WIC program

Housing Program

- Union/Non-union
- Certifications of EHS Staff (5 categories)

# Data and Organizational Issues





# Data and Organizational Issues

- Annual Report Data: completion rates, completeness and validity of data, changes in data elements
- Potential need to go back to primary data sources to fill in gaps (10 years)
- Determining appropriate outcomes for lead, water and septic