

# Economic Cost of Communicable Disease Monitoring in Colorado

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## Disclaimer:

Any results, conclusions, findings or errors in this study are the sole responsibility of the authors and do not reflect the views of the funding agency

# Project Introduction

- ⌘ Little data on the cost of developing and maintaining infrastructure, and providing essential population-based public health services.
- ⌘ Difficult to make a clear financial case for public health services.
- ⌘ Limits the amount of informed decision-making that can be done by public health leaders.
- ⌘ National programs laid the groundwork for our current understanding of the essential components and capabilities of a local public health agency.

# Core Services

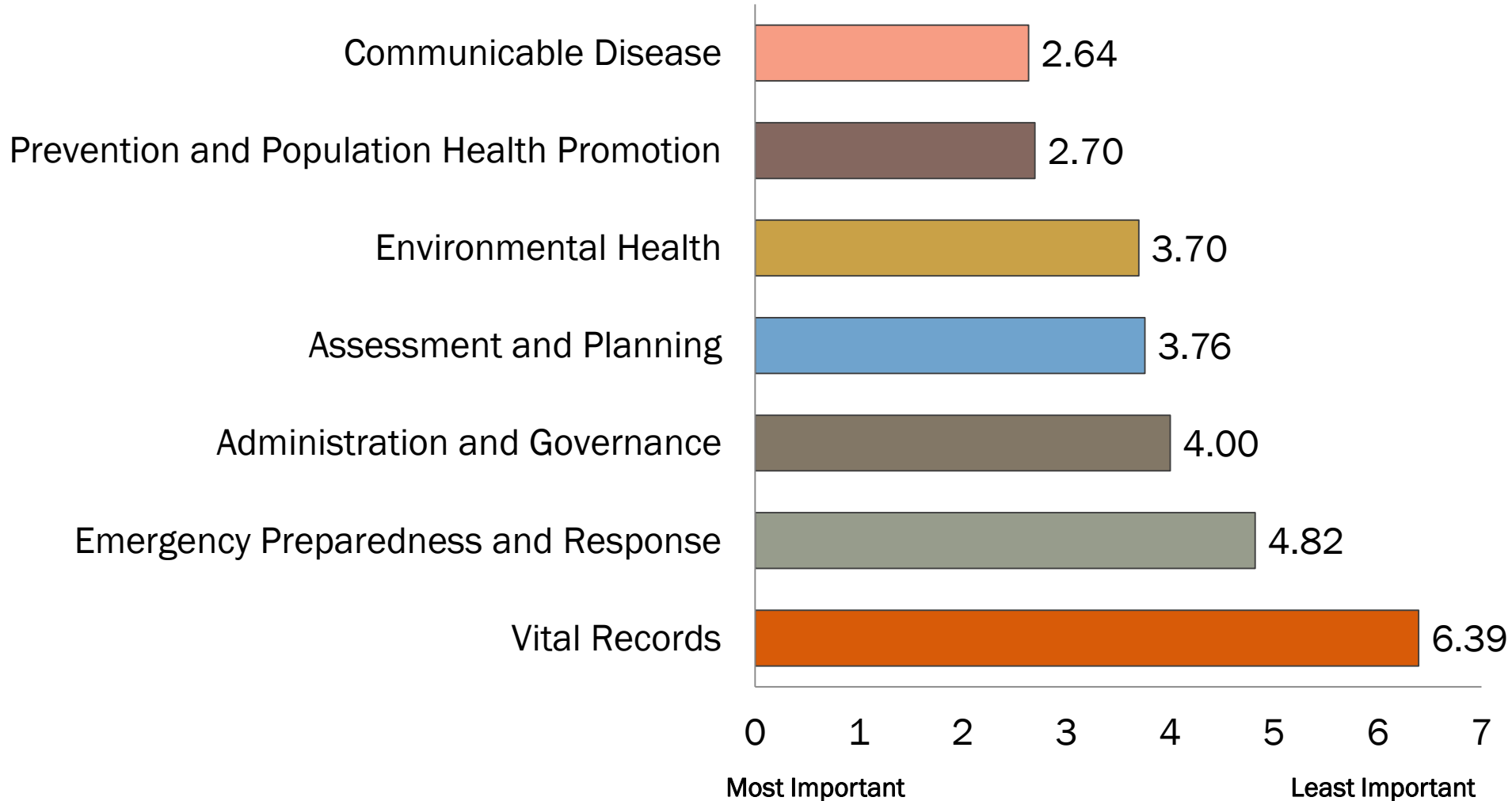
## ∞ Lists of “Recommended” Core Services

- IOM / NACCHO / Colorado

## ∞ Colorado List:

1. Communicable Disease Surveillance / Investigation
2. Disease Prevention / Population Health Promotion
3. Environmental Health
4. Assessment and Planning
5. Emergency Preparedness
6. Administration and Governance
7. Vital Records

# Core Service Ranking Poll



## Listeria Outbreak Traced to Cantaloupe Packing Shed



Ed Andrieski/Associated Press

The Food and Drug Administration recalled 300,000 cases of melons from Jensen Farms in Colorado following a listeria outbreak.

By WILLIAM NEUMAN

Published: October 19, 2011

A nationwide listeria outbreak that has killed 25 people who ate tainted cantaloupe was probably caused by unsanitary conditions in the packing shed of the Colorado farm where the melons were grown, federal officials said Wednesday.

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The New York Times

Business Day

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## Arrests Made in Colorado Outbreak of Listeria

By THE ASSOCIATED PRESS

Published: September 28, 2013

DENVER — The owners of a Colorado cantaloupe farm were arrested on Thursday on charges stemming from a [2011 listeria epidemic](#) that killed 33 people in one of the nation's deadliest outbreaks of food-borne illness.

Federal prosecutors said the owners, the brothers Eric and Ryan Jensen, were arrested on misdemeanor charges of introducing adulterated

# Research Questions

1. What is the cost of routine communicable disease surveillance by LPHA?
2. Are there economies of scale?

# Colorado Idiosyncrasies

- ∞ Some “regional” programs
  - Regional Epidemiologists across state
- ∞ The state role
  - STI's
  - Maintaining databases



# Methods



# Methods

Need measures of both *Inputs* and *Output*

## ∞ Inputs

- Time in minutes / Cost

## ∞ Output

- Number of cases investigated
- Both “confirmed” and “deleted”

∞ Current study looks at relationship between the number of cases investigated and time spent on communicable disease surveillance

# How Does Communicable Disease Monitoring Work?

Series of tasks by Local Public Health Agency (LPHA):

- ☞ Monitoring CEDRS
- ☞ Tabulating data
- ☞ Assessing community risks and trends
- ☞ Receiving reportable disease/condition reports
- ☞ Phone or email communication from Regional Epi or Infection Control Practitioner
- ☞ Phone or email communication to providers
- ☞ Data entry and analysis
- ☞ Travel

# Methods: Cost Survey

- ∞ Basic approach: micro-costing
- ∞ Key Questions:
  - Number of FTE's associated with each activity and also the number of staff hours
- ∞ Time cost based on staff logs
  - Record activities in 15 minute interval of work over a two week time period



# Cost Survey II

- ∞ Augment the cost survey with a manager survey
  - Provide data on employee wages, fringe rates
  - Salaries based on salary range
- ∞ Calculate the per-minute cost of each staff member type

# Output Data

- ✎ Based on the Colorado Electronic Disease Reporting System “CEDRS”
- ✎ Reported conditions by location
  - Can be entered either by the state or LPHA
- ✎ Reportable conditions defined by statute
- ✎ Can be reported by:
  - Physicians
  - Other healthcare providers
  - Laboratories



**To Report a case please contact:**  
 Colorado Department of Public Health & Environment  
 4300 Cherry Creek Drive South  
 Denver, CO 80246  
 Phone: 303-692-2700  
 Toll Free Phone: 1-800-866-2759  
 Confidential Fax: 303-782-0338  
 Toll Free Fax: 1-800-811-7263  
 Evening/weekend hours: 303-370-9395

Colorado Department  
 of Public Health  
 and Environment

Effective: November 30, 2012

**COLORADO BOARD OF HEALTH  
 CONDITIONS REPORTABLE BY ALL PHYSICIANS AND HEALTH CARE PROVIDERS  
 IN COLORADO**

(Infection in Colorado residents ascertained out-of-state should also be reported.)

The list below applies to physicians and health care providers. Laboratories have separate reporting requirements. A case must be reported to the state or local health department following diagnosis within the timeframe indicated.

**The State Health Department requires reporting all suspected cases, whether or not supporting laboratory data are available.**

**24-Hour Reportables**

Animal Bites by dogs, cats, bats, skunks or other wild carnivores	Haemophilus influenzae (invasive disease)	SARS (Coronavirus)
Anthrax (Bacillus anthracis)	Hepatitis A (Anti-HAV IGM)	Smallpox
Botulism (Clostridium botulinum)	Human Rabies - suspected	Syphilis, early (1 <sup>o</sup> , 2 <sup>o</sup> , early latent)
Cholera (Vibrio cholerae)	Measles (Rubeola)	(Treponema pallidum)
Diphtheria (Corynebacterium diphtheriae)	Neisseria meningitidis (invasive disease)	Tuberculosis (active disease)
Group Outbreaks – known or suspected of all types including foodborne, waterborne or other illness	Pertussis (Bordetella pertussis)	Typhoid Fever (Salmonella typhi)
	Plague (Yersinia pestis)	
	Poliomyelitis	
	Rubella	

**7-Day Reportables**

AIDS and HIV infection	Hepatitis C	Q Fever (Coxiella burnetti)
Aseptic / viral meningitis	Hepatitis other viral	Relapsing Fever (Borrelia sp.)
Brucellosis	Hantavirus	Rocky Mountain Spotted Fever
Campylobacteriosis	Hemolytic uremic syndrome if < 18 yrs	Rubella, congenital
Chancroid (Haemophilus ducreyi)	Influenza – associated hospitalization	Salmonellosis
Chlamydia trachomatis	Influenza – associated death ≤ 18 yrs	Shigellosis
Cryptosporidiosis	Kawasaki Syndrome	+TB skin test in workers exposed to active disease
Cyclospora	Legionellosis	Tetanus
Escherichia coli 0157:H7 & shiga toxin-producing E.coli	Leprosy (Hansen's Disease)	Toxic Shock syndrome
Encephalitis	Listeriosis	Trichinosis
Giardiasis	Lyme Disease (Borelia burgdorferi)	Transmissible spongiform encephalopathy
Gonorrhea, any site	Lymphogranuloma venereum	Tularemia (Francisella tularensis)
Hepatitis B	Malaria (Plasmodium species)	Varicella (Chicken pox)
	Mumps	
	Psittacosis (Chlamydia psittaci)	

**Immediate reporting by phone is required of any illness suspected to be caused by Biological, Chemical, or Radiologic Terrorism**

All reports should include:

1. Name of disease or condition
2. Patient's name
3. Patient's date of birth, sex, race and ethnicity
4. Patient's home address and phone
5. Physician's name, address and phone
6. Lab info – test name, collection date and specimen type

Disease Report Forms can be downloaded from

[www.co.gov/cdphe](http://www.co.gov/cdphe), search for: Reporting a Disease  
 Please fax completed Disease Report Form to 303-782-0338

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# CEDRS Data

- ✎ Provided by State Department of Health
  - Required permission of each individual LPHA
  - Confirmed
  - “Deleted”
- ✎ Matched CEDRS data to time-log data by 2-week time period
- ✎ Excluded data on animal bites
  - Recorded inconsistently by LPHA

# Model

$$\text{Time} = \beta_0 + \beta_1 \text{Confirmed Cases} + \beta_2 \text{"Deleted" Cases} + \beta_3 (\text{Total Cases})^2 + \beta_4 \text{Regional EPI} + \beta_5 \text{Dedicated CD Employee} + \beta_6 \text{Other Factors} + \varepsilon$$

## ∞ Hypotheses:

- $B_1 > 0$
- $B_2 > 0$
- $B_3 < 0$
- $B_4 = 0$
- $B_5 < 0$

## ∞ Other control variables

- Case-Mix – types of conditions
- County Characteristics – poverty rate, population, population density

# Cost Estimates

- ∞ Calculated the Total Cost per Minute for each Employee
  - Salary and Fringe rate provided on Manager Survey
  - Converted Salary to wage/minute
  - Multiplied wage/minute by fringe rate and indirect rate
- ∞ Calculated the Cost of CD Surveillance for each employee (for a 2 week period)
  - Multiplied their total cost per minute by the number of minutes spent on CD Surveillance work
  - Excluded employees who spent less than 0.1 FTE, unless no one at agency spent more than .1 FTE
- ∞ Indirect rates estimated from agency level state-negotiated rate
  - Imputed missing values
- ∞ Calculated the Cost of CD Surveillance for each agency (for a 2 week period)
  - Added up all employees for each agency

# Results, Descriptive



# Description of Time Log Data Collection

## Two data collection time periods

- ∞ April 7<sup>th</sup>, 2014 to June 20<sup>th</sup>, 2014
- ∞ October 13<sup>th</sup>, 2014 to November 14<sup>th</sup>, 2014

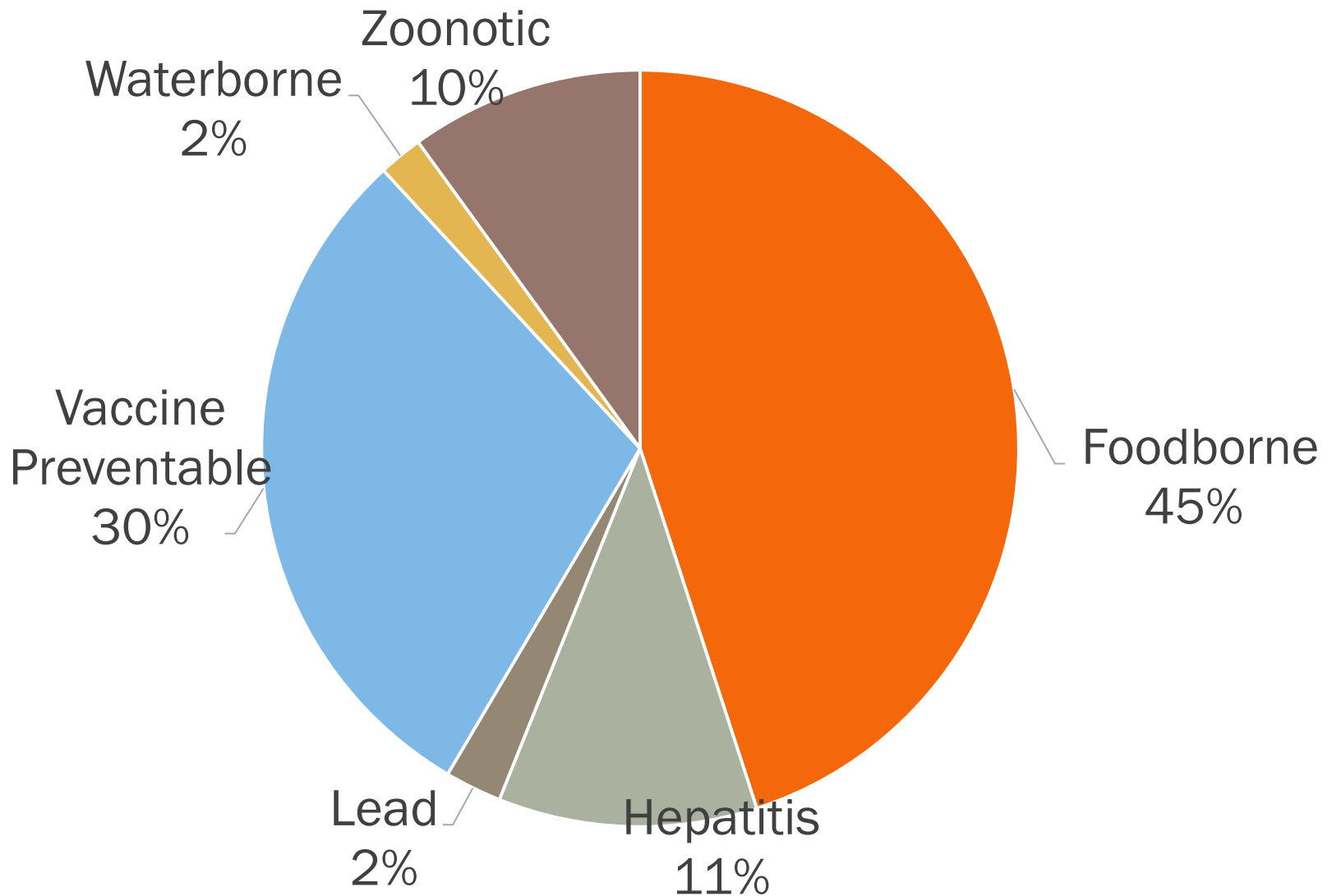
## 43 Unique Agencies Participated (86%)

- ∞ 41 agencies (82%) Spring
- ∞ 27 agencies (54%) Fall

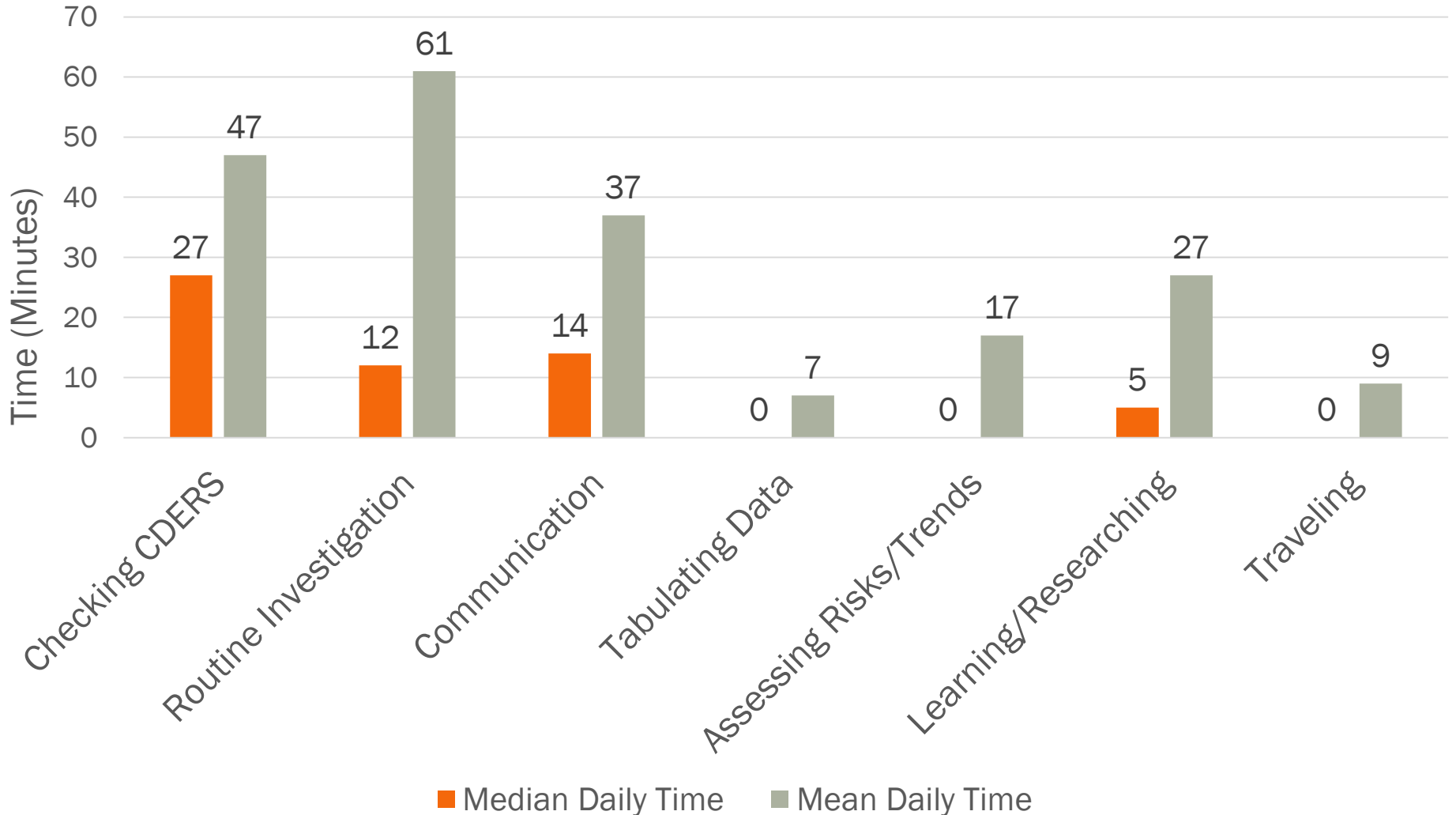
## Total of 191 completed time logs

- 144 employees greater than 0.1 FTE
- 10 regional epidemiologists

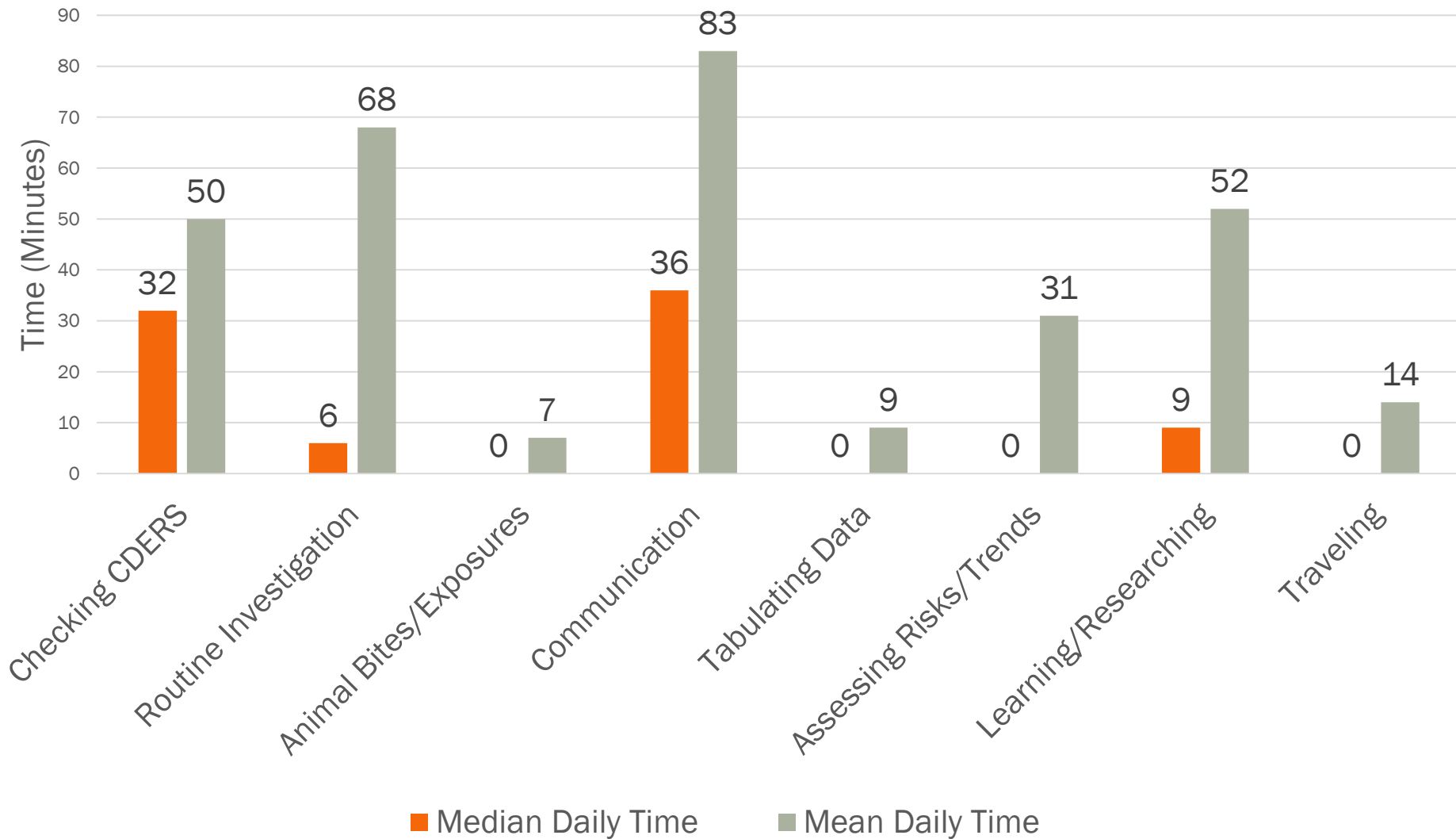
# Case Mix During Data Collection Period



# Daily Agency Time Spent on CD Surveillance, Spring



# Daily Agency Time Spent on CD Surveillance, Fall





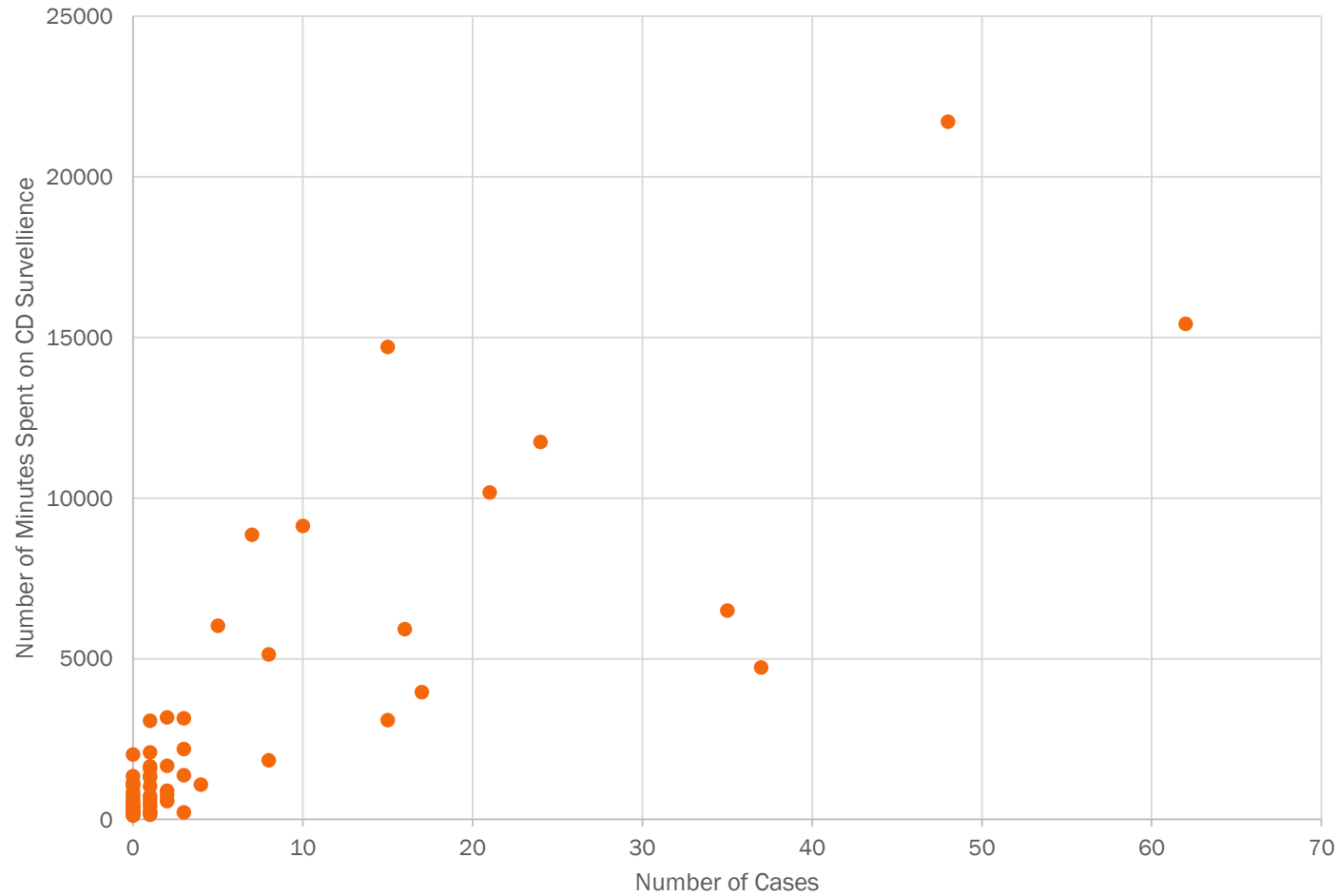
# Zero Counties

- ∞ **6 Counties** did not have any cases assigned to them over their 2-week period for either time period
  - **15 counties** spring
  - **11 counties** fall
  - Mean Population Size of these Counties: 11,055 (Spring) / 7,516 (Fall)
  - Largest Population of these Counties: 30,528
- ∞ These agencies spent an average of **455 minutes** on CD surveillance over two weeks
  - Minimum: 120 minutes over two weeks
  - Maximum: 2,025 minutes over two weeks
- ∞ Time Spent:
  - Checking CEDRS (42%)
  - Communicating with Regional Epis, Infection Control Practitioners, etc. (18%)
  - Routine Investigations (9%)
  - Learning and Research (7%)
  - Assessing Community Risks and Trends (4%)

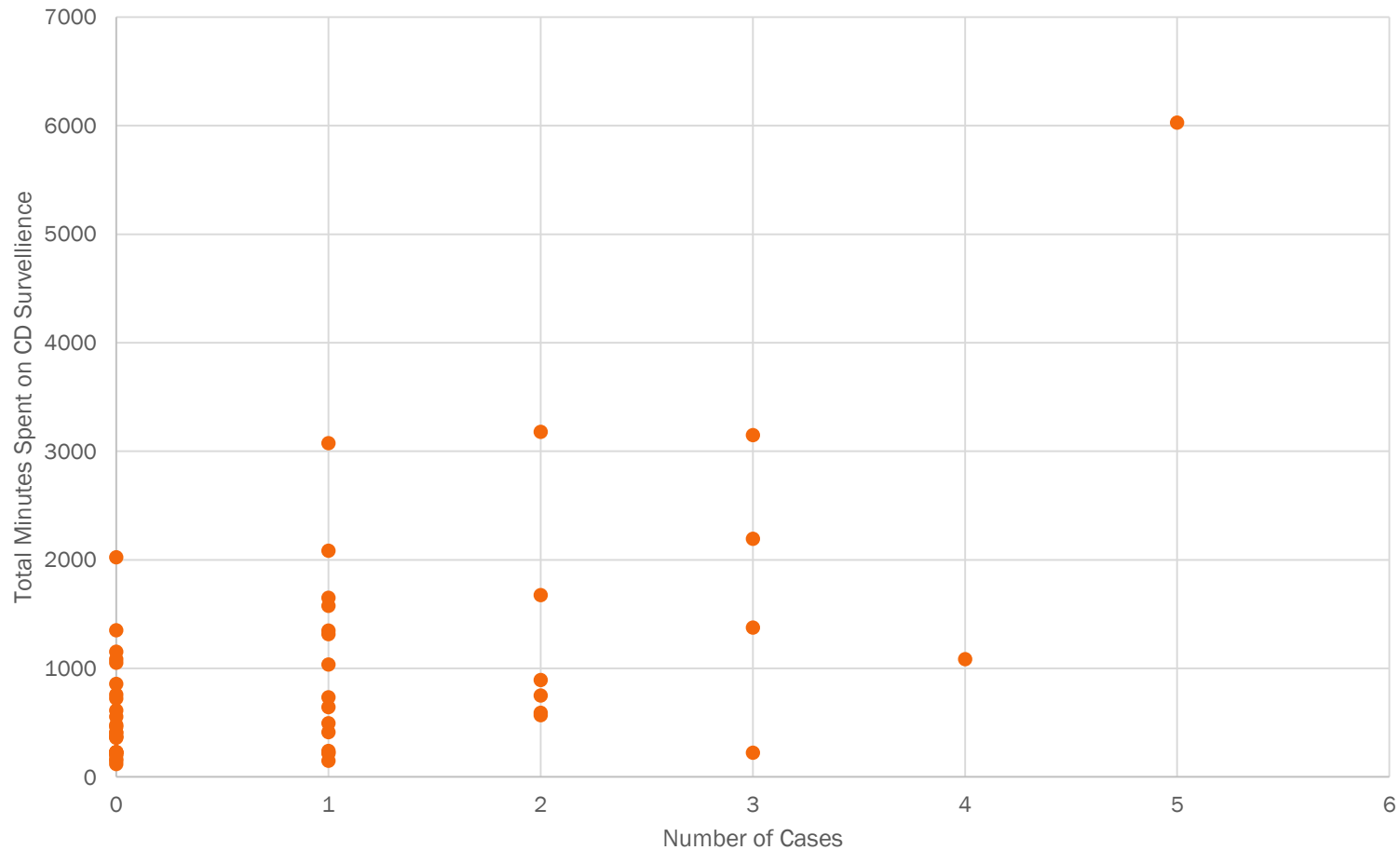
# Results, Minutes



# Relationship between the Number of Cases Reported and the Minutes Dedicated to CD Surveillance



# Relationship between the Number of Cases Reported (<5) and the Minutes Dedicated to CD Surveillance



# Results: Regression Analysis Minutes per 2 Week Period

Variable	Coefficient	SE	t statistic	P value
Number of Actual Cases	491.48	77.426	6.35	<0.00
Number of Deleted Cases	731.26	249.240	2.93	0.01
Total Cases Squared	-4.34	1.193	-3.64	<0.00
In-house Regional EPI	4741.95	885.3477	5.36	<0.00
In-house Dedicated CD Employee	-1982.96	893.1539	-2.22	0.031

Insignificant in model: Case Mix Control (Vaccine Preventable, Waterborne, Foodborne, Zoonotic), Poverty Rate, Season (Fall vs Spring). Density significant (B= -1620.95, p<0.01).

n=67 R<sup>2</sup>=0.888

# Results, Cost



# Results: Regression Analysis Cost

Variable	Coefficient	SE	t statistic	P value
Number of Cases	418.29	67.084	6.24	0.00
Number of Deleted Cases	566.42	215.949	2.62	0.01
Total Cases Squared	-3.40	1.034	-3.29	0.00
In-house Regional EPI	3396.52	767.092	4.43	0.00
In-house Dedicated CD Employee	-1375.64	773.856	-1.78	0.08

Insignificant in model: Case Mix Control (Vaccine Preventable, Waterborne, Foodborne, Zoonotic), Poverty Rate, Season (Fall vs Spring). Density significant (B= -1124,  $p < 0.01$ ).

n=67  $R^2=0.882$

# Limitations

- ∞ Measures of Quality
- ∞ Issues of Seasonality
- ∞ State Costs
- ∞ Indirect Costs
- ∞ CEDRS Data
  - Only includes cases where local agency is tasked with the follow-up
  - Some counties do not report animals bites to CEDRS
  - Lead Poisoning cases can also be incomplete
    - There is a different database at CEDRS to track these cases



# Data Collection Period vs. Average

- ☞ Compared the number and type of cases that occurred during the two week data collection period to the average
- ☞ Average number of cases based on 5 years of CDERS data
- ☞ Paired T Test did not show any significant differences

	T Statistic	P Value
Total Cases	1.277	0.209
Foodborne Cases	1.049	0.301
Hepatitis Cases	1.903	0.064
Lead Cases	0.234	0.817
Vaccine-Preventable Cases	0.744	0.461
Waterborne Cases	0.113	0.911
Zoonotic Cases	0.954	0.346

# Typical vs. Atypical Week

- ∞ When asked, “Was this a typical week?”
  - ∞ Typical is defined as within 10% of the hours you would dedicate to these activities or 10% of the quantity that you would have in a week without outbreaks or other extraordinary activity within Communicable Disease Surveillance.
- 
- |   |   |
|---|---|
| <ul style="list-style-type: none"><li>• Week 1<ul style="list-style-type: none"><li>• Typical: 54 employees</li><li>• More Work: 27 employees</li><li>• Less Work: 25 employees</li><li>• Don't Know: 5 employees</li></ul></li></ul> | <ul style="list-style-type: none"><li>• Week 2<ul style="list-style-type: none"><li>• Typical: 63 employees</li><li>• More Work: 17 employees</li><li>• Less Work: 25 employees</li><li>• Don't Know: 6 employees</li></ul></li></ul> |
|---|---|

*However, concerns about this point led us to field the second survey which showed no statistically significant differences*

# Bottom Line

- ☞ Number of minutes per confirmed case (1 case): 49
- ☞ Number of minutes per confirmed case (10 cases): 44
  
- ☞ Number of minutes per “deleted” case (1 case): 73
- ☞ Number of minutes per “deleted” case (10 cases): 68
  
- ☞ Cost per confirmed case (1 case): \$418
- ☞ Cost per “deleted” case (1 case); \$566
- ☞ Cost per confirmed case (10 cases): \$384
  
- ☞ In-house Dedicated CD Employee reduces spending by \$138 per day

# Conclusions

- ∞ Results suggest some economies of scale
  - Increases at a decreasing rate
- ∞ Huge variation in time
  - Appears unrelated to type of case investigated
- ∞ Possible cost savings if smaller agencies coordinate
  - In-house CD dedicated employee saves time in investigation but isn't feasible for smaller agencies

# Special Thanks to our Participating Agencies:

Alamosa County Public Health  
Department

Baca County Public Health Agency

Bent County Public Health Agency

Boulder County Public Health

Broomfield Health and Human  
Services Department

Chaffee County Public Health  
Department

Cheyenne County Public Health Agency

Conejos County Public Health and  
Nursing Service

Costilla County Public Health Agency

Custer County Public Health Agency

Delta County Department of Health &  
Human Services

Denver Public Health Department

Denver Environment Health

Dolores Public Health Agency

Eagle County Health and Human  
Services

El Paso County Public Health

Fremont County Public Health Agency

Garfield County Public Health Agency

Grand County Public Health Agency

Gunnison County Public Health

Hinsdale County Public Health Agency

Kit Carson County Health and Human  
Services

Las Animas-Huerfano Counties District  
Health Department

Lincoln County Department of Public  
Health

Mesa County Health Department

Montezuma County Public Health  
Agency

Montrose County Department of  
Health and Human Services

Northeast Colorado Health  
Department

Northwest Visiting Nurses Association

Ouray County Public Health Agency

Park County Public Health Agency

Community Health Services, Inc

Prowers County Public Health &  
Environment

Pueblo City-County Health Department

Rio Grande County Public Health  
Agency

Routt County Public Health Agency

Saguache County Public Health Agency

San Juan Basin Health Department

San Miguel County Department of  
Health and Environment

Summit County Health and Human  
Services

Teller County Public Health  
Department

Tri-County Health Department

Weld County Dept of Public Health &  
Environment

*Thank you!*

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303-724-4471