# Magical Metrics and Dazzling Data

## A.K.A., Using Data to Improve Health in Animal Shelters

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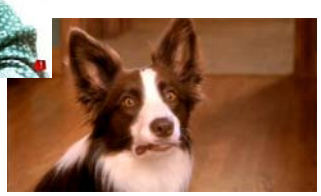
## Shelter Metrics: Oh no!!!!



## Some thoughts regarding data collection

- Data collection is time-consuming and expensive.
- Don't collect data for their own sake.

Collect data that will improve the health of animals in your shelter (i.e., ***influence thinking and actions*** in the shelter).

Be thoughtful and parsimonious.

## Thoughts . . . .

- The data that you do choose to collect must be *accurate and complete.*
- *Train,* periodically *retrain,* and *reward* staff for collecting data well.


## How can data be used for medical purposes?

**For individual animal care; for example,**

- Scheduling vaccinations, surgeries, wormings, treatments
- Review the medical record electronically
  - Change treatments
  - Review history
- Adherence to protocols: (E.g., Monitoring dose, frequency and duration of treatments)

## How can data be used for medical purposes?

For Population Health

- Disease Surveillance
  - Evaluate trends
  - Dx outbreaks
  - Assess disease burden

- Monitor the effectiveness of health-related protocols / changes / treatments
- Identify high risk groups
- Identify high risk time periods
- Identify factors contributing to disease
- Monitor disease-related deaths
- Setting and monitoring progress towards goals

## Other uses of medical data

- Motivation of staff
- Reports to management
- Justification for more funding
- Ordering medical supplies

## Objectives today

- Encourage you to think about how to use your medical data more extensively to improve the health of your shelter populations
- Share data-use examples that could enhance health care in your shelter
- Demonstrate calculation of prevalence and incidence metrics
- Share some insights relating to use of your data

## Managing health

| Of Individuals | Of a population |
|---|---|
| Physical exam (Look for disease signs) | Identify the diseases present Assess their frequency Calculate overall disease and mortality rates |
| Run diagnostic tests | Characterize disease rates by age, length of stay, neuter status, etc. (formulate and test explanations) |
| Plan for treatment | Plan for changing or enhancing adherence to protocols |
| Treatment Monitor effectiveness | Make changes Monitor effectiveness |
| Recommendations to prevent this disease in the future or for provision of ongoing care | Recommendations to sustain the changes or make new recommendations |

## Focus on today

- Establishing the baseline frequency of disease in your shelter
- Disease surveillance
  - Evaluation of disease trends
  - Outbreak recognition and investigation
  - Evaluate effectiveness of protocol changes
- Identifying risk groups, time periods
- Assess the shelter disease burden
- Monitor medical reasons for euthanasia
- Health goal setting and monitoring
- Sharing thoughts/insights

## Baseline Frequency of Disease

(or taking the "pulse" of the population)

## Remember . . . .

Incidence metrics measure the probability of *developing* disease (or other events).

Prevalence metrics measure the probability of *having* disease.

Choice depends on your question(s).

## Types of disease and their frequency in a shelter: 2010

| | Cats | | Dogs | |
|---|---|---|---|---|
| **Disease / sign** | **No. of cases** | **% affected** | **No. of cases** | **% affected** |
| Coccidia | 46 | 2.9 | 24 | 3.6 |
| Giardia | 22 | 1.4 | 56 | 8.3 |
| Heartworm | | | 3 | 0.4 |
| Sarcoptic mange | | | 8 | 1.2 |
| **URI** | **249** | **15.8** | **8** | **1.2** |
| FeLV | 15 | 1.0 | | |
| | | | | |

## Disease surveillance

(ongoing monitoring of disease frequency)

## Why?

- Monitor trends over time
- Identify outbreaks
- [Share this information with staff, management and Board members]

## Evaluate disease trends over time

## Frame your question(s) thoughtfully

- The metric(s) you want to use will be determined by the question(s) that you pose.
- Take time and think through what you most want to know.

## Let's look at a shelter's data

| Category | 2010 | 2011 |
|---|---|---|
| Total Intake | 1580 | 1521 |
| Still in shelter on 1/1<br>Had URI on 1/1<br>Had URI in previous year | 216<br>14<br>26 | 143<br>2<br>8 |
| Tested positive for FeLV | 34 | 33 |
| Tested for FeLV | 1138 | 1193 |
| Had URI this year | 291 | 272 |
| Entered the shelter with URI | 60 | 65 |
| Diagnosed with URI in this year | 217 | 205 |

## Example 1

- Has the annual period prevalence of FeLV infection changed among cats entering the shelter between 2010 and 2011?
  - Need data regarding test result for FeLV and date of test result for 2010 & 2011.

Number of cats testing positive for FeLV
Number of cats tested for FeLV
(X 100) to get the %
during 2010 and during 2011

## Calculation

| 2010 | 2011 |
|---|---|
| Among cats that were tested | Among cats that were tested |
| 34/1138 = 3.0% | 33/1193 = 2.8 % |
| Prevalence of cats testing positive for FeLV | Prevalence of cats testing positive for FeLV |

## Example 2:

- Has the annual period prevalence of feline URI declined in 2011 compared to 2010?
  - Need data regarding :
    - the number of cats with the diagnosis of feline URI
    - the date of each diagnosis of URI;
    - the number of cats *at risk population for having URI*

in 2010 & 2011

## Whose at risk of having URI in a year?

- Those present on January 1
- Those entering the shelter throughout the year

Intake → + In shelter on January 1

Shelter

## So, who is counted in your intake numbers?

- Owner surrendered cats
- Stray cats
- Adoption returns
- Cats transferred in
- Seizures
- [Service-in: might include special programs such as temporary hold for animals of battered women]
- [Clinic-in: might include S/N, TNR]
- [DOA, others?]

## Intake categories (2011)

- These categories are in the set-up in your software

| Category | Number of Cats | % of Intake |
|---|---|---|
| Owner surrender | 850 | 55.9 |
| Stray | 509 | 33.5 |
| Returned adoption | 108 | 7.1 |
| Transfer-in | 9 | 0.6 |
| Seized | 25 | 1.6 |
| Service-in | 20 | 1.3 |
| Total | 1521 | 100 |

## Calculating period prevalence

- Number of cases of URI (numerator)
  - 2010: 291 2011: 272
- Intake of cats*
  - 2010: 1580 2011: 1521
- Cats still in shelter at beginning of 2010 & 2011
  - 2010: 216 2011: 143

* All cats spending time in the shelter were counted (including service-in and seized)

## Comparison of period prevalence estimates for 2010 & 2011

**2010**

Period prevalence:
291/(1580+216) = 16.2%

**2011**

Period prevalence:
272/(1521+143) = 16.3%

## Ask a question about incidence

- Getting the appropriate data gets trickier
  - Now asking about the risk (or probability) of getting sick (or developing a complication, a particular outcome, etc)
    - Numerator includes animals that are experiencing a "case" of disease for the first time in the period of interest
    - Denominator includes animals that are "at risk" of developing disease (or event)

## Example 3:

- Has the annual incidence of feline URI declined in 2011 compared to 2010?
  - Need data regarding :
    - the number of cats that *developed* URI
    - [the date of each diagnosis of these cases of URI]
    - the number of cats *at risk population for developing URI*

in 2010 & 2011

## What cats are not *at risk of developing URI* in a given year?

Among those cats *still in the shelter* on January 1

- those that had URI in the previous year
- those that have URI on Jan 1.

- Data regarding multiple infections, either sequentially or concurrently [are animals at risk of getting developing a second case of the disease?]

?

## What other cats are not *at risk of developing URI* in a given year?

Among those cats that enter the shelter in a given year

- Those that entered with URI
- [Those that develop URI in the first ~ 3-5 days]
- [Those that are euthanized immediately – how should immediately be defined?]

So . . .

In the shelter with 1580 cats entering in 2010, remove the 60 that entered with URI; in 2011 remove 65 from 1521;

## Calculations:

- **Population at risk (2010)**
  - 216 in shelter on 1/1 – (26 that had URI the previous year + 14 that currently have URI)
    = 176 at risk on 1/1/2010
  - 1580 cats enter the shelter – 60 that entered with URI = 1520 at risk during yr

  or 1696 (1520+ 176) cats at risk in 2010 of developing URI

[REPEAT PROCESS FOR 2011]

## Calculations

New cases :If 291 cats had a diagnosis of URI, then identify of those, which developed their URI in 2010 and remove those that had URI on Jan. 1

291 – [14+60] = 217 new diagnoses of URI in 2010

[REPEAT PROCESS FOR 2011]

## Calculation of annual cumulative incidence for 2010 & 2011

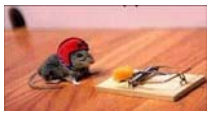
2010: 217 / 1696 = 12.8%

2011: 205 / 1589 = 12.9%

## Other animals that might not be at risk?

- If, after their intake examination, cats are immediately euthanized, depending on your question, you will probably want to remove them from the population at risk.
- Transfers [if transferred immediately??]
- Others?

  Depends on your question!



## So, to make matters more complicated . . .

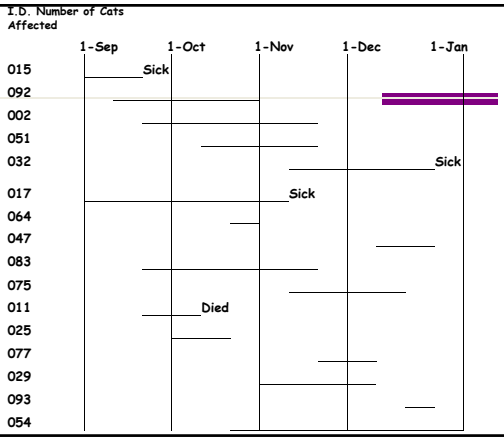
Using cumulative incidence may *not* be OK.

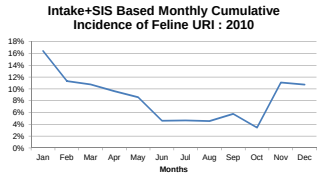
In epidemiologic research, incidence density metrics would be used.

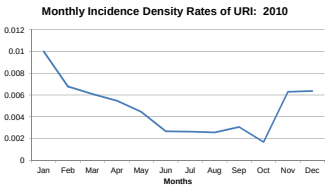
- Number of new cases of URI (numerator)

  Same approach as we just discussed

- Denominator uses the *care-days at risk*
  - Epidemiologically, the method of choice for populations where animals are entering and leaving frequently

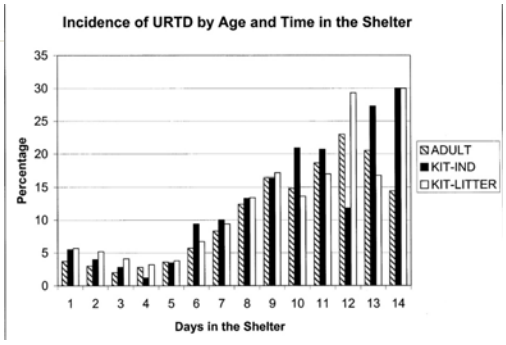




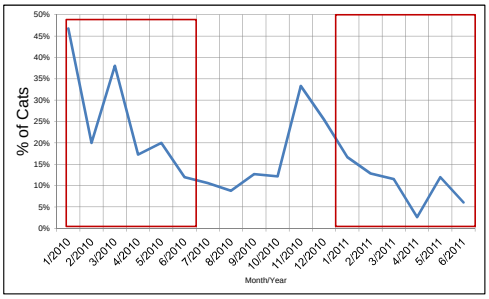




## Proportion and rates with URTD

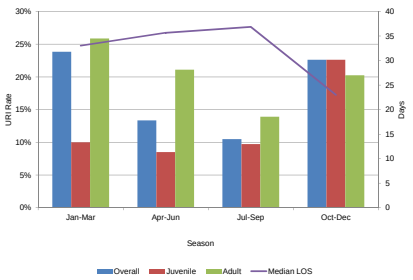
| | Litters (n=701) | Ind. Kittens (n=531) | Cats> 7 mos (n=2,203) |
|---|---|---|---|
| Percent | 33 | 26 | 30 |
| Rate/100 cat-days | 6.7 | 6.2 | 5.6 |



## URI cumulative incidence by month: January 2010 – June 2011




## Incidence of URI by Season and Median LOS




## Identify and Investigate Outbreaks

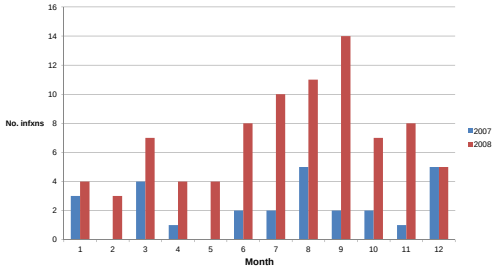
## Variation on outbreaks

- Canine distemper
- Feline URI
- Incision infections

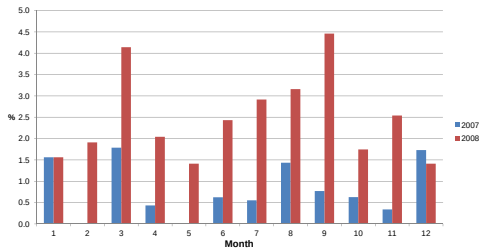
## History

- In the late fall of 2008, a call came in to the shelter medicine program at Cornell from a veterinarian working in a large urban shelter.
- He was convinced that he had an outbreak of incision infections in the shelter. Many more cats (but not dogs) were developing infections at their spay incision sites and he wanted to understand why and, of course, how he might reduce their frequency.

## Comparing the number of incision infections over time



## Comparing monthly attack rates of incision infections over time




## Descriptive data: attack rates over time July 2008 - Nov. 2008

| Month | No. Infections | No. of Spays | Attack Rate (%) |
|---|---|---|---|
| July | 10 | 343 | 2.9 |
| August | 11 | 348 | 3.2 |
| September | 14 | 314 | 4.5 |
| October | 7 | 401 | 1.7 |
| November | 8 | 315 | 2.5 |
| | 50 | 1721 | 2.9 |

## Additional history and observations

- Large urban shelter handling ~10,000 dogs and cats annually
- Open admission
- 2 3/4 veterinary FTEs
- 7 LVTs
- Perform ~ 3400 cat spays per year
- Veterinary clinic within the shelter
- Modern surgery suite with three tables, state of art anesthetic machines
- Not sure exactly when the outbreak began, but some months ago

## Comparison by possible risk factors Feb. 2008-Nov. 2008

| | Cats with infections | Cats without infections | P Value |
|---|---|---|---|
| Median age at surgery: | 5 mos | 4 mos | 0.29 |
| Min, Max | 2mos, 4 yrs | 2mos, 5 yrs | |
| Median days to surgery (days): | 12 | 15 | 0.5 |
| Min, max (days) | 5, 32 | 1,35 | |

***Note:*** we needed to compare characteristics of affected cats to unaffected cats (took a sample of unaffected)

## Attack rates by surgeon July 2008 - Nov. 2008

| Surgeon | No. Infections | No. of Spays | Attack Rate | P value |
|---|---|---|---|---|
| 1 | 27 | 1015 | 2.7 | 0.16 |
| 2 | 18 | 430 | 4.2 | |
| 3 | 5 | 276 | 1.8 | |
| | 50 | 1721 | | |
| Pearson's Chi Square Test was used | | | | |

## Comparison of attack rates July 2008 - Nov. 2008

| Technician | No. Infections | No. of Spays | Attack Rate (%) | P value |
|---|---|---|---|---|
| 1 | 10 | 250 | 4.0 | 0.13 |
| 2 | 4 | 244 | 1.6 | |
| 3 | 11 | 245 | 4.5 | |
| 4 | 3 | 242 | 1.2 | |
| 5 | 10 | 242 | 4.1 | |
| 6 | 4 | 251 | 1.6 | |
| 7 | 8 | 247 | 3.2 | |
| | 50 | 1721 | 2.9 | |

## Regrouping of data for technicians July 2008-Nov. 2008

| Technician status | No. Infections | No. of Spays | Attack Rate (%) | P Value |
|---|---|---|---|---|
| Recent Hire | 39 | 984 | 4.0 | 0.003 |
| Experienced | 11 | 737 | 1.5 | |

Recently hired technicians were 2.7 times more likely to have worked on a cat that developed an incision infection than experienced technicians [4.0/1.5=2.7], p= 0.003

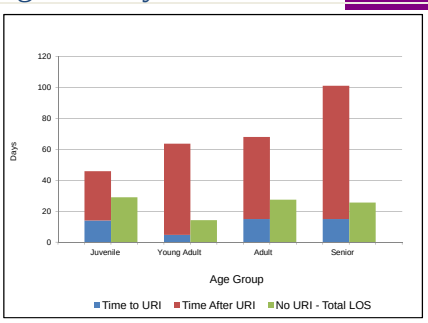
## Assess the disease burden

## Some ideas other than incidence or prevalence

- Average daily census of sick cats
  - Of cats - 190
  - Of sick cats - 15
  - 7.9% of cats in the shelter each day (or month, etc) were ill

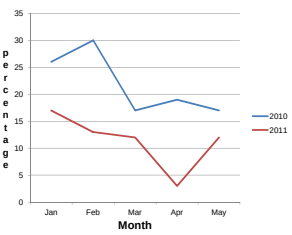
- Ave % use of isolation ward cages
  (e.g., ave. of 90% of the isolation cages were filled daily for the month of July)
- Ave. percentage of care-days in the shelter devoted to sick cats by month/year

## Effect of age and URI on median length of stay: 2010




## Evaluate effectiveness of changes in protocol

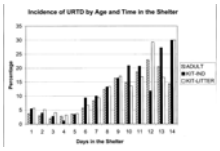
## Cum. incidence of feline URI for 2010 and 2011

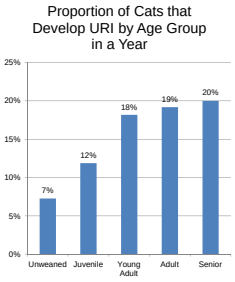



- AveDaily census (Jan-May):
  - 2010 – 193
  - 2011 – 119
- MedLOS
  - 2010 - 33
  - 2011 - 25

## Other questions

- Identify
  - High risk groups (e.g., age groups)
  - High risk time periods






## Effect of disease on euthanasia risk

## Medical reasons for euthanasia

| Dispositions | Ind. Kittens | Adults |
|---|---|---|
| | % | % |
| Developed URTD | | |
| Adopted | 42.3 | 31.0 |
| Euthanized | 49.6 | 63.7 |
| Other | 8.0 | 5.3 |
| No URTD | | |
| Adopted | 64.2 | 33.8 |
| Euthanized | 25.1 | 61.0 |
| Other | 10.7 | 5.2 |

## Other factors to monitor

## Other factors to monitor

- Duration of illness
- Success of treatments?
  - By time to cure
  - By time to switch from one antibiotic to another

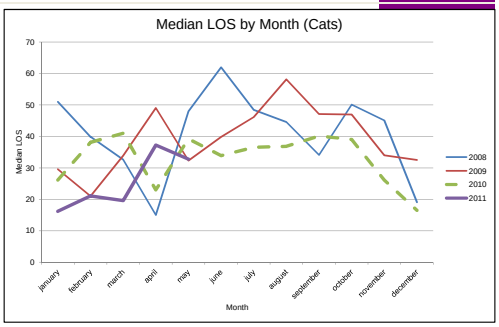
(decide how you will measure duration – by location in isolation or time on antibiotic)

## Health related goal-setting

## Health-related goal setting

- **If you don't set goals to improve population health, you are likely to maintain the status quo**
- Examples: reduce C.I. of URI by 5% next year; decrease median LOS; reduce risk of panleukopenia in kittens; decrease time to S/N

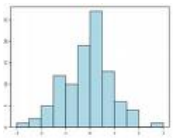
## Goal: reduce median LOS




## Other Considerations

## How easy are the data to obtain?

- From reports feature of software package
- From the monthly data dump (e.g., Pet Point®)
- Specific tallies of interest to you
- Graphs
  - All done with Excel
  - Staff, volunteers, kids??



## What are the "best" medical metrics?

## Ideas

Really depends on what you most want to know

Our current thoughts

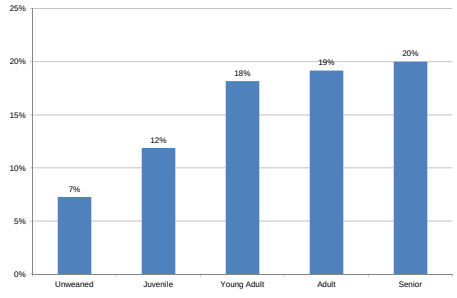
- Baseline annual period prevalence of disease (e.g., URI) – could substitute incidence
  - By age, source of animal (e.g., stray, surrender)
- Trends in period prevalence of disease (e.g., URI)
  - By month, season, year, age, source, etc
- Ave daily census of sick cats/dogs (by disease)
- % of care-days devoted to sick cats/dogs
- Complication rates, time to recovery, treatment failures
- [cost-related stats]
- Many others . . . .

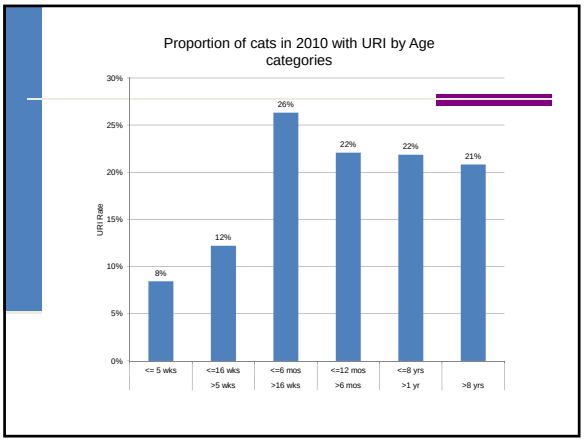
# Insights, thoughts

## Sharing some insights

- *MUST* have clear definitions of age, illness, other things you want to evaluate.
  - Determined by "*you*" in your software set-up and MUST have a key to your definitions
- Take-home message!
  - "YOU" must become familiar with your software "set-up" and definitions (if they already exist) OR
  - Be involved in the set-up for your shelter

## Proportion of cats that are diagnosed with URI by age group: 2010






## Sharing some **insights**

- Consider how your intake categories are set up in your software (what is your question?)
  - **Intake**
    - Owner guardian surrender
    - Stray
    - Return
    - Transfer In
    - Seizure
    - Service-In (include animals admitted for TNR and S/N)

## Insights cont'd

- Specify your questions very carefully.
  - Include animals in foster or not?
  - In the software set-up: what conditions / diagnoses were included?
- Be careful of changing definitions in your database.
- Need to keep a log of database changes with dates (if you make changes)
- Similarly, need a log of protocol and other shelter changes (e.g., change in philosophy, addition of staff veterinarian, with dates)
- Carefully interpret your data. (What other factors might affect the interpretation?)

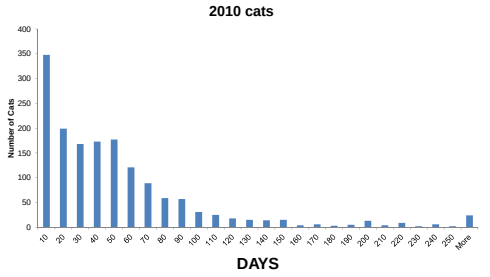
## Caution: confounding

| Age group | Pre-altered? | Developed URI | Intake | URI incidence |
|---|---|---|---|---|
| All | Yes | 33 | 231 | 14 % |
| All | No | 190 | 1180 | 16% |

| Age group | Pre-altered | Developed URI | Intake | URI incidence |
|---|---|---|---|---|
| Kitten | Yes | 0 | 5 | 0% |
| Adult | Yes | 33 | 226 | 15% |

| Age group | Pre-altered | Developed URI | Intake | URI incidence |
|---|---|---|---|---|
| Kitten | No | 62 | 667 | 9% |
| Adult | No | 126 | 509 | 25% |

## Think about your data: frequency distribution of LOS




## Insights cont'd

- Consider
  - The accuracy of your data
  - The completeness of your data – how much missing data?
  - Share analyses with Board, management, staff, volunteers: motivates, informs, directs utilization of resources
- Force yourself to make examination of shelter data a regular occurrence!!

## Shelter Goal:

Provide for the best welfare of the animals in your shelter as possible
- (e.g., minimize disease and reduce suffering, prevent euthanasia)

Collecting and using your data can help you do this better!!!

## Thank yous

- Maddie's Fund®
- Colleagues
  - Drs. Greenberg, Berliner, Newbury, Hurley, others
- Shelters