

Assessment of B-SAFER data streams by influenza challenge

Bio-Surveillance Analysis Feedback

Evaluation and Response (B-SAFER) project

Collaboration of:

- University of New Mexico Health Sciences Center
- New Mexico Department of Health, Office of Epidemiology
- Los Alamos National Laboratory

Extended Public Health Surveillance

**Can we
build a better
mousetrap?**

**and if we build it,
will they come?**

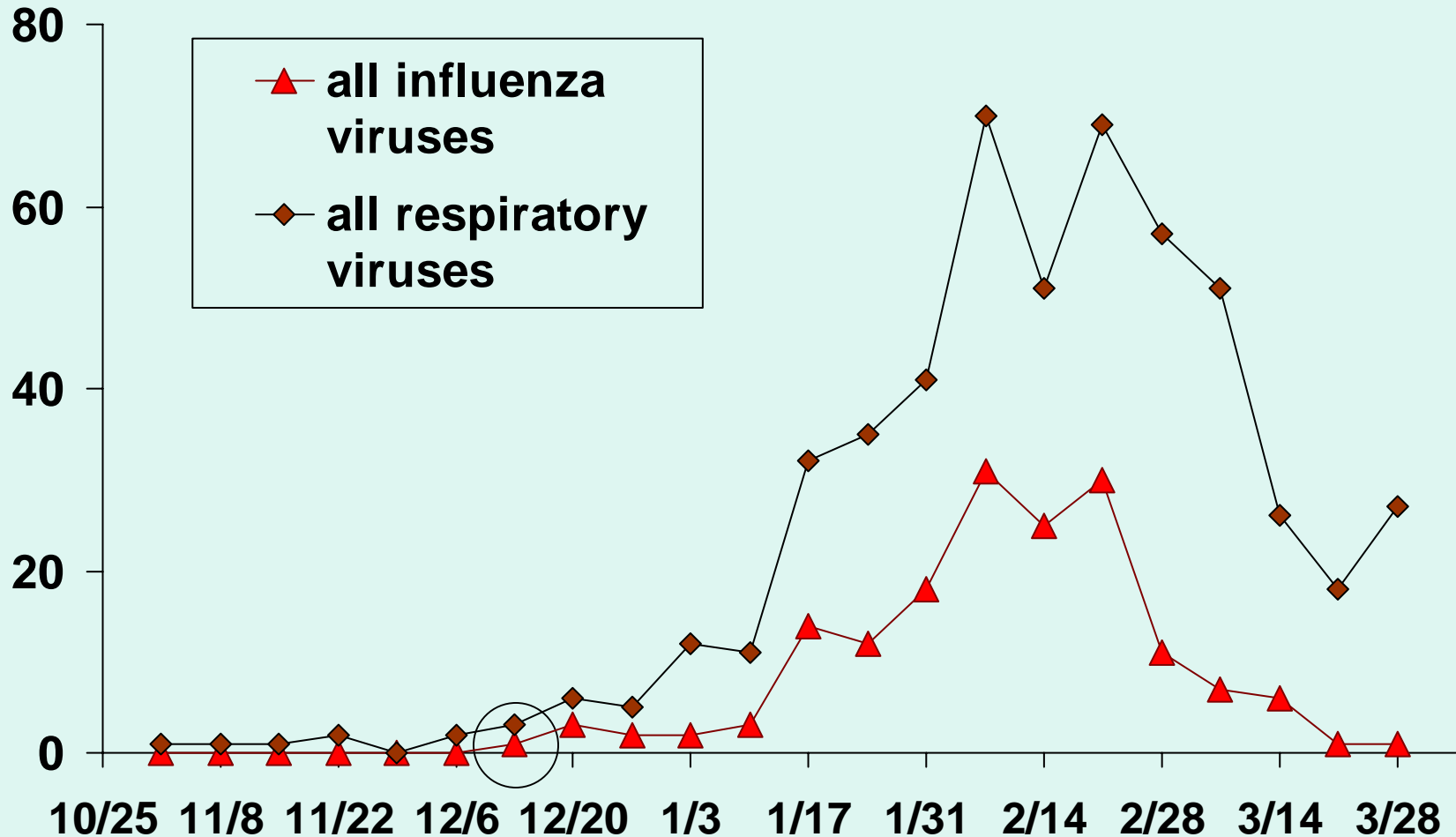
- **Review real-time flu season data (“when did flu season start?”)**
- **Brief description of B-SAFER results**
- **Clues from extended surveillance data**
- **Surveillance vs outbreak investigation**
- **Relationship between surveillance staff and staff doing outbreak management**
- **Conclusion**

When did flu season start?

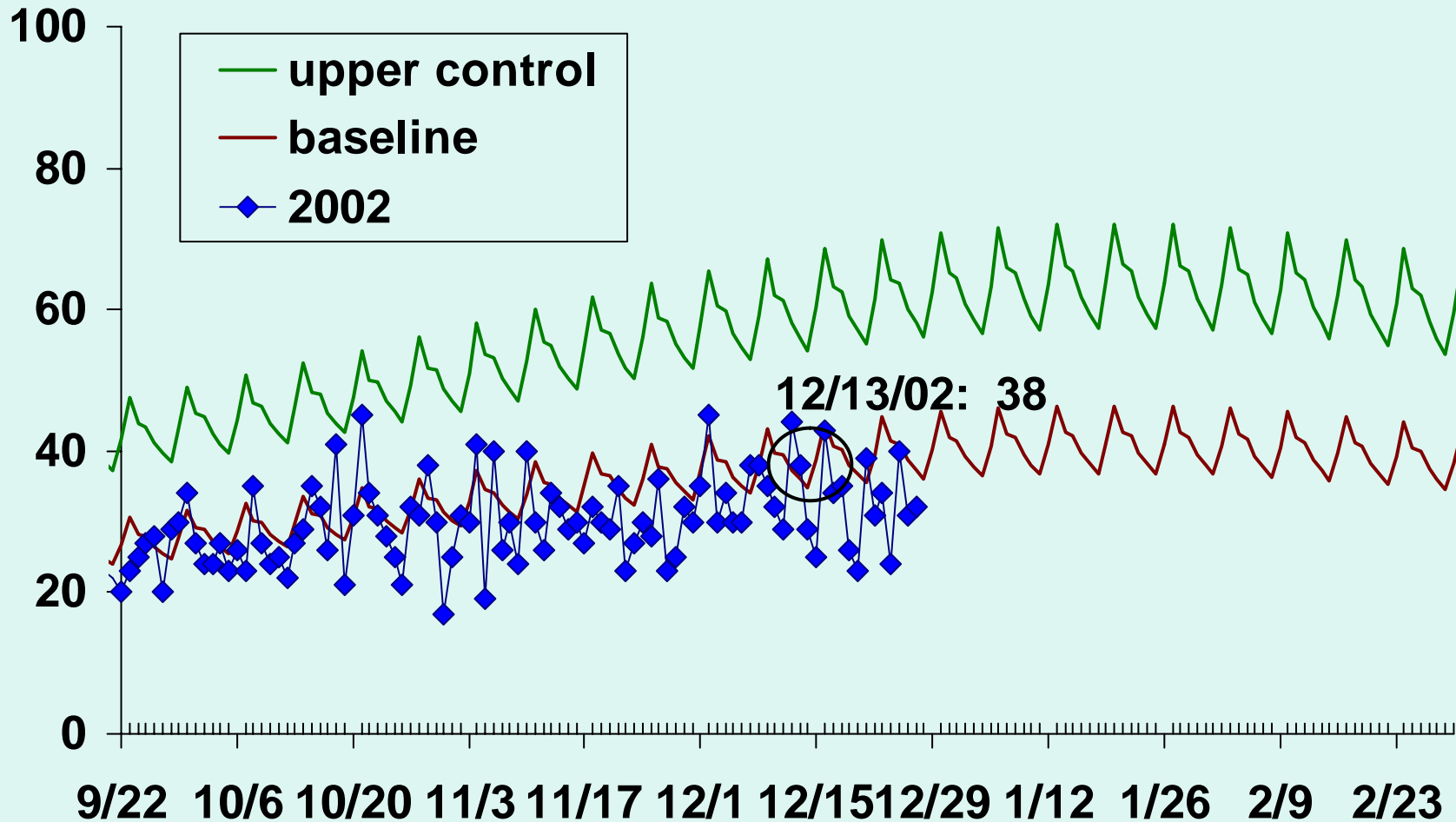
**NM Department of Health announced
the first report of laboratory confirmed
(culture positive) influenza in the state**

12/13/2002

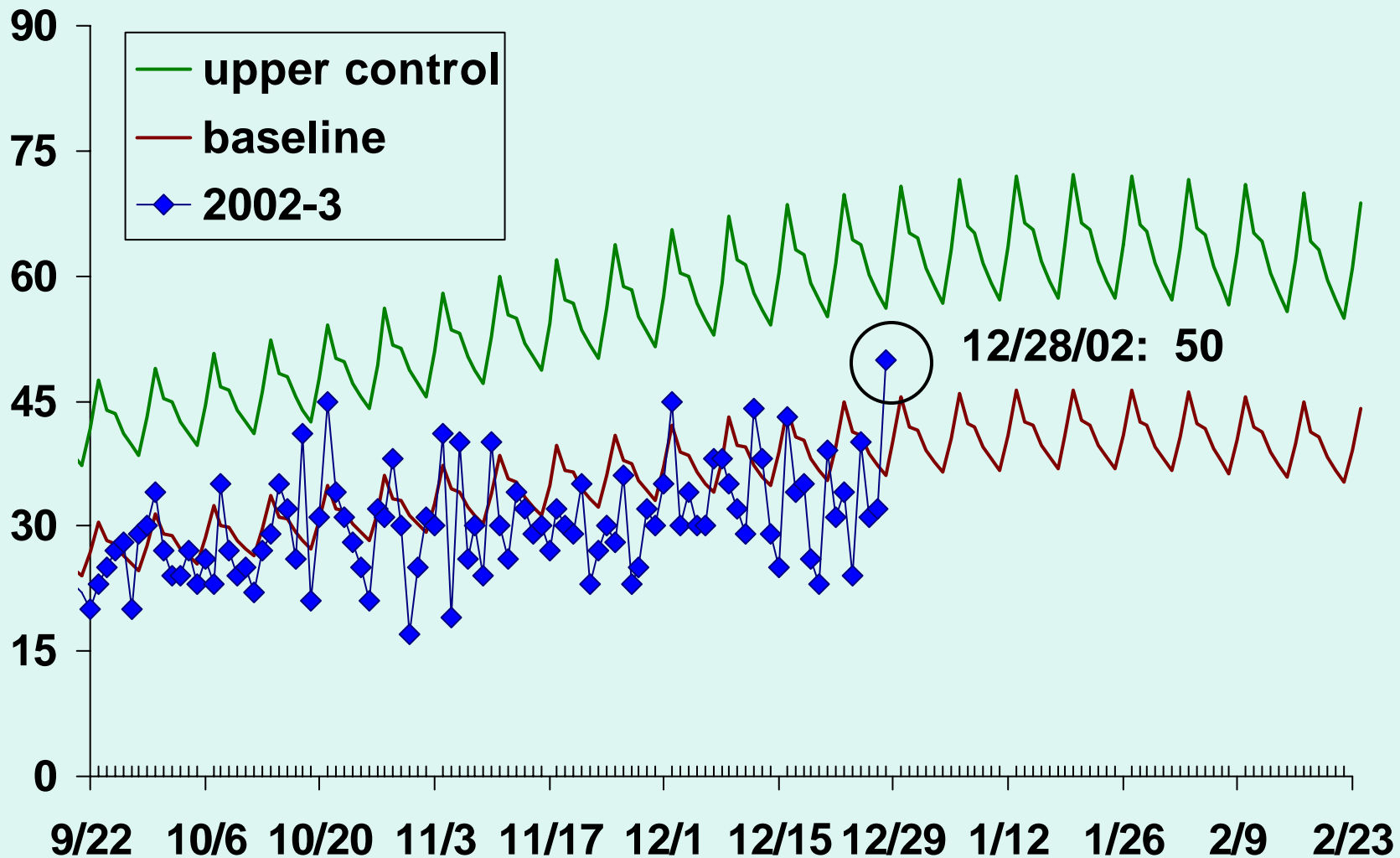
Respiratory virus reports from clinical and public health virology labs in NM by week 2002-3



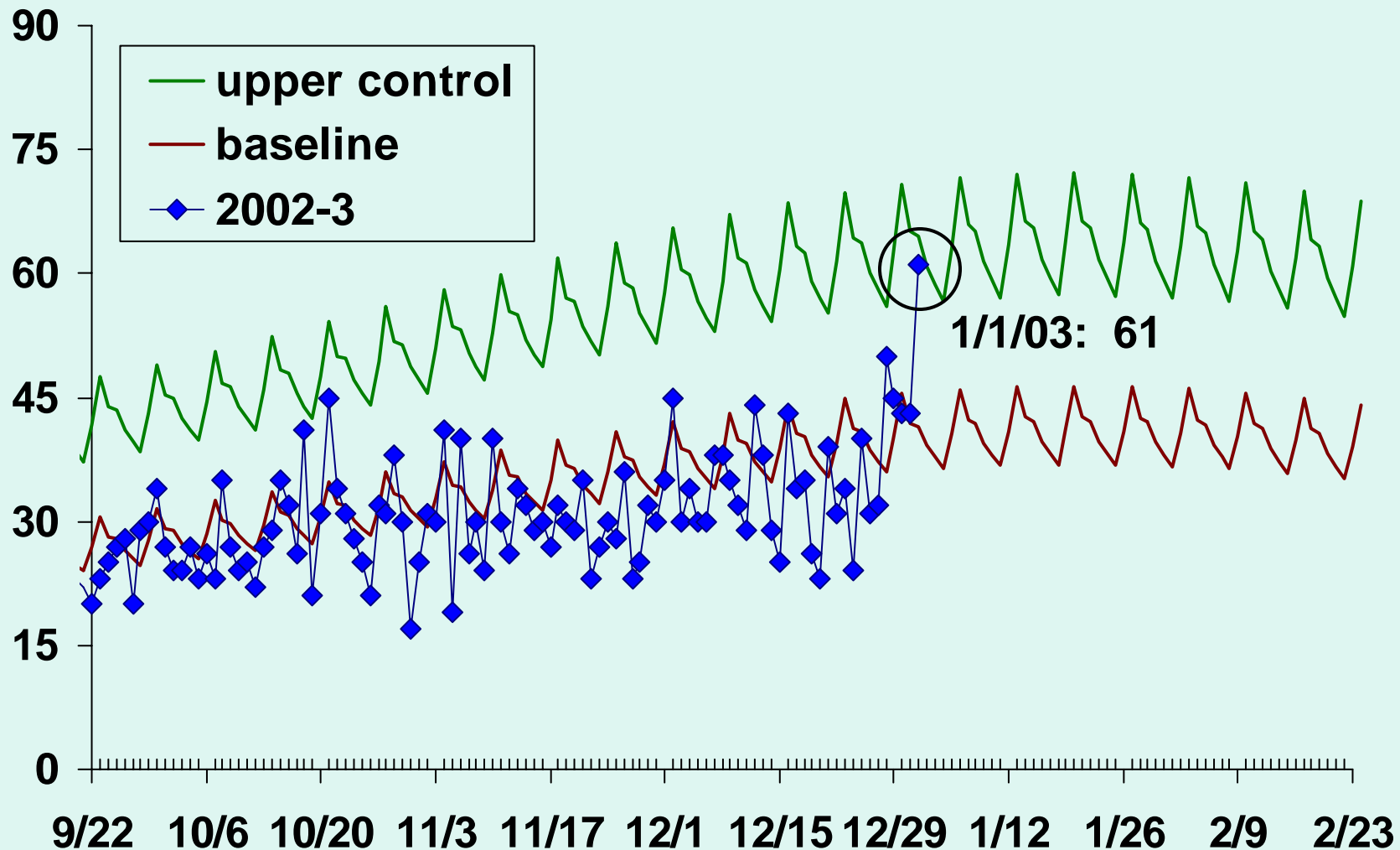
Patients at University Hospital Emergency Department with respiratory complaints 2002



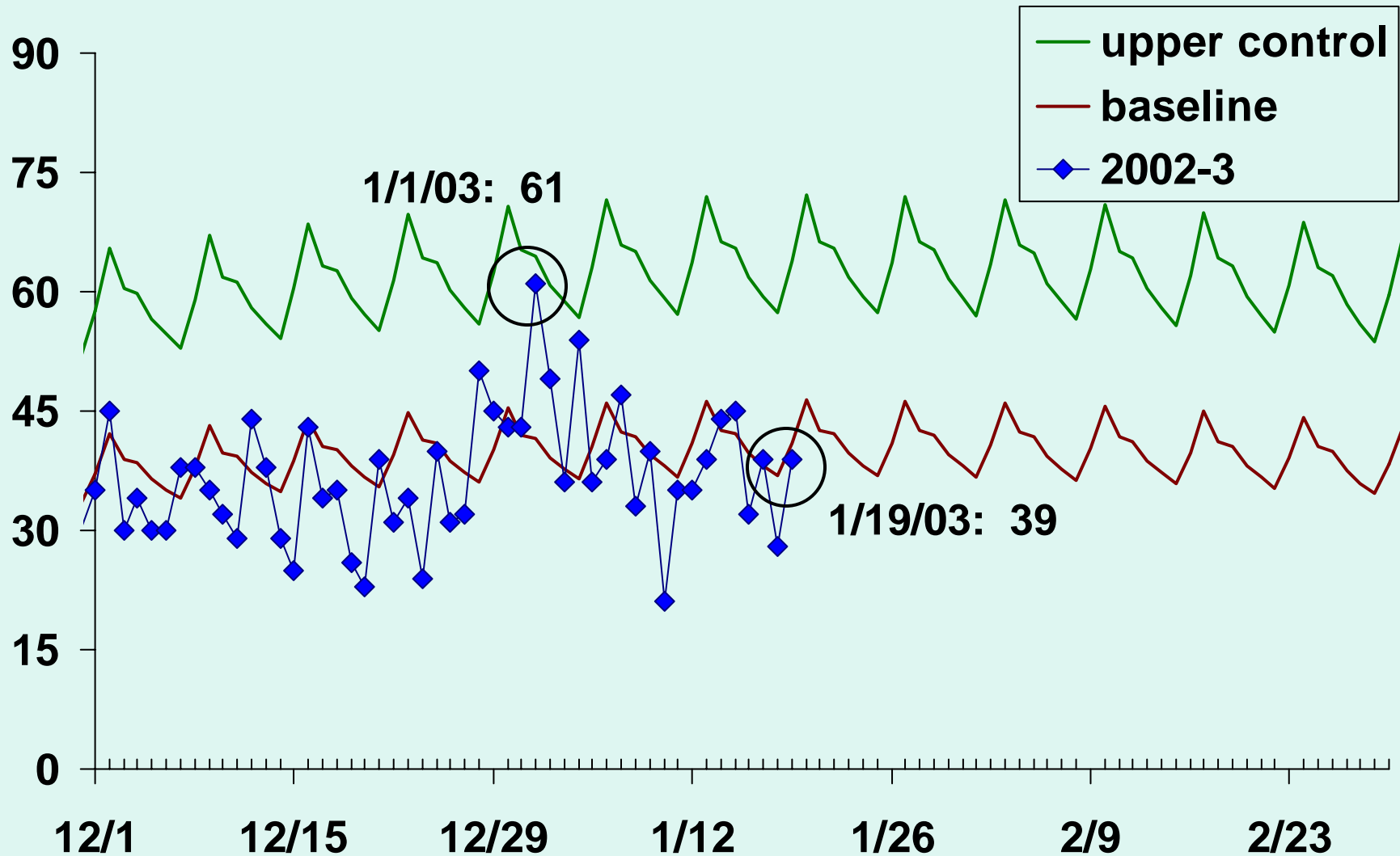
Daily counts of Emergency Department respiratory complaints 2002-3



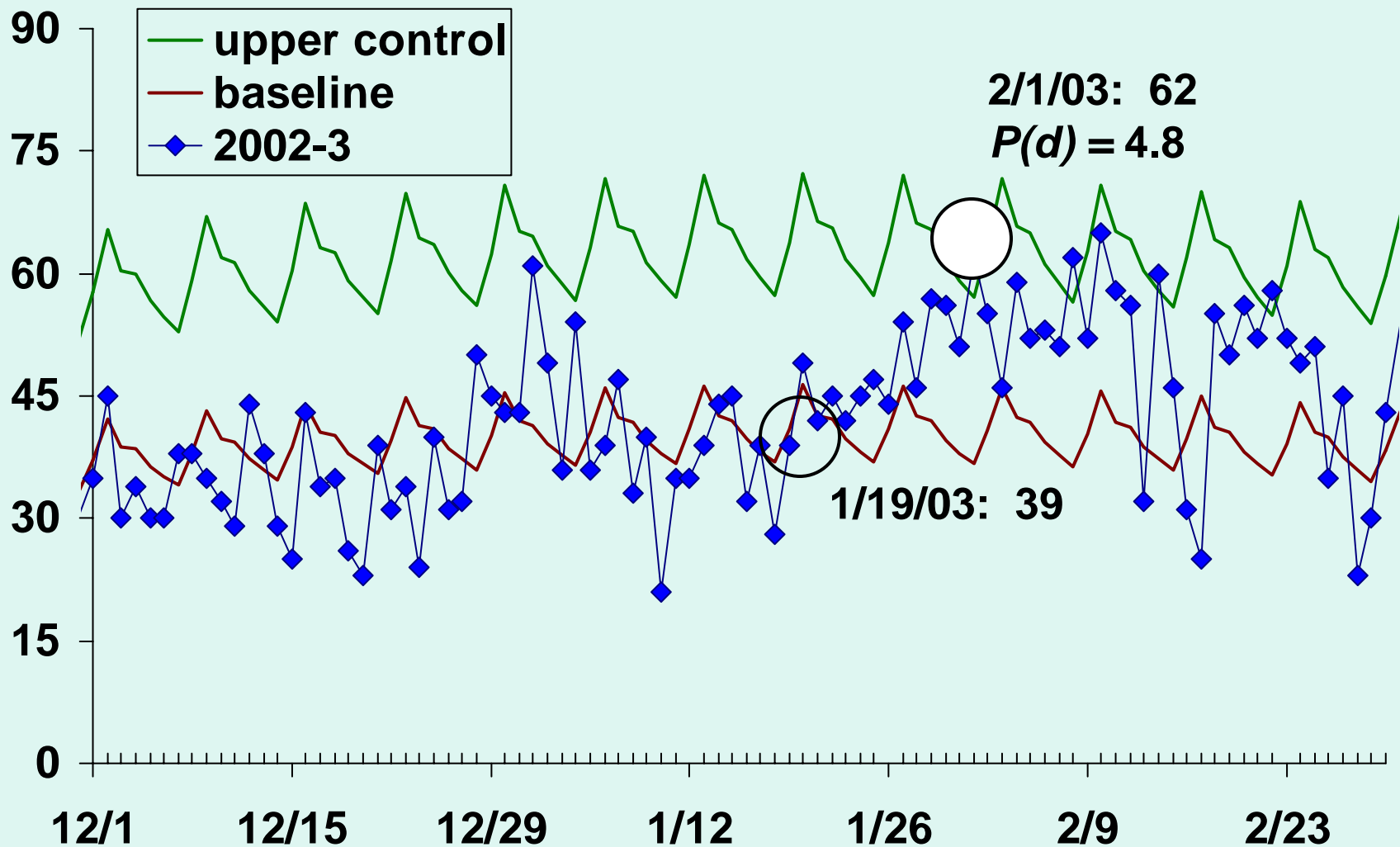
Daily counts of Emergency Department respiratory complaints 2002-3



Daily counts of Emergency Department respiratory complaints 2002-3



Daily counts of Emergency Department respiratory complaints 2002-3



When did flu season start?

ED respiratory complaint counts

12/28/02	50	
1/ 1/03	61	
2/ 1/03	62	> 2 SD above baseline

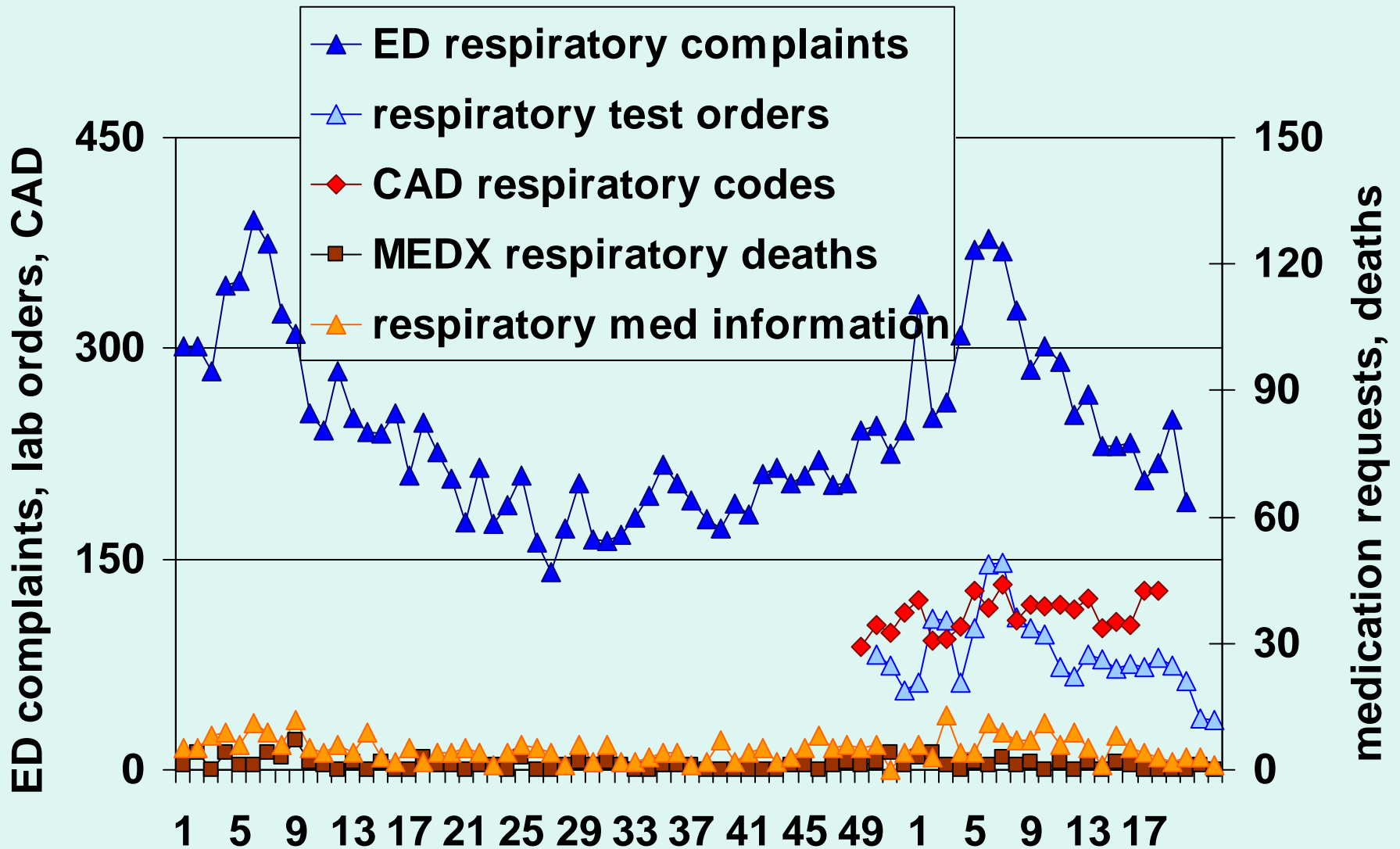
ED respiratory complaints: Page's statistic $P(d)$

12/28/02	0.9	
1/ 1/03	1.2	
2/ 1/03	4.8	above 3.0 for the first time

Data source	Description	Respiratory category Examples
UNM HSC University Hospital ED	Waldo log of ED visits: patient complaints, diagnoses	cough, chest pain, short of breath, trouble breathing
Albuquerque Ambulance Service	Computer assisted dispatch (CAD) codes	breathing problem, allergic reaction
NM Office of the Medical Investigator	MEDX: clinical and pathologic syndromes	clinical: fever + cough or chest pain; pathological: pneumonia, DAD; pharyngitis, epiglottitis
Regional Poison Center	Database of calls for information on medications	Respiratory Class: cough and cold meds; asthma medications
UH hospital information system	Orders for lab tests	sputum culture, rapid viral tests, strep test, <i>Legionella</i> serology

B-SAFER data streams by week

1/2002-6/2003



Reference values

University Hospital ADT log

- 8 years of historical data used to create a modeled baseline incorporating day of the week, seasonal and long term effects on day to day case counts; baseline and 2 standard deviation (SD) upper control limit

Other data streams

- 2 years or less of historical data, simple average + 2 SD defines the baseline and upper control limit

Assessment of deviation from baseline

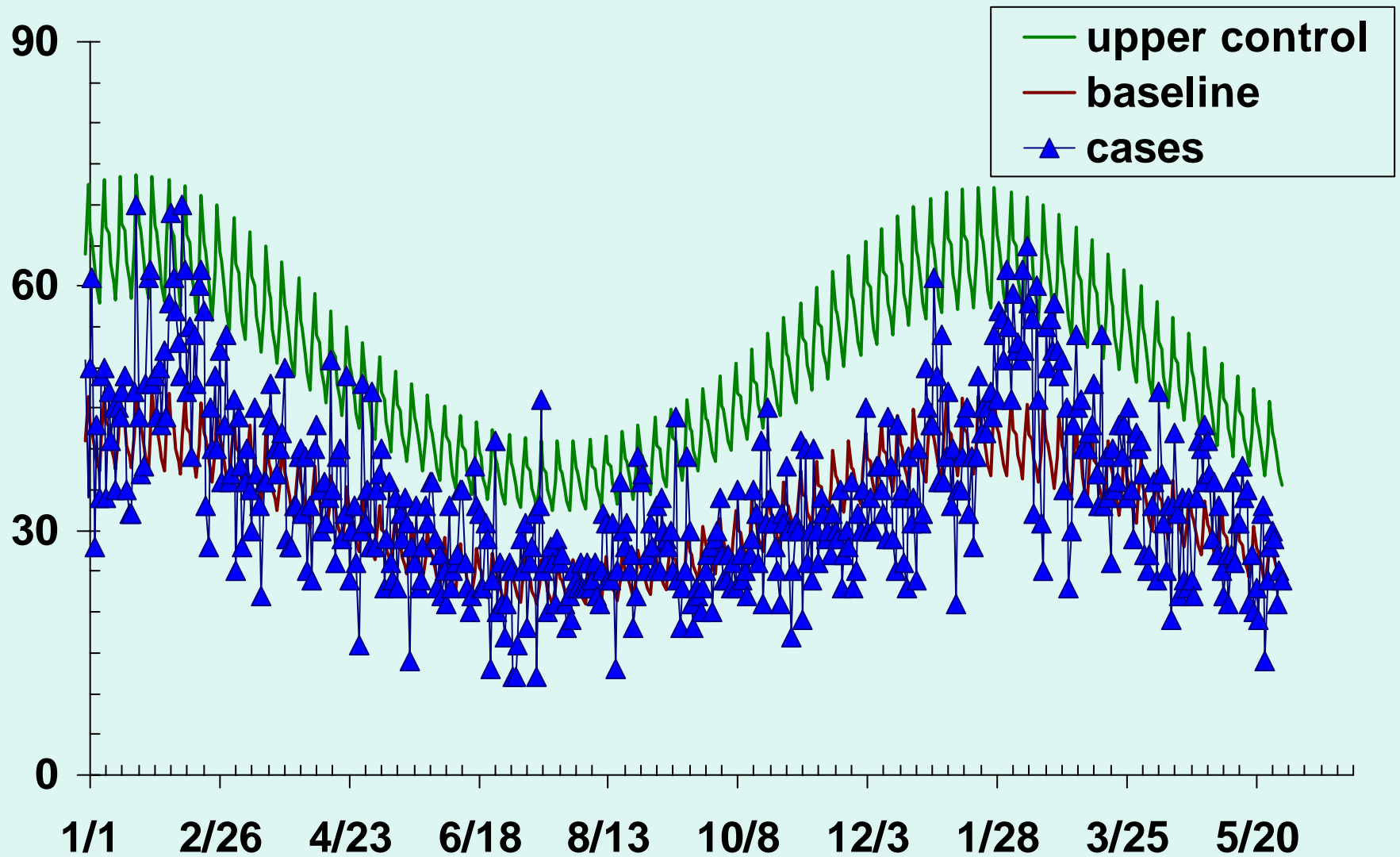
Upper control limit: 2 SD above the mean or baseline

Scaled CUSUM: scaled error for today added to the sum of previous errors

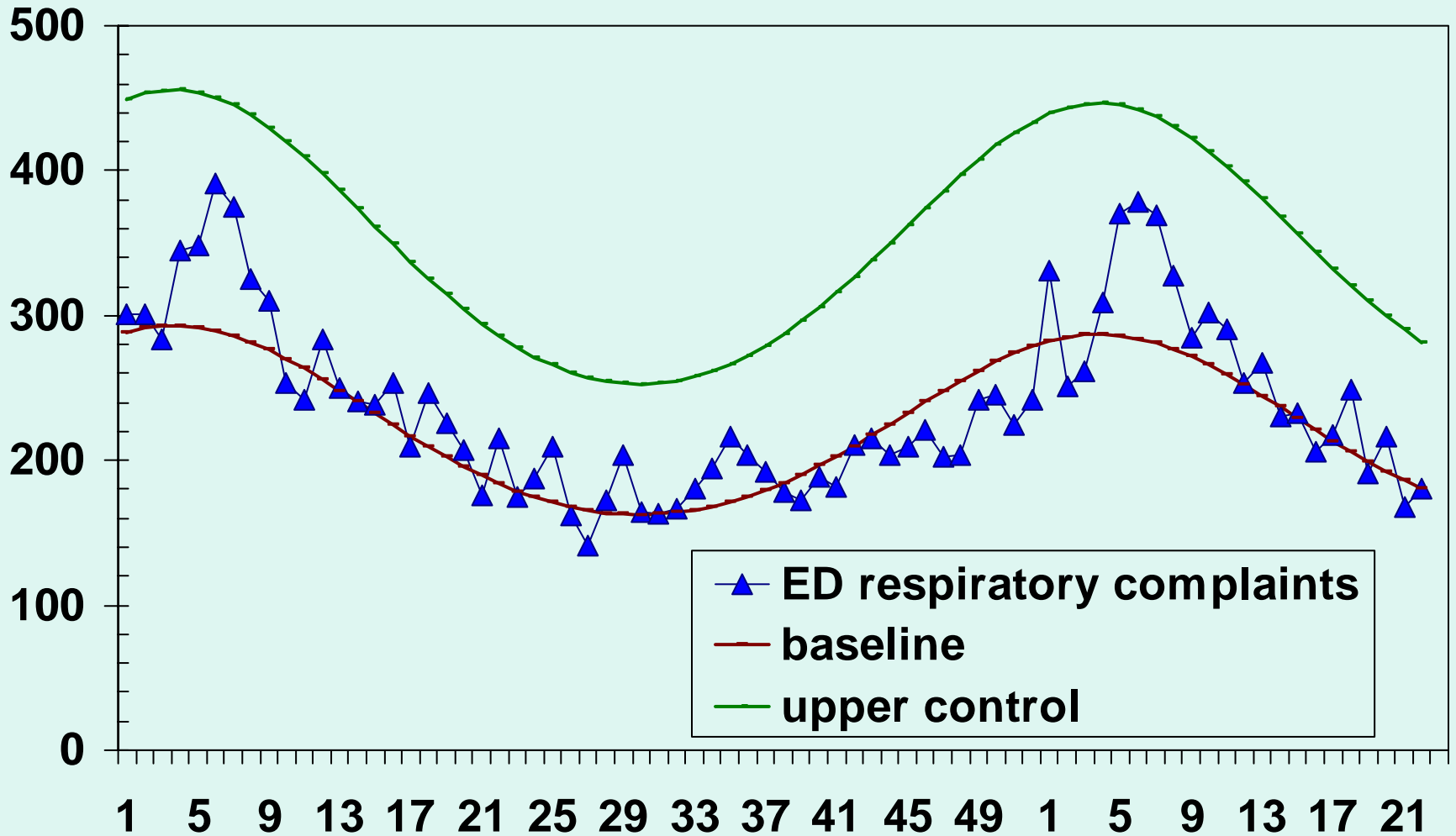
Page's statistic ($P(d)$, a modified cusum): scaled error minus 0.5 [= 1 SD] added to the sum of previous errors, but reset to 0 if a negative number

$$\text{scaled error} = (\text{observed} - \text{expected})/\text{SD}$$

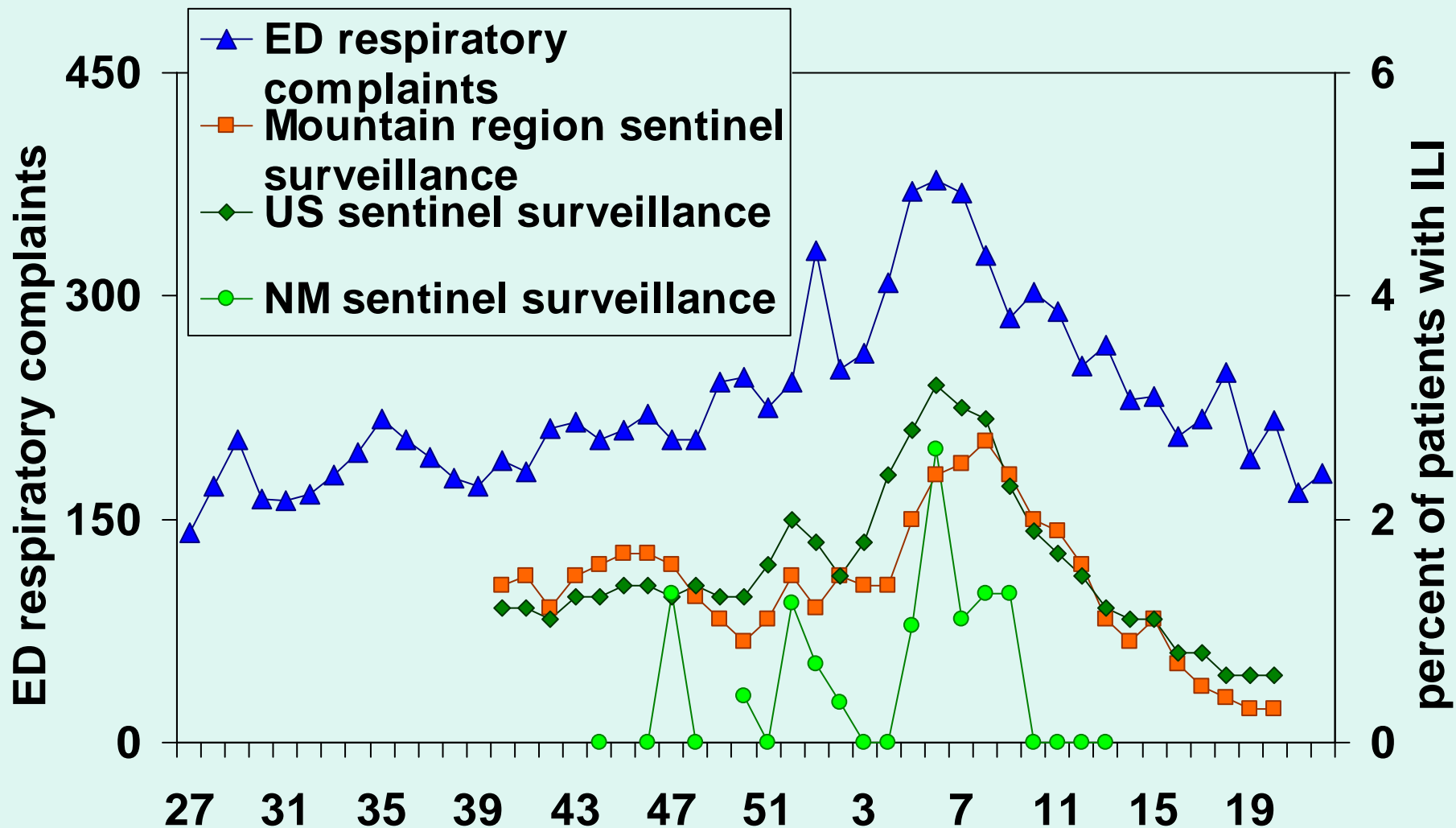
UH ED respiratory complaints by day 2002-3



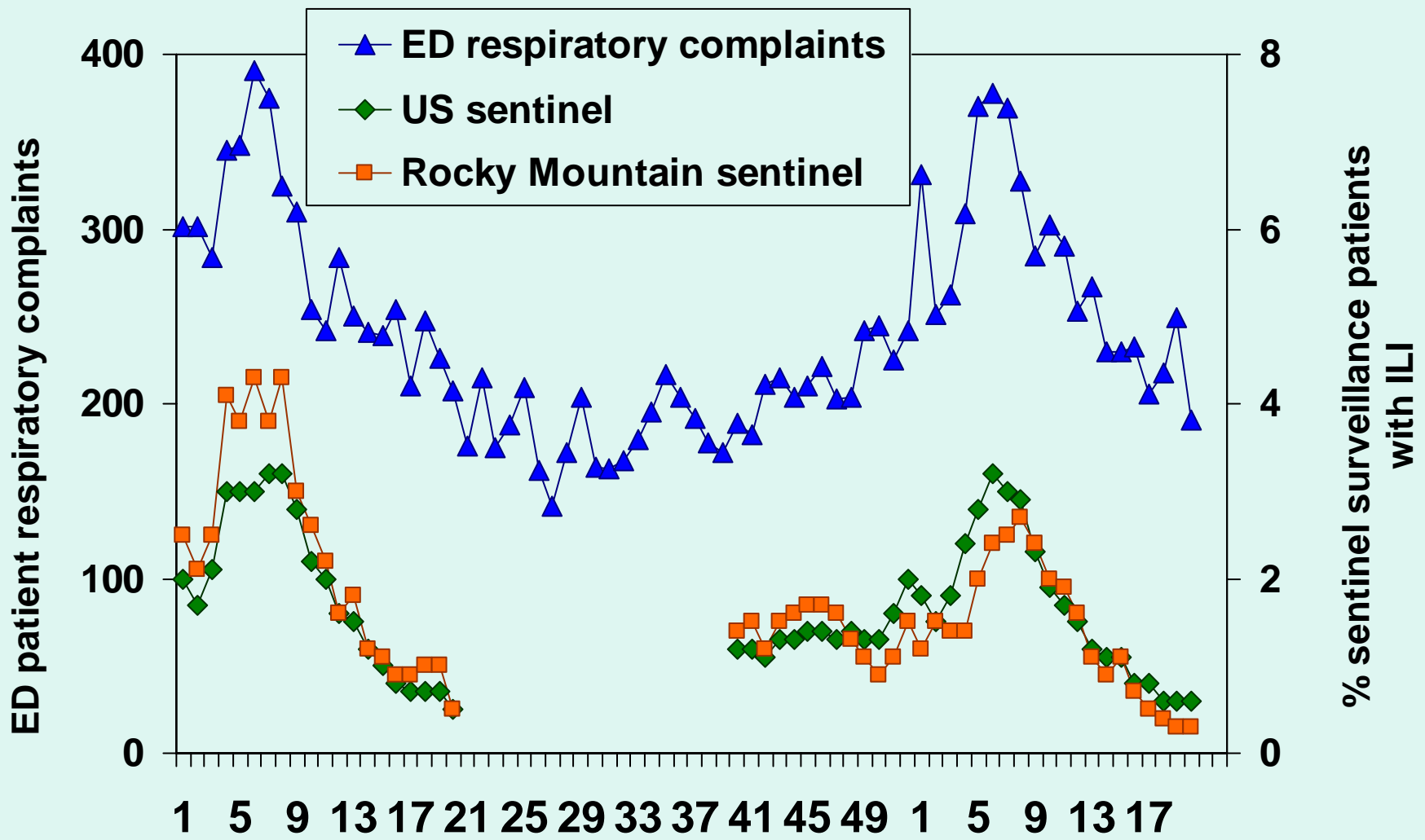
UH ED respiratory complaints by week 2002-3



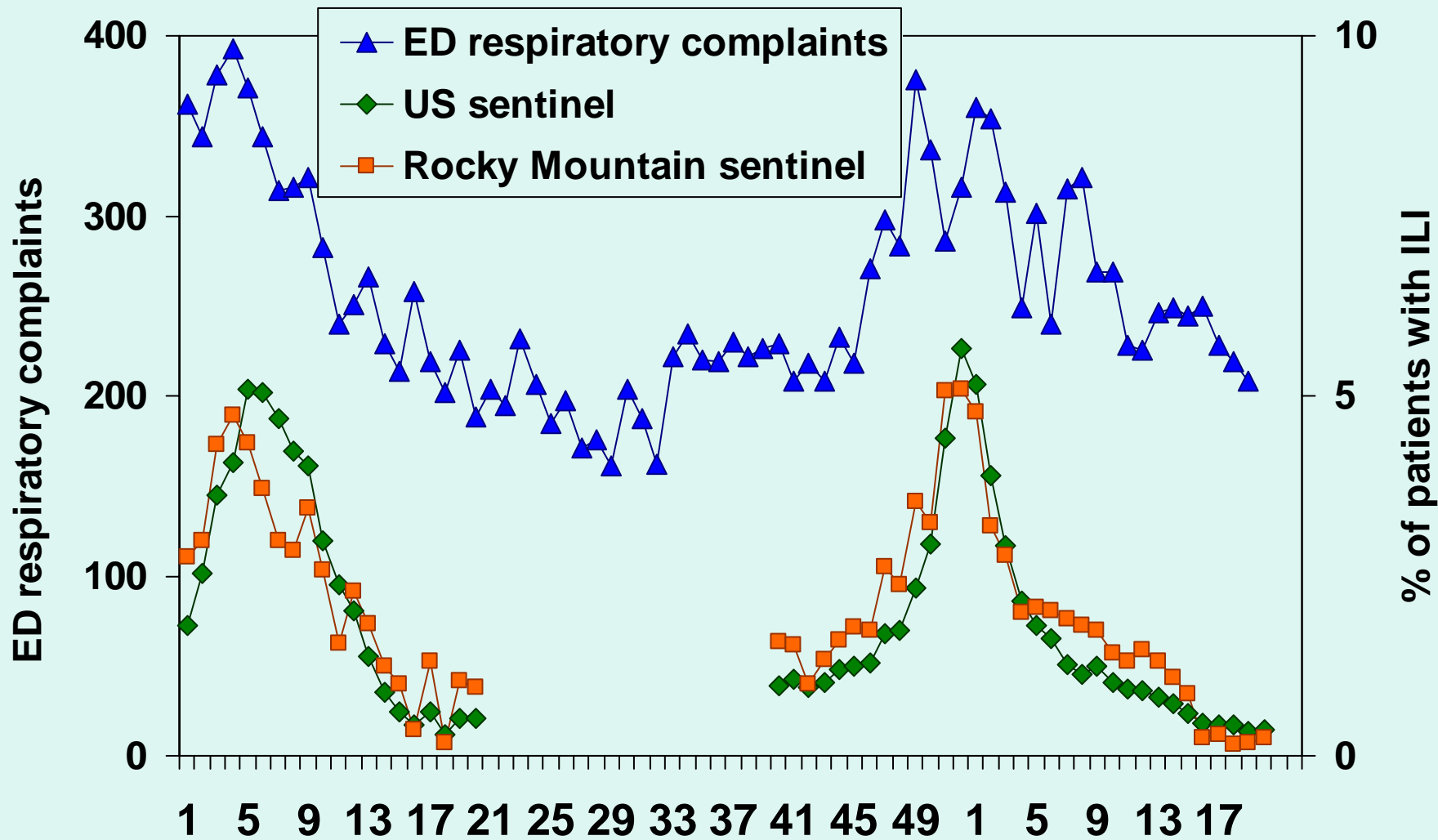
UH ED respiratory complaints compared to sentinel surveillance (percent of patients with influenza-like illness) by week 2002-3



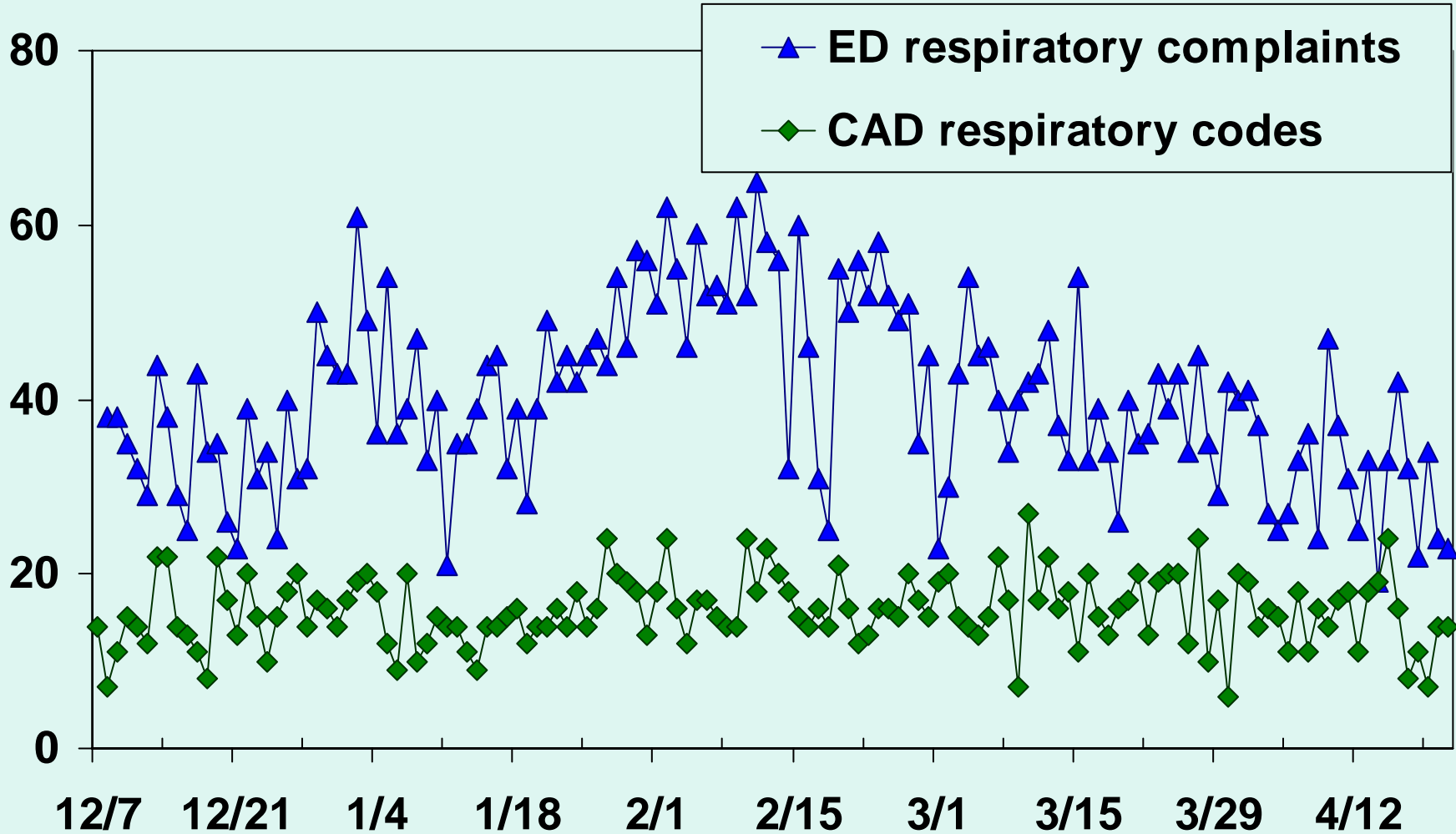
ED respiratory complaints vs US and Rocky Mountain region sentinel surveillance by week 2002-2003



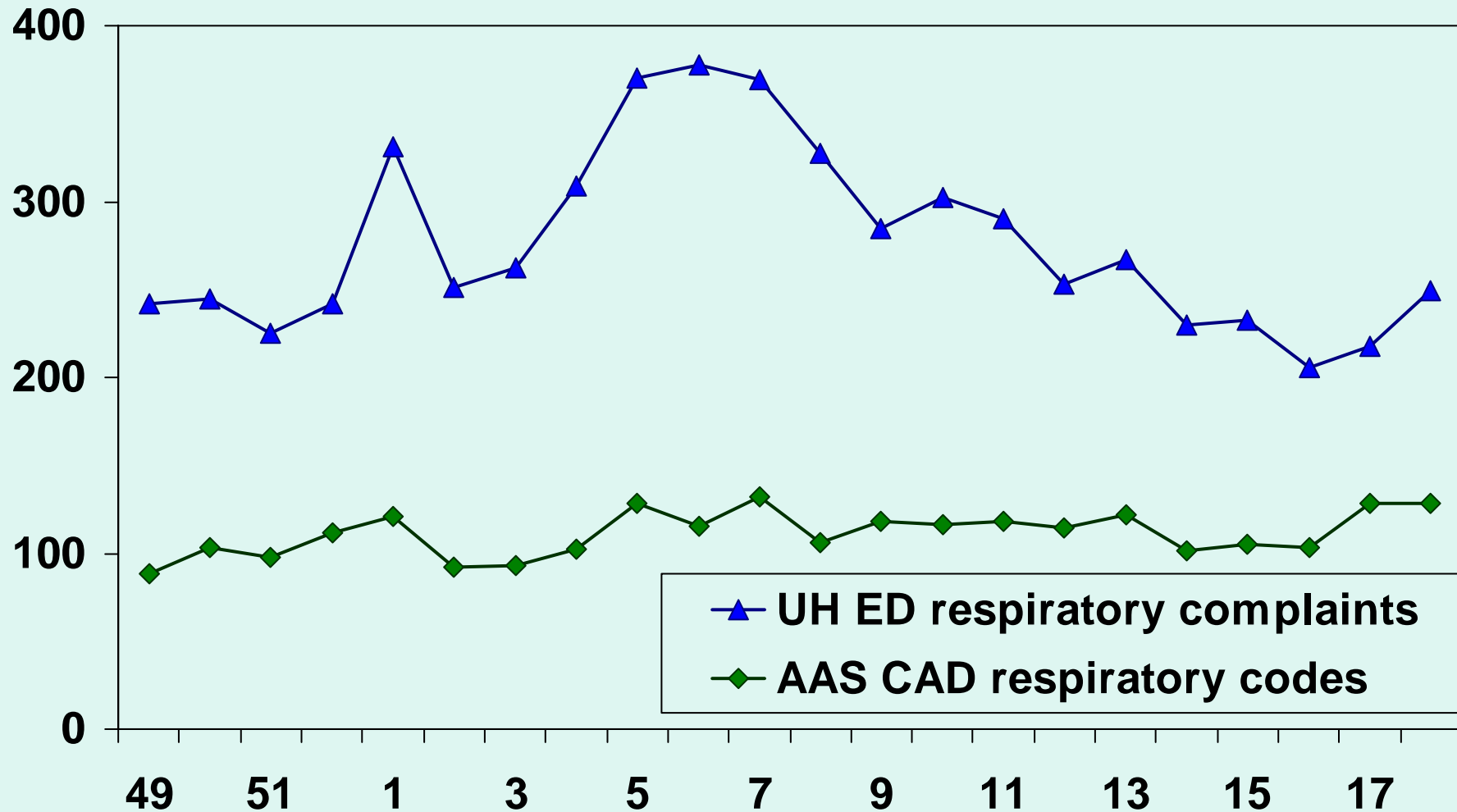
ED respiratory complaints vs US and Rocky Mountain region sentinel surveillance by week 1999-2000



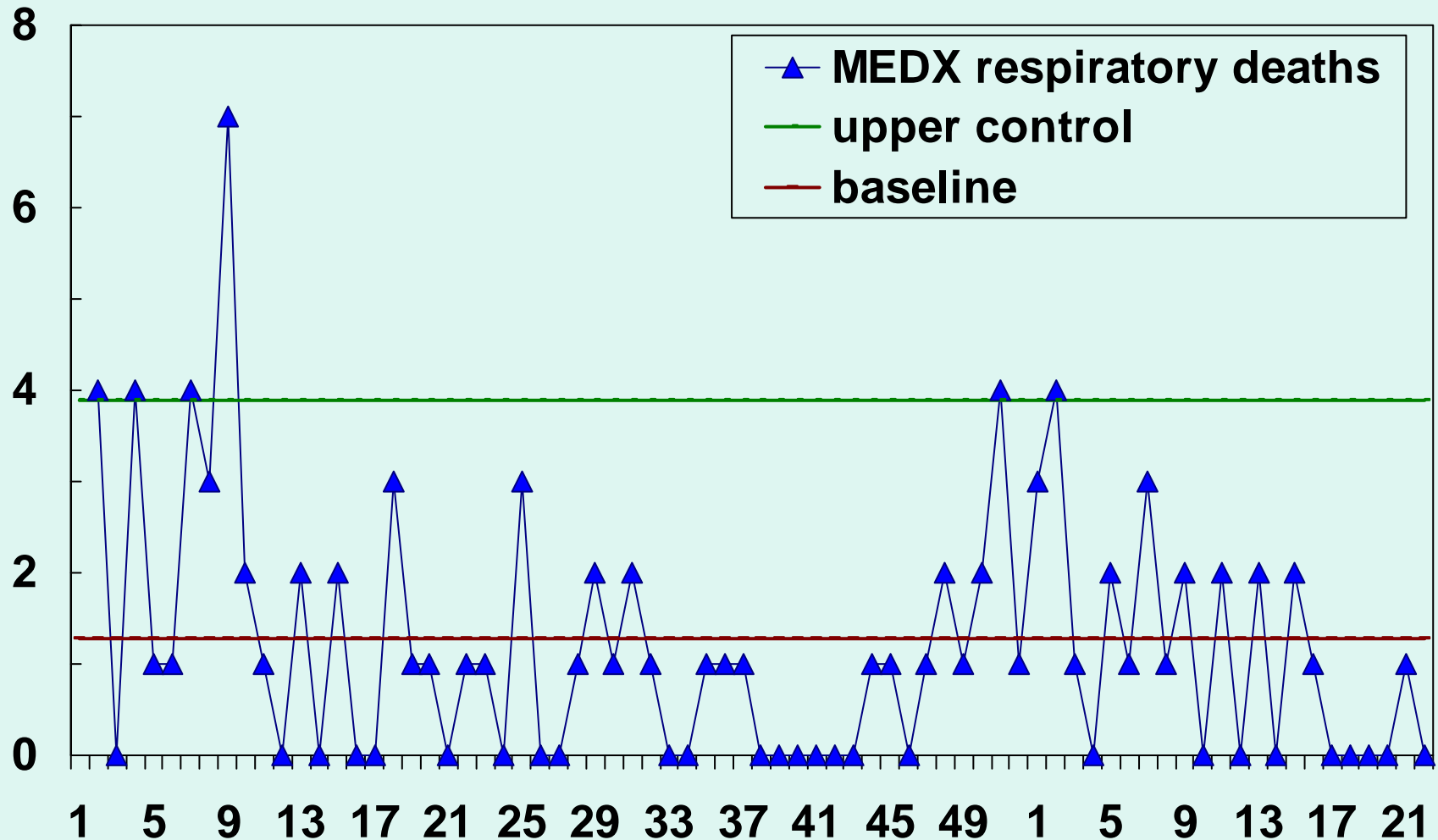
Albuquerque Ambulance Service CAD respiratory codes compared to ED respiratory complaints by day



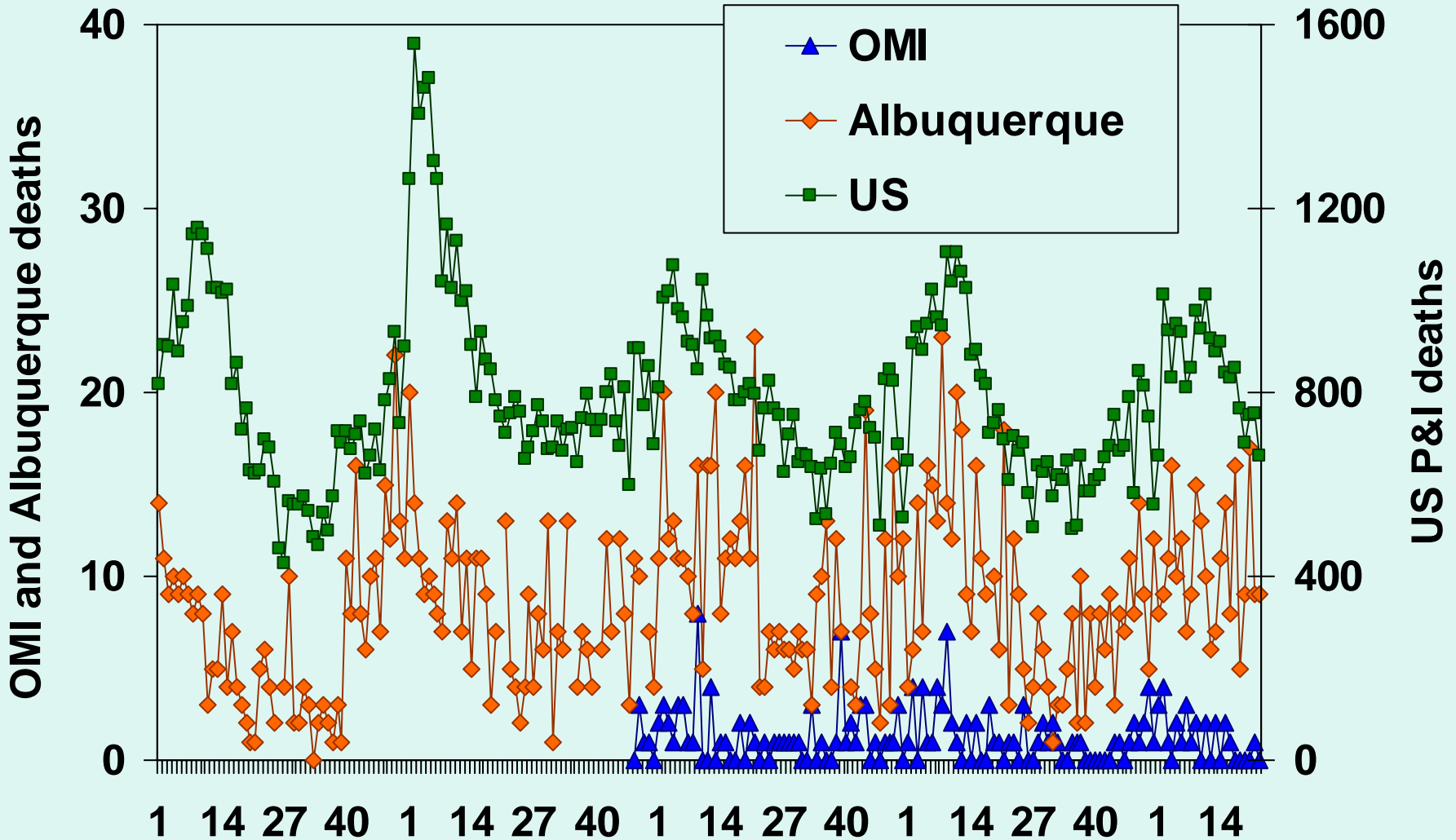
Albuquerque Ambulance Service Computer-Aided Dispatch respiratory codes compared to UH ED respiratory complaints by week 2002-3



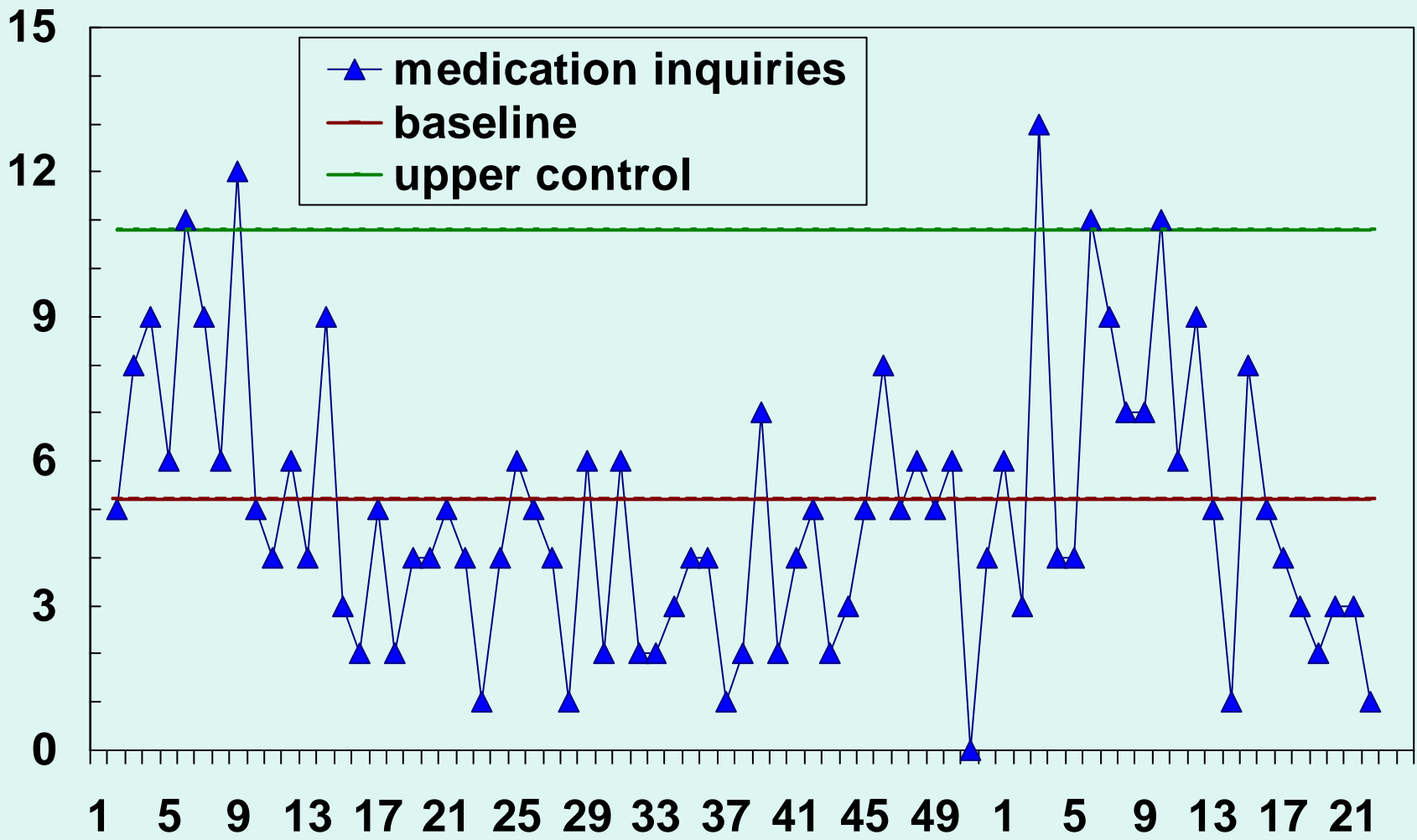
NM OMI – deaths due to respiratory infection by week 2002-3



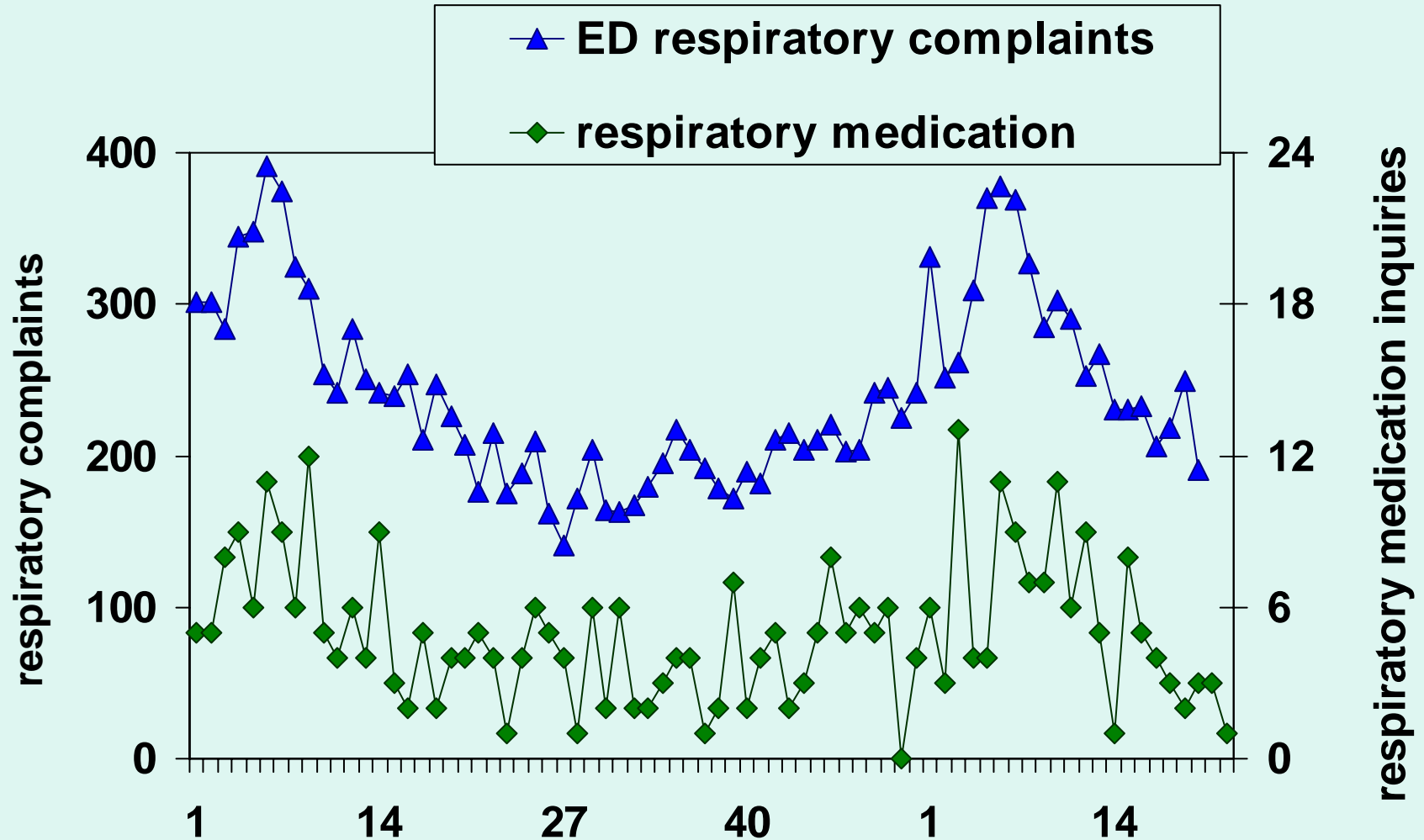
OMI respiratory deaths compared to Albuquerque and US P&I deaths by week 1999-2003



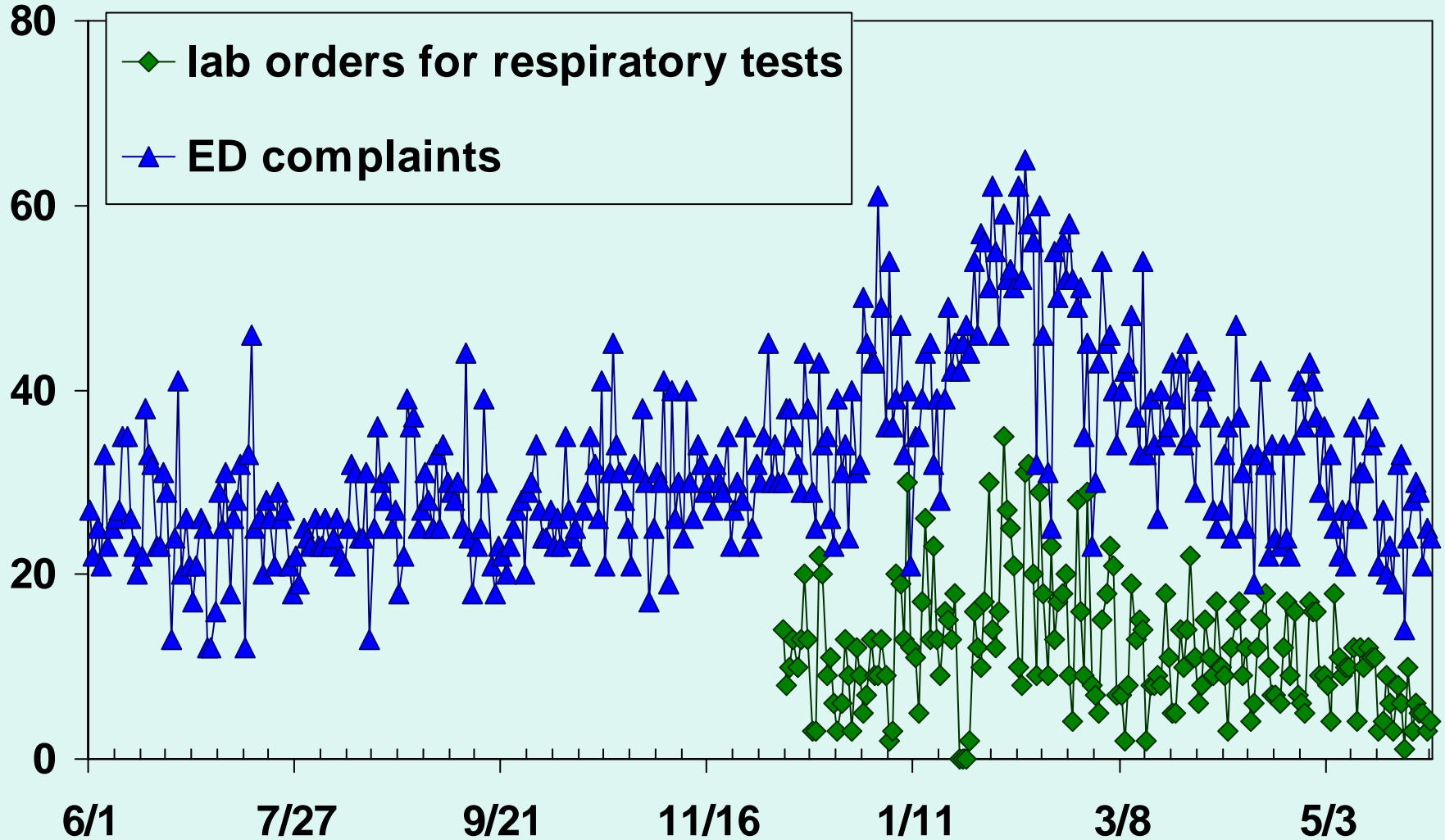
Poison Center respiratory medication inquiries by week 2002-3



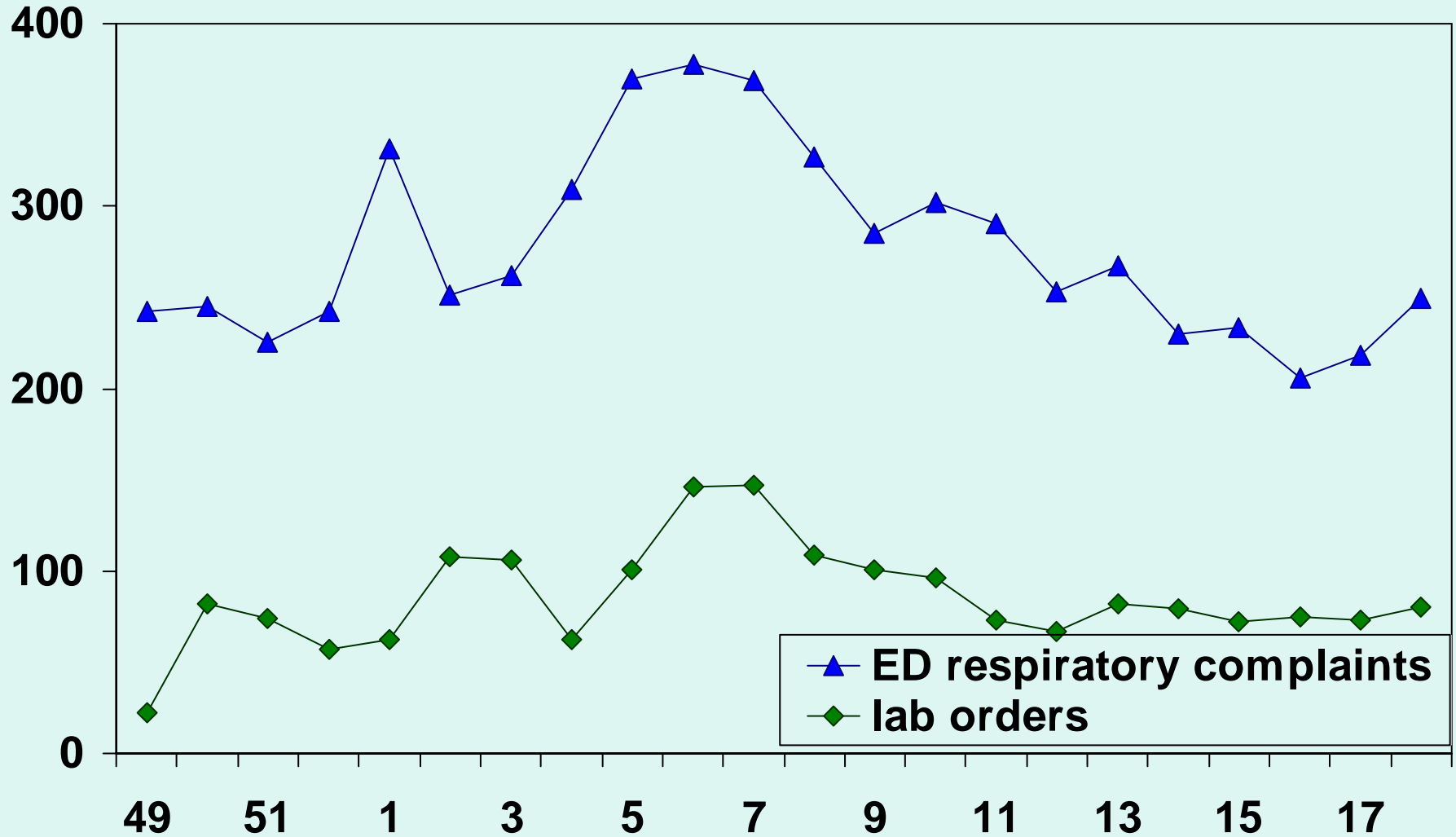
ED respiratory complaints compared to Poison Center respiratory medication inquiries by week 2002-2003



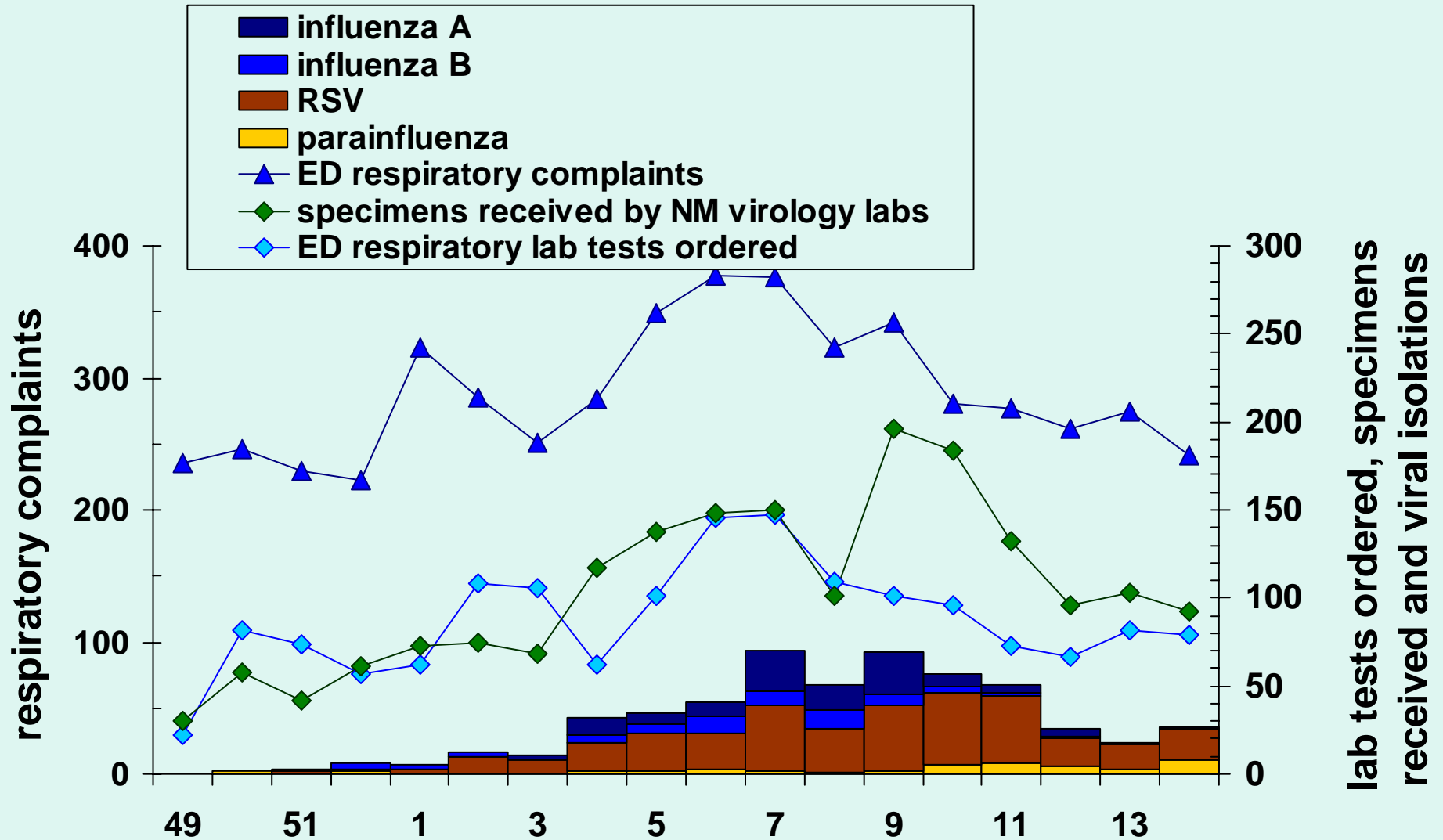
UH ED orders for respiratory infection lab tests compared to ED respiratory complaints by day



UH orders for respiratory infection lab tests compared to ED respiratory complaints by week 2002-3



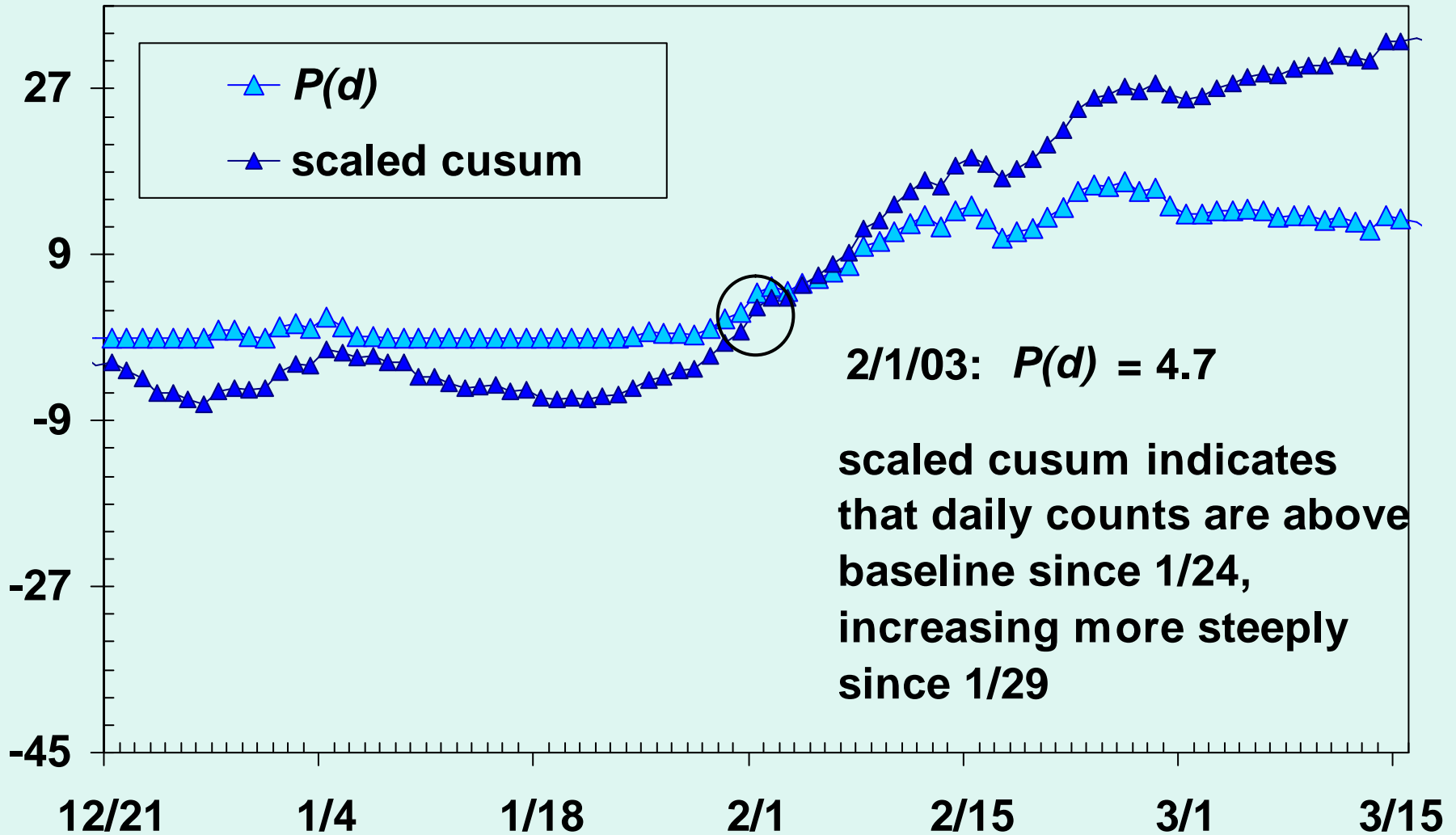
ED patient respiratory complaints compared to specimens received and viruses isolated 2002-3



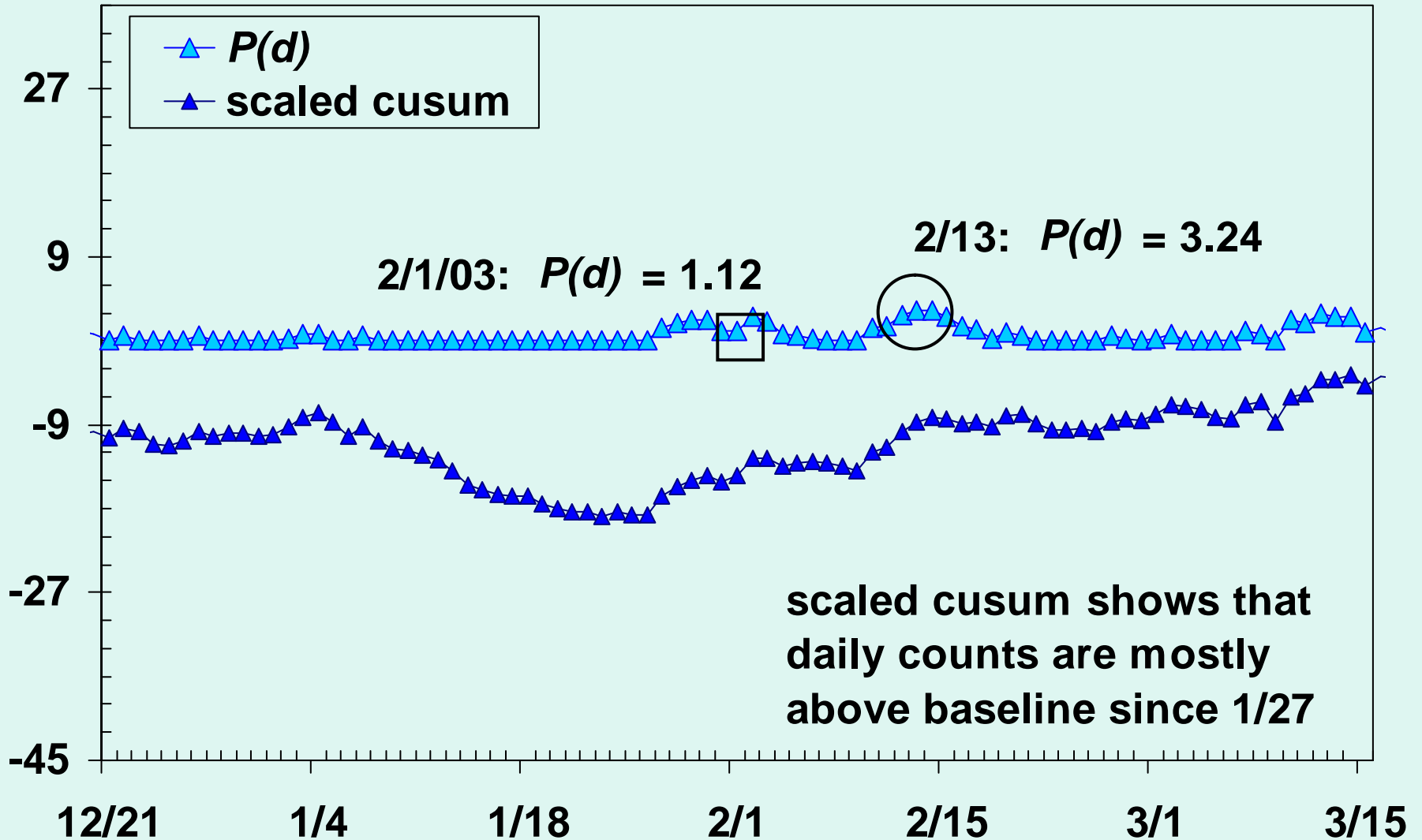
Page's statistic – a modified cusum

- $P(d)$ = the value of Page's statistic for day = d
- $P(d) = \max (0, (P(d-1) + (\text{scaled error}(d) - 0.5)))$
- $\text{Scaled error}(d) = \frac{(\text{value}(d) - \text{value}(\text{baseline}))}{\text{standard deviation}}$
- **Baseline** = average or expected value
- **Standard deviation** = SD of average or expected values
- **Useful properties of $P(d)$:**
 - resets to zero so variance does not increase over time
 - an increase in the $P(d)$ of 3.0 represents an increase in the scaled daily error (or departure from the baseline or expected value) of 3 SD

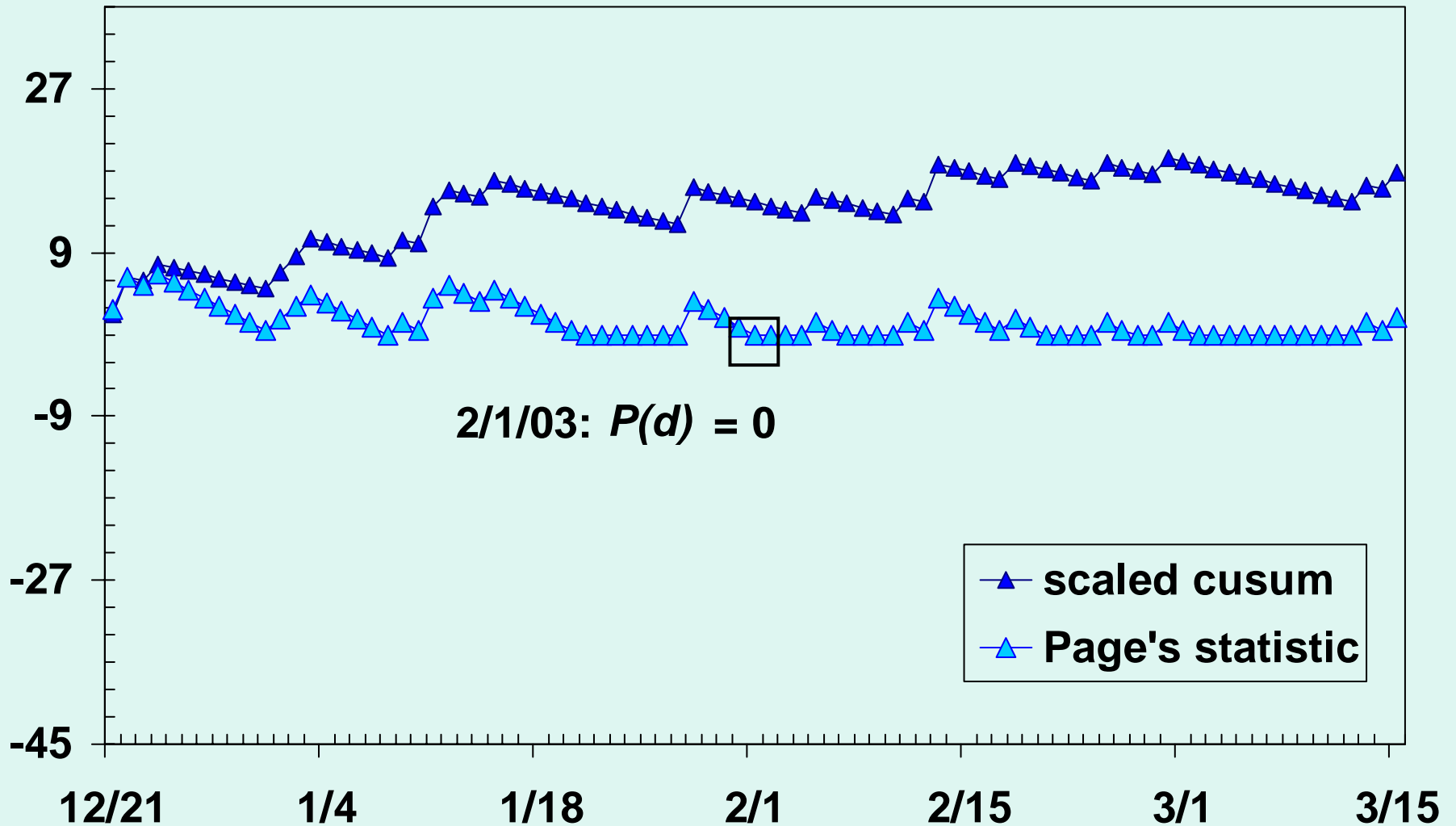
Measures of change: ED respiratory complaints by day 2002-2003



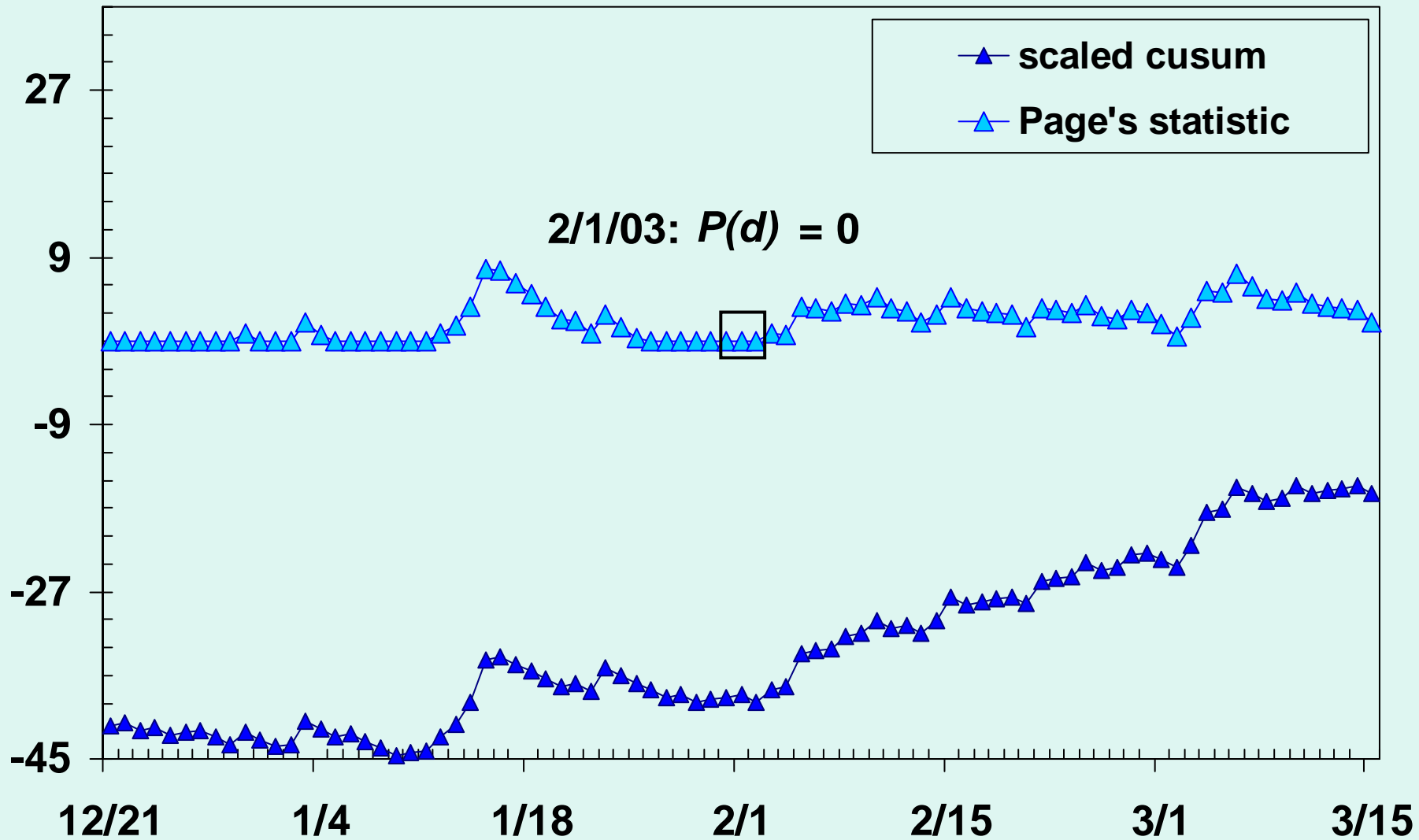
Measures of change: CAD respiratory codes 2002-2003



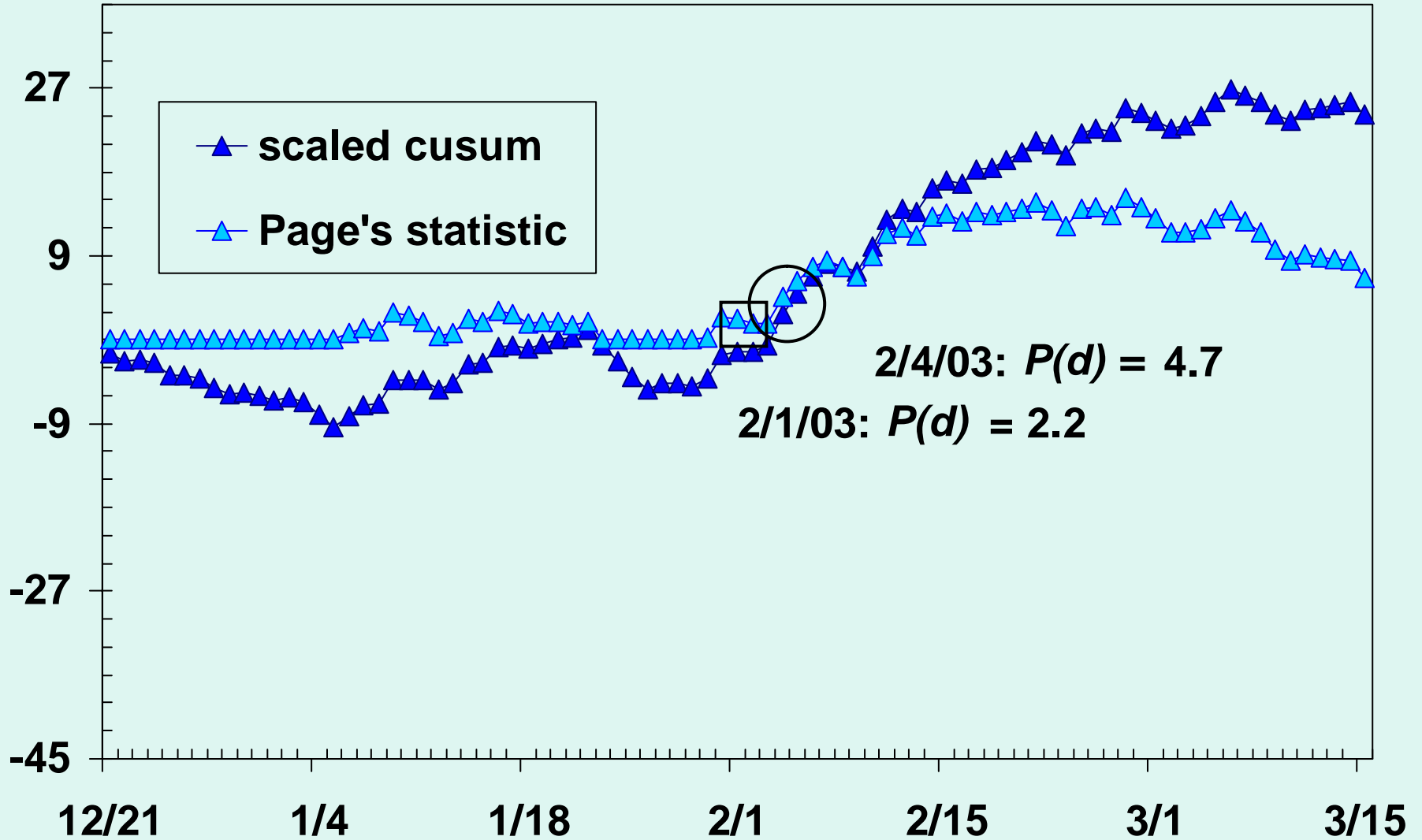
OMI deaths due to respiratory infection



Regional Poison Center – respiratory medication inquiries



UH ED orders for respiratory infection lab tests



Outbreak investigation – adverbial array

Is there really something abnormal?

Or is the apparent cluster a just a coincidental confluence of unrelated events?

- Is there a cluster in space (**where**) and time (**when**)?
- **Who** is affected? Demographics, especially age.
- **What** is the cause of the illness?
- **How** were people exposed or predisposed?

Surveillance to outbreak management

Surveillance

- **Detects the event**
- **Provides some context (denominator, variance)**
- **May provide demographic data and identify affected individuals**

Outbreak investigation

- **Case finding**
- **Hypothesis generation and testing**

Clues from extended or syndromic surveillance data

In addition to the date (? time) of the trigger event(s):

- Are they seen in more than one location or source of data?**
- Has there been a recent trend prior to the trigger event?**
- How severe is the illness; are patients being admitted to the hospital**
- What are the demographics of affected individuals (age, sex, place of residence)**

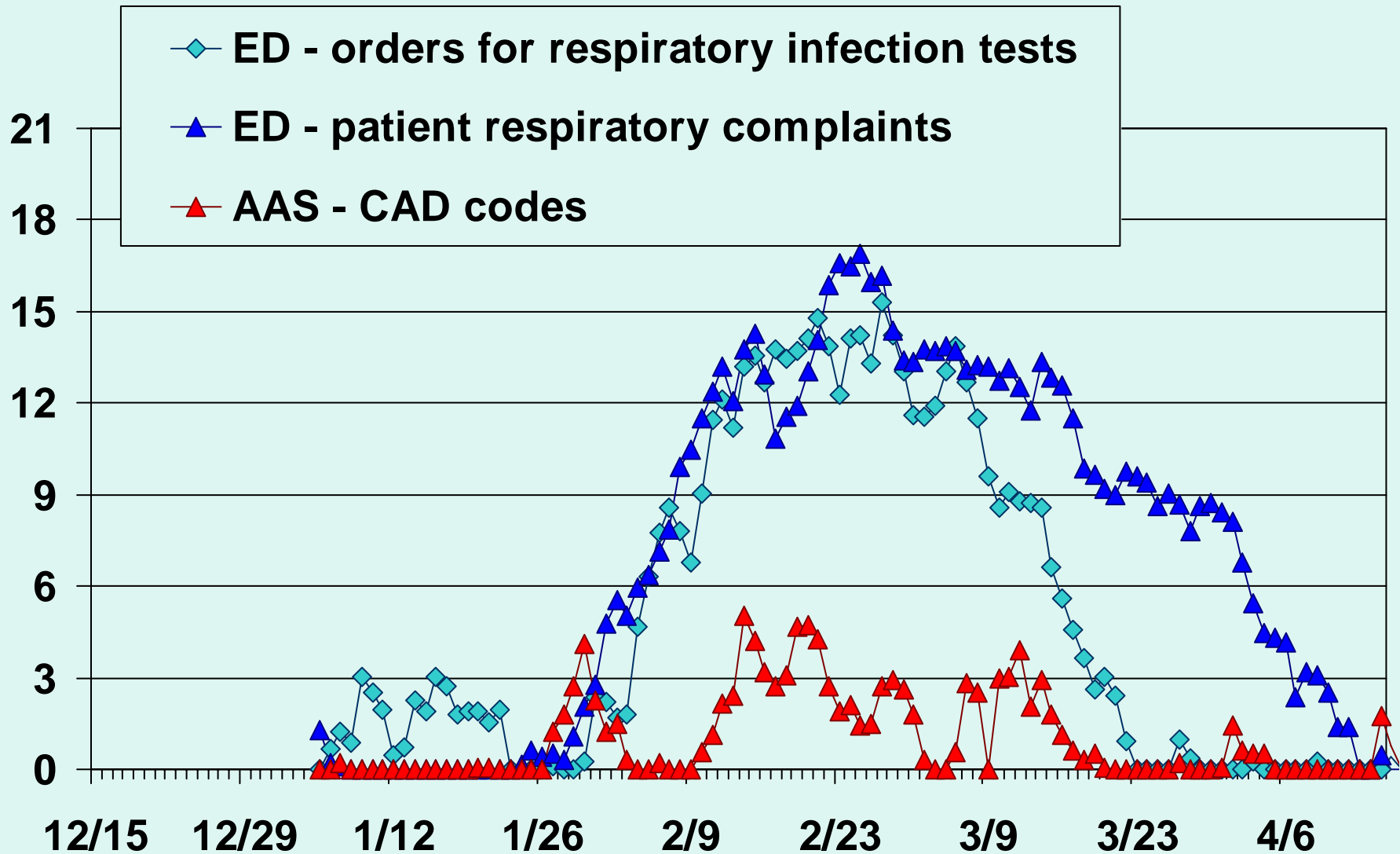
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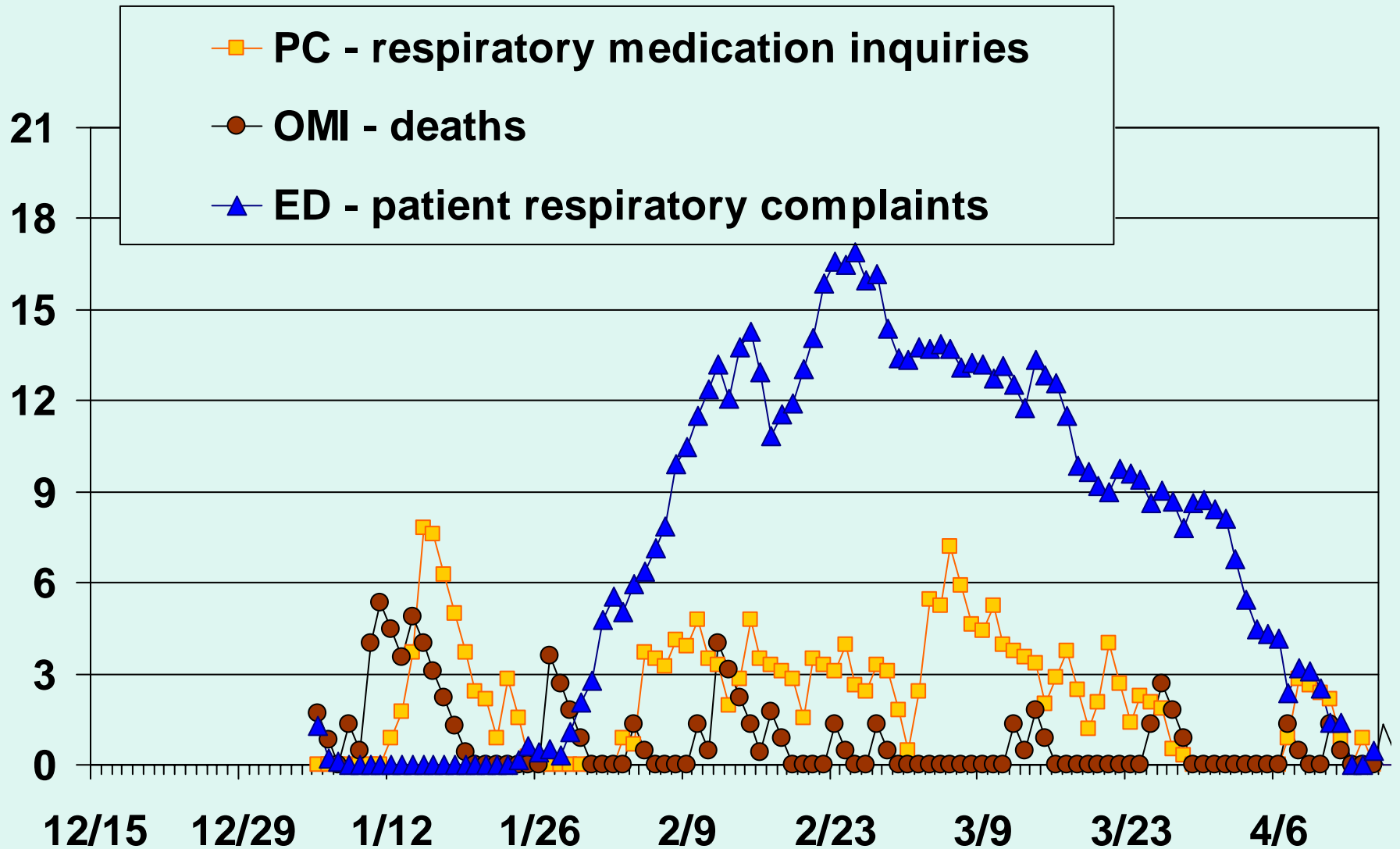
Comparison across data sources-

Page's statistic for respiratory condition time series

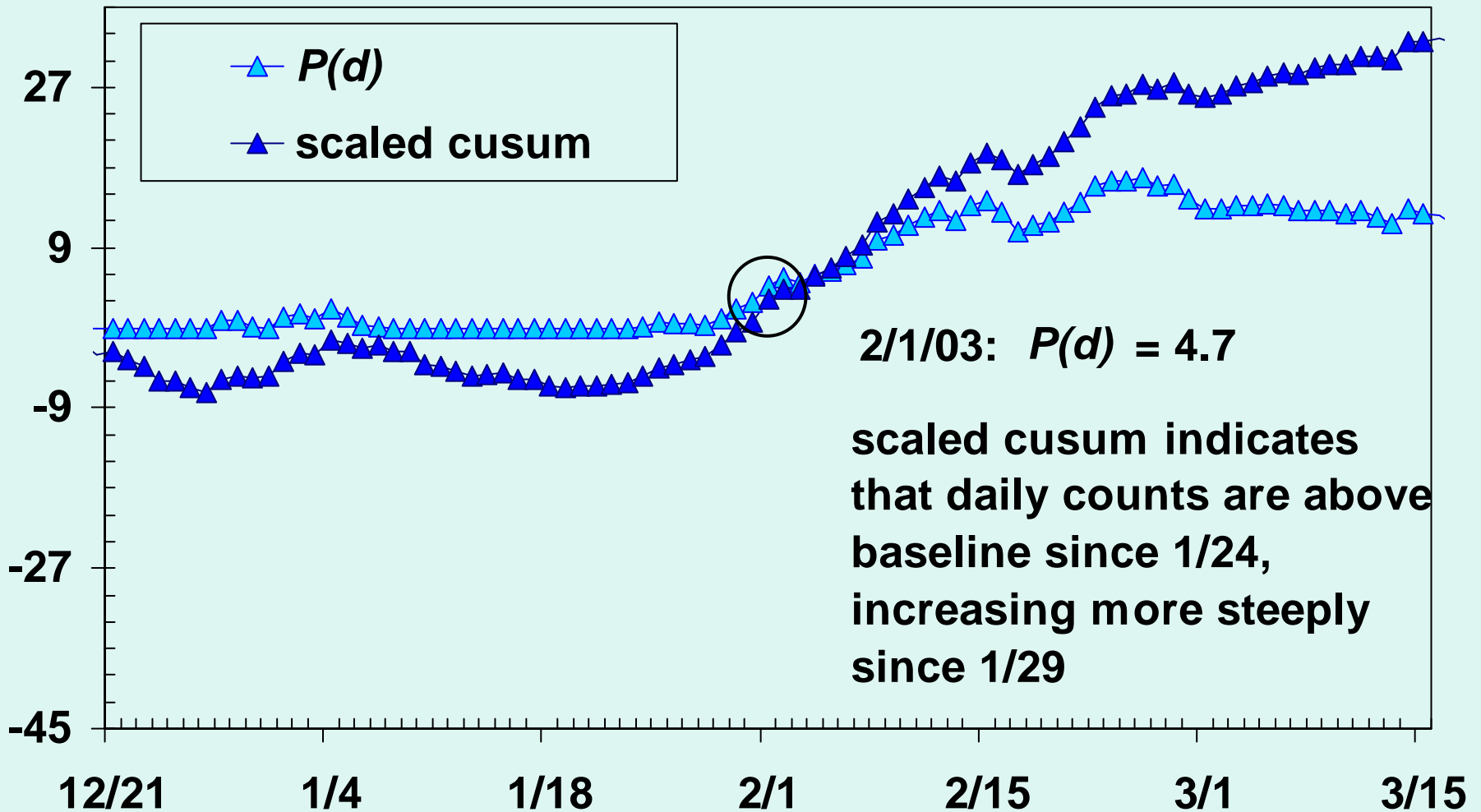


Comparison across data sources-

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Measures of change: ED respiratory complaints by day 2002-2003



Clues from extended or syndromic surveillance data

In addition to the date (? time) of the trigger event(s):

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Clues from extended or syndromic surveillance data

Can you review individual patient records?

B-SAFER collects an encrypted medical record number; the hospital epidemiologist or infection control practitioner can decrypt the medical record number to identify the patient for public health follow up

Who does it?

Outbreak management

- **Traditionally (and still) the responsibility of the local public health authority**
- **Not much is really new in roles and methods**

What is new

is the potential for larger outbreaks and more difficult circumstances

Who does it?

Surveillance

- **Traditionally the responsibility of the local public health authority**
- **Conducted by traditional methods: individual clinician reports, positive lab reports for specific conditions**
- **Roles and methods are changing for many public health agencies**
 - **research institutions (universities)**
 - **state and federal safety and security agencies, national laboratories and the military**

Recipe for instant **chaos** and **resentment**

Hey outbreak management people – LRI counts at City Hospital just hit 3 SD. And the drug stores sold twice as many thermometers yesterday.

Better get right on it!

What are you surveillance people talking about?

What's LRI?

And who cares about thermometers?

Call us back when you get the lab reports!

How do you reduce the **chaos** and prevent **resentment**

No magic answers

Consider:

- **The NYC system: everybody takes turns**
- **Cross-train**
- **Incorporate surveillance indicators in exercises**
- **Simulate outbreaks using ongoing surveillance data**
- **Use emerging infections to demonstrate the utility of extended surveillance**

How do you reduce the **chaos** and
prevent **resentment**

No magic answers

When interest in extended surveillance
doesn't develop on its own

When you hear “this is the way we’ve
always done surveillance” or “we don’t
have time to do more work than we have
already”

How do you stimulate and develop interest?

B-SAFER Conclusions

Operationally, we have demonstrated the feasibility of monitoring data from **multiple sources in real time**

Data **signals compare with each other and with similar signals in influenza surveillance data**

Extended surveillance will be accepted by surveillance staff only when the **data is seen as useful** to them (and therefore valued by them)

B-SAFER conclusions

UH ED patient complaints provide the strongest signal and have a well developed modeled baseline

Lab test orders track well with patient complaints and provide useful information about suspected specific conditions or agents (e.g. atypical pneumonia, RSV)

B-SAFER conclusions

Ambulance dispatch codes performed less well than expected but may be improved by regrouping codes

Poison Center medication inquiries and OMI MEDX pathologic syndromes are small signals but correlate well with other signals; MEDX syndromes are highly specific

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