Measuring Disease Frequency

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Measuring Diseases/ Events

Epi. Objective:

1. Distribution
2. Comparison with reference to population size and, Time

For

a. Prioritization
b. Trend study
c. Resource allocation

- The fundamental task in epidemiologic research is to **quantify** the occurrence of illness

- The goal is to evaluate causation of illness by relating disease occurrence to characteristics of people and their environment

- Rates, Ratios, and Standardized Rates are **primary tools** for quantifying occurrence of illness

Counting Tools

- Rate
- Ratio
- Proportion

Rate?

"a measure of speed with which events are occurring in a population in a specified time period."

- A numerator
- A denominator that "appropriately" relates the numerator to population at risk
- A "unit" such as per 1000, per 100,000 or per million

Why a rate?

- To ensure comparing apples with apples

Ratio:

"a fraction (a/b) of two mutually exclusive groups with elements "a" & "b".

Proportion:

"a fraction (a /a + b) of two mutually exclusive groups with elements "a"& "b"

+

Index	Numerator	Denominator
Proportion	People with disease	All people with & without disease
Ratio	People with disease	People without disease
Rate	People with disease in a ***given period***	All people with & without disease

Counting diseases

- Mortality
  - **Tools**
    - **Crude Mortality**
    - **Case fatality**
    - **Proportional Mortality**
    - **Standardized Mortality**
    - **Age specific Mortality**
- Morbidity
  - **Tools**
    - **Prevalence**
    - **Incidence**

Morbidity Measuring: Prevalence-

Prevalence -

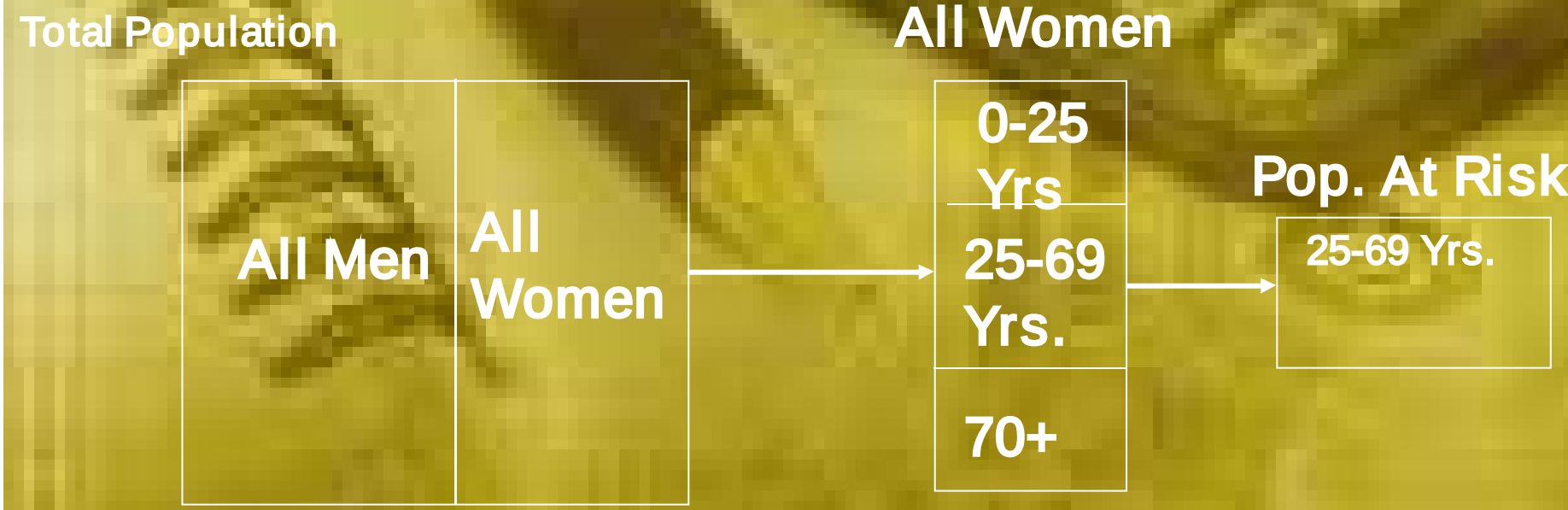
$$\frac{\text{Total no. of cases (new + old)}}{\text{Total population over specified period}} \times 100$$

Point prevalence

Period prevalence

Prevalence rate- a Ratio, reflects status

Population at Risk- in a study of Cancer cervix



Only Pop. At risk should go into denominator of Prevalence rate but at times it is the total population that is considered

Prevalence:

Prevalence can be expressed either as a proportion or as a rate

Expressed as a proportion, prevalence is a number between 0 and 1

As a rate, prevalence can be expressed as per 1000, per 100,000, or per whatever

Prevalence - Types

- **Point**
- **Period**

So far as prevalence is concerned it generally refers to point prevalence. However when the period of observation is large it is referred as period prevalence where the numerator will have all existing cases plus all new cases occurring during period of observation an denominator will be mid year population

Prevalence: Example

In a sample of 1,038 women (70-74 years), 70 were found to have rheumatoid arthritis.

The prevalence of arthritis is:

$$P = \frac{70}{1{,}038} = 0.07 \text{ per women (70-74)}$$

Or

P= 70 per thousand women age 70-74

Or

P= 7 percent for women age 70-74

Or……

Prevalence:

Choice of scale of rate usually depends on the **ubiquity** of the disease.

Thus, more **common** disease prevalence may be presented as **percentage**

Rare disease prevalence may be presented as per **100,000 or per million**

In 2004 there were 1076 cases of Tuberculosis in District X among 50000 men in age group of 40-44 years.

The Prevalence rate will be:

$$p = \frac{1076}{50000} = 0.0215 \text{ per year}$$

= 21.5 per thousand per year

= 215 per 10 thousand per year

= 2150 per million per year

Change in Prevalence reflects

- Change in incidence or duration of disease
- Introduction or impact of an intervention
- Selective attrition
- Change in disease definition or classification
- Significant migration

Prevalence has its use in –

1. Determination of the sickness load
2. Planning of health services in relation to
    a. Infrastructure
    b. Manpower
    c. Facilities, and
    d. Finances
3. In making community diagnosis

Incidence Rate

$$I = \frac{\text{number of new cases occurring during a period of time}}{\text{“total person time” at risk}} \times 100$$

What is “person time”:

The duration of time a person is at risk

Usually expressed as person years but can be expressed as anything, e.g., person months, person weeks, etc.

Incidence Rate - Types

Cumulative Incidence (CI):

$$\frac{\text{New cases}}{\text{Population at risk (PAR) during a specified period}} \times 100$$

Incidence Density (ID)/ Incidence rate

$$\frac{\text{New cases}}{\text{Total Person time of observation in PAR, over a specified period}} \times 100$$

"Total Person Time"

Sum of person time of all individuals who were at risk and were available for observation.

Equivalence of "total person time"

50,000 person years

= 5,000 persons observed for 10 years

= 1,000 persons observed for 50 years

= 10,000 persons observed for 5 years

Say In 2009 there were 1139 cases of Measles in City “X” (Pop.-2500000, children- 15%) among children 0-5 years. The number of person years was 375000.

The incidence rate will be:

$$I = \frac{1139}{375000} = 0.00317 \text{ per person per year,}$$

or = 3.17466 per thousand per year,

or = 31.7066 per 10 thousand per year,

or = 3170.666 per million per year

To be more accurate, we must add another qualifier, namely, “for children 0-5 years of age”

This would mean exclusion of

a. people currently having disease
b. people who had had the disease
c. people who are protected on account of-immunization, habits and earlier intervention;

from the population at risk

Incidence Rate: Expressed as -

Morbidity rate-

New cases\total population at risk

Mortality rate-

No. Of deaths due to a disease\total population

Case fatality rate-

No. Of deaths due to a disease\total no. Of cases of that disease

Attack rate-

No. Of cases of a disease, not persons / total population at risk for a very short period

Change in Incidence reflects

- Introduction of a new risk factor
- Changes in habits
- Change in virulence
- Change in intervention strategy
- Selective migration

Incidence useful in

- surveillance
- understanding etiology & pathogenesis &
- planning of new services

Prevalence V/S Incidence

Prevalence:

A “snapshot” of disease at a point in time in a population

Incidence:

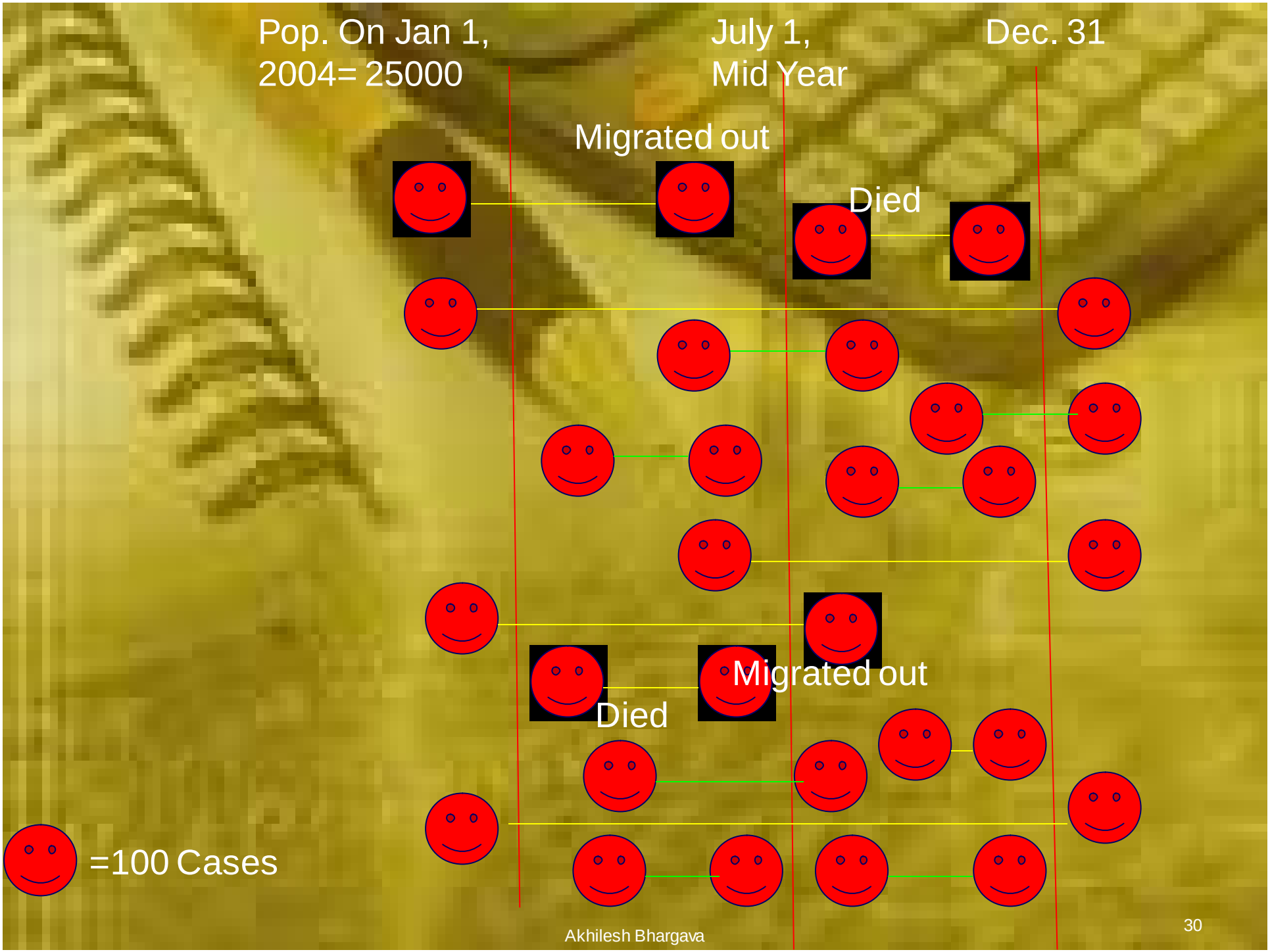
A description of how new cases of disease are occurring. “force of morbidity” “rate of flow” of cases from non disease to disease state

Prevalence (P) and Incidence (I)

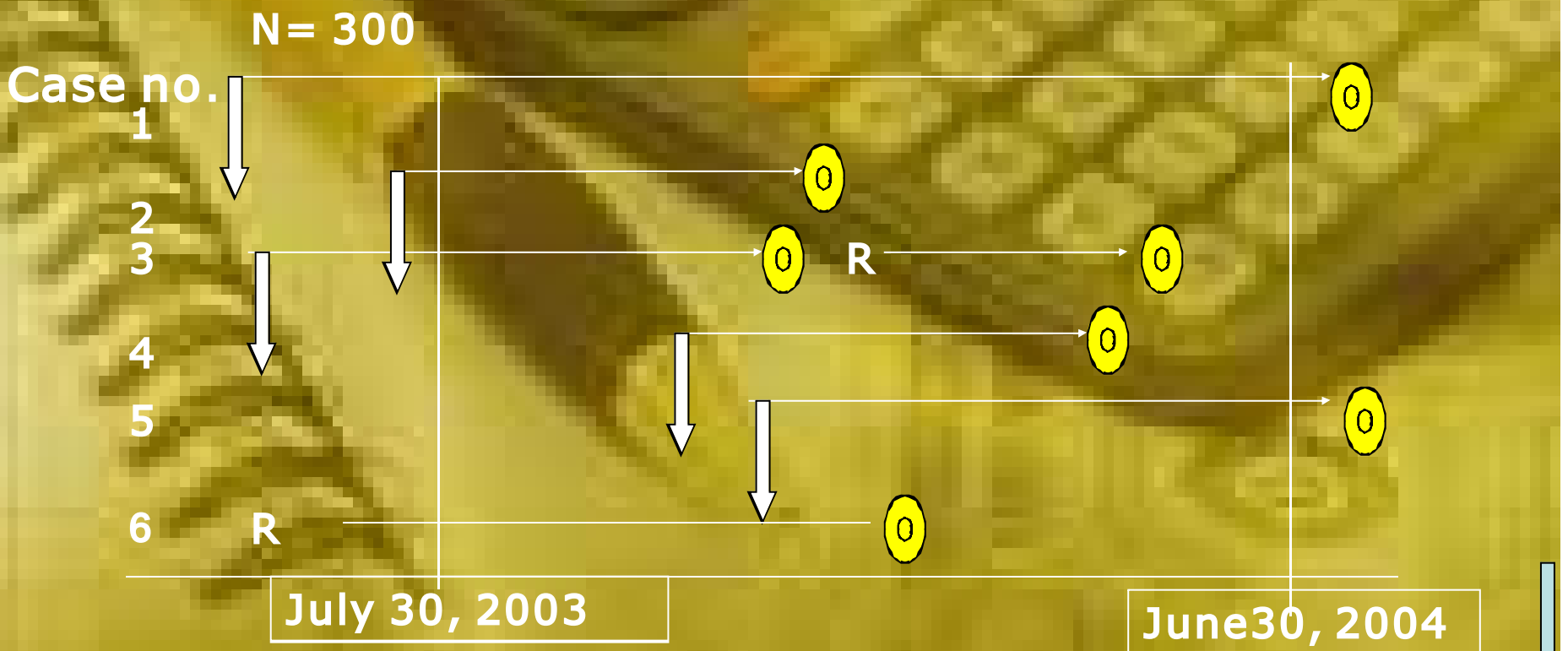
P= I x d

d=duration

If the disease is stable, that is, if the incidence and duration remains constant over time.


Pop. On Jan 1, 2004= 25000
July 1, Mid Year
Dec. 31
Migrated out
Died
Migrated out
Died
=100 Cases

- **Point prevalen**ce on Jan.1, 2004 = 400 / 25000 x 100 = 1.6 %
- **Point prevalence** on July, 1, 2004 = 600/ 24800 (i.e. 25000-200) x 100 = 2.41 %
- **Point prevalence** on December 31, 2004 = 400/ 24600 (i.e25000-400) x 100 = 1.62
- **Period prevalence** in one year = 400+1100 / 25000-200 x 100 = 6.51%
- **Cumulative Incidence** for the year (Jan.1, 2004-December 31, 2003) =1100/ 25000-400x 100= 4.47



R = Date of recurrence

Date of Onset of disease

Date of Termination or death

Point prevalence on July 30, 2003= 4 cases(1, 2, 3, 6)/ 300

Incidence rate on July 30, 2003= 2 cases (4, 5) /296

Period prevalence between July 30, 2003 to June 30, 2004= 6 /300

Prevalence Vs. Incidence

Prevalence:

- Relevant for planning of health services

Incidence:

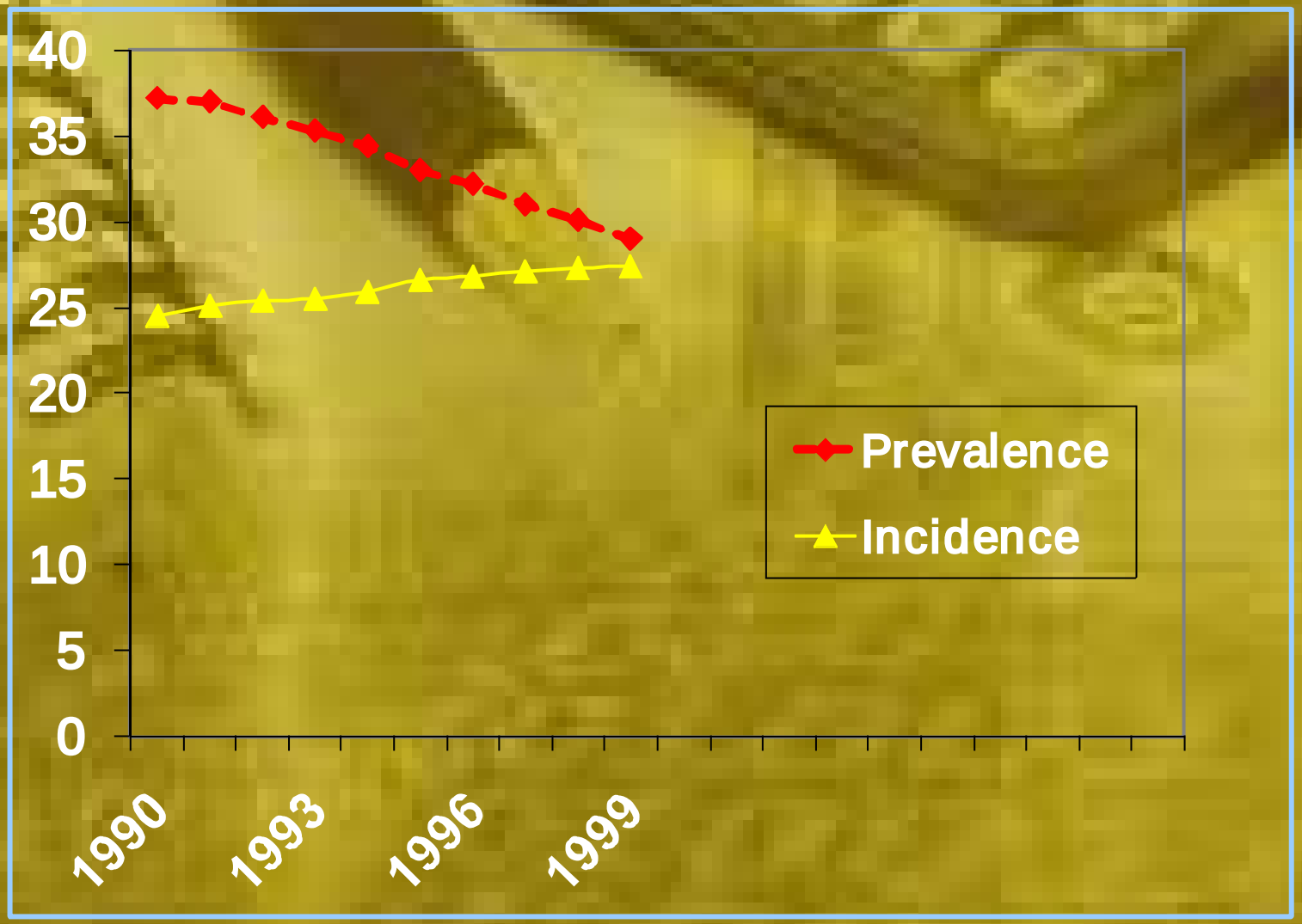
- Relevant for exploring causal theories

Incidence & Prevalence

Rate	Type	Numerator	Denominator
Morbidity	Incidence	New cases	Total PAR*
Mortality	Incidence	Deaths due a disease or all causes	Total population
Case fatality	Incidence	Deaths due to a disease	No. of case of that disease
Attack rate	Incidence	No. of cases of disease	Total PAR for limited period
Period prevalence	Prevalence	No. of Cases New + Old	Total population

* population at risk

Incidence increasing but prevalence decreasing

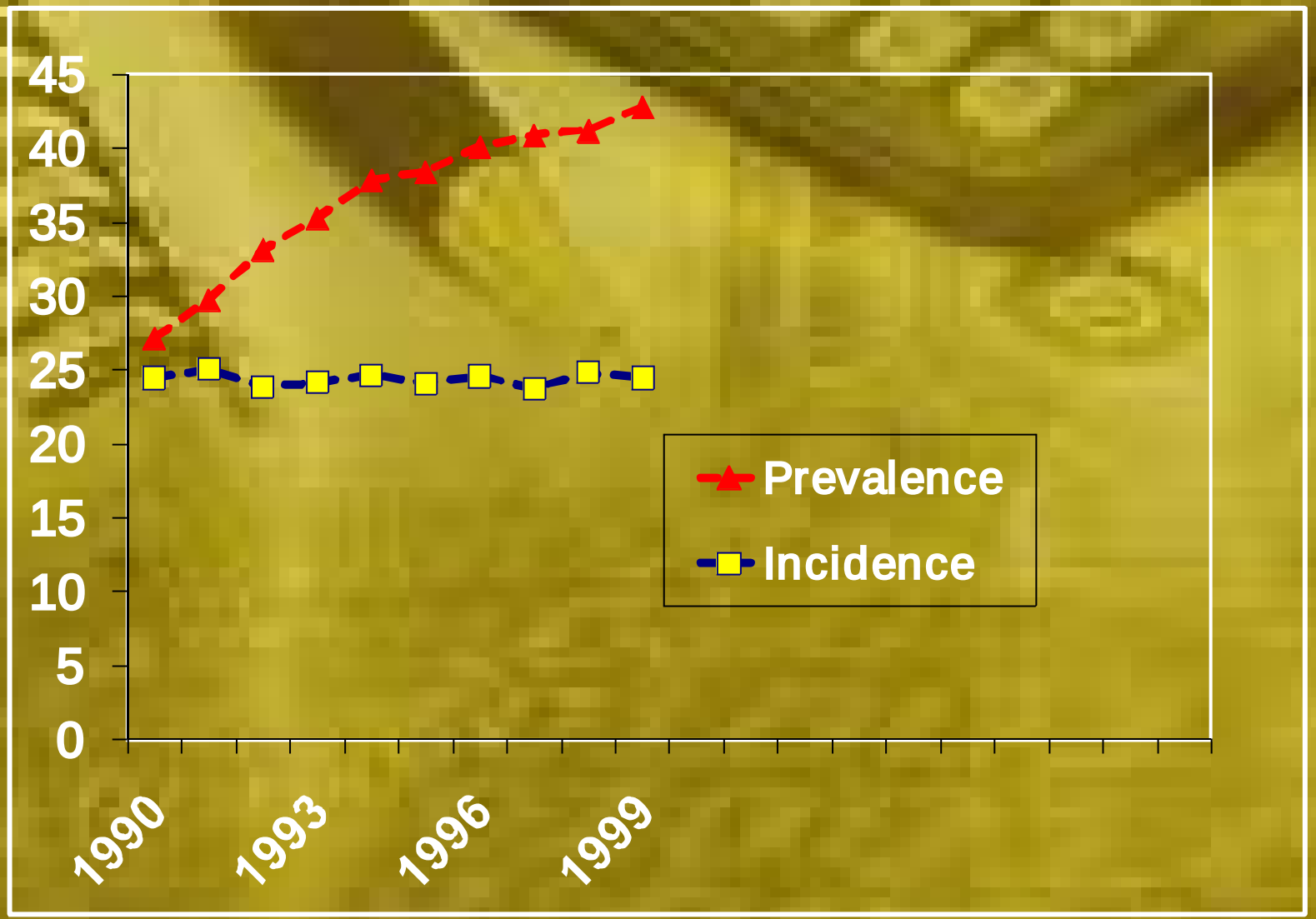


Interpretation:

Disease duration is reduced and it is becoming acute, or

Disease becoming more fatal

Incidence stable but prevalence increasing indicates:-



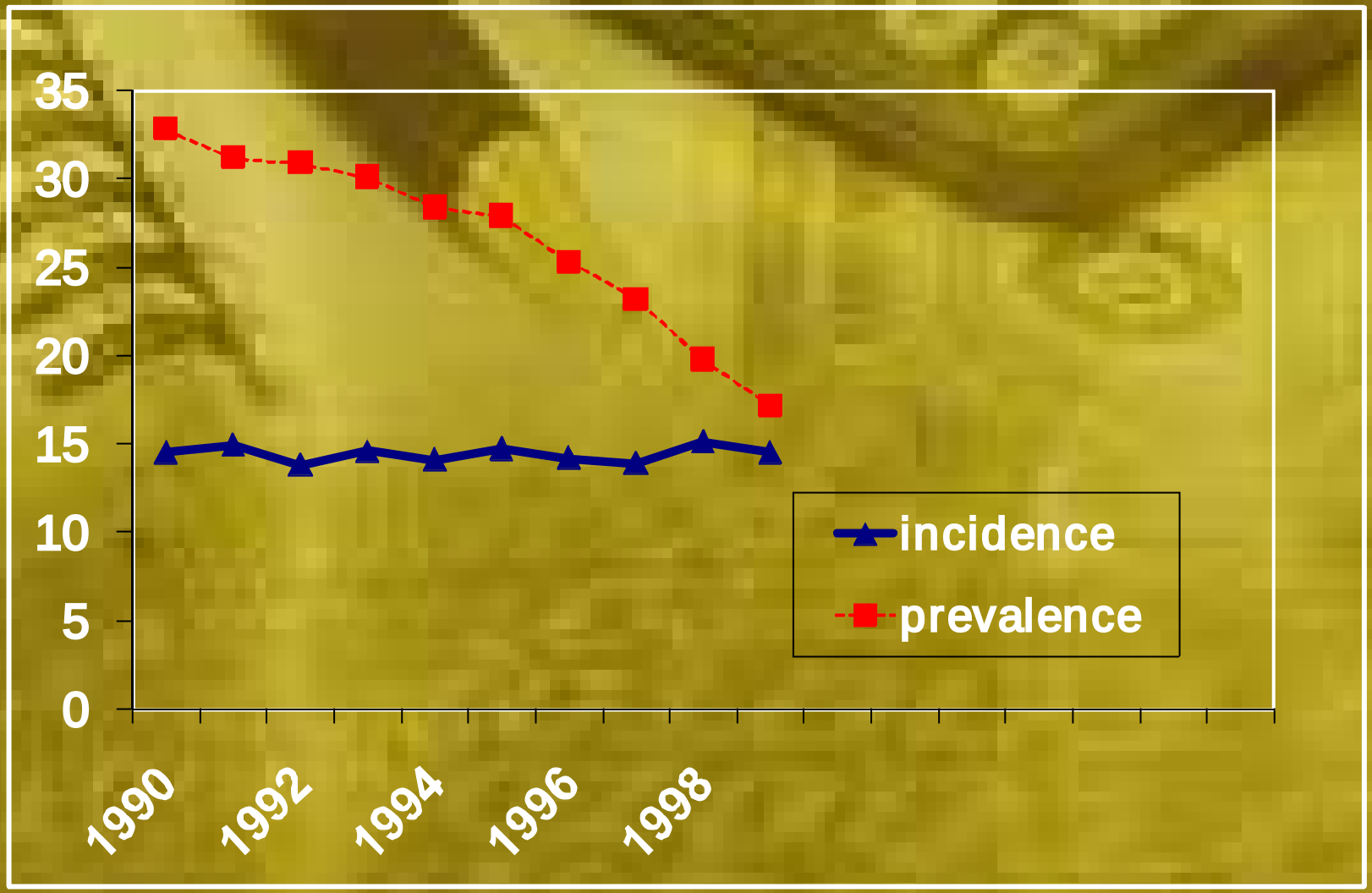
Interpretation

1. Slow recovery (disease becoming chronic, drugs less effective) or,

2. Fatality reduced (potent drugs available, new drugs effective) or,

3. Immigration of cases from other area (for better facility available).

Incidence maintained but prevalence declining means:-



Recovery is becoming rapid, (may be a new drug identified is more effective)

Disease turns into a more fatal one (because of treatment failure, change in virulence, drug resistance) or,

Selective emigration of cases (to seek treatment elsewhere)