

The Incidence of Duodenal and Gastric Ulcers in a Large Health Maintenance Organization

JOHN H. KURATA, PhD, MPH, GORDON D. HONDA, AND HAROLD FRANKL

Abstract: We report the incidence of peptic ulcers (duodenal, pyloric canal, gastric, and combined) verified by radiologic, endoscopic, or surgical evidence in a large Health Maintenance Organization (HMO) in Los Angeles, California. For members age 15 and above, the peptic ulcer incidence rate was 0.86 per 1,000 person-years (p-y) (males 1.10, females 0.63). The male to female sex ratio was 1.7. Two hundred twenty-two duodenal, 17 pyloric canal, 89 gastric, and 21 combined first-time diagnosed ulcer cases were located. For duodenal and pyloric canal ulcer, the incidence rate for members age 15 and above was 0.58 per 1,000 p-y (males 0.76,

females 0.40). For gastric ulcer, the incidence rate for members age 15 and above was 0.21 per 1,000 p-y (males 0.23, females 0.18). The combined ulcer rate was 0.05 per 1,000 p-y (males 0.07, females 0.02). Gastric ulcer rates were two times higher in 1980 than in 1977. Peptic ulcer age-specific incidence rates increased with age. Incidence rates were much lower than those reported in previous studies, but the gastric to duodenal ulcer ratio and the age and sex relation to ulcer incidence were similar to those previously reported. (*Am J Public Health* 1985; 75:625-629.)

Introduction

Previous studies of ulcer incidence have used questionnaire data based on self-reports,¹ or proxy measures of incidence including hospitalization,²⁻⁶ surgery^{2,7,8} mortality,^{2,4,9} and outpatient office visit data.⁶ Only two previous studies used strict radiologic or surgical criteria in determining ulcer incidence rates.¹⁰⁻¹² No similar studies have been reported for the United States.

In this article we report the incidence of peptic ulcers (duodenal, pyloric canal, gastric, and combined) confirmed by radiology, endoscopy, or surgery in a Health Maintenance Organization (HMO) in Los Angeles, California.

Methods

Population

The Sunset Medical Center is one of eight centers in the Southern California Kaiser Permanente Medical Care Program (KPMCP), which has a total membership of 1.5 million. The membership allocation for the Sunset Medical Center was 291,000 for 1977 and 296,000 for 1980. KPMCP members may visit any of the centers so these allocations are only estimates of the population at risk.

Diagnostic Criteria

All persons in this study have a first-time diagnosed peptic ulcer confirmed by an upper gastrointestinal (UGI) x-ray, endoscopy, or from surgical evidence.

UGI x-ray diagnoses were based on dictated reports and the criteria were similar to those of Bonnevie.¹⁰ For duodenal and pyloric canal ulcers these criteria were the radiologic identification of an active crater, deformity, or diagnosis of "chronic ulcer disease" in the duodenum or pyloric canal (or pyloric channel). UGI x-ray diagnoses of gastric ulcers were based on the visualization of an active crater or a diagnosis

of "chronic ulcer disease" in the stomach region exclusive of the pyloric canal. A combined ulcer (gastric and duodenal or gastric and pyloric canal) was defined as: 1) co-existence of both ulcers at the same time; or 2) the diagnosis of ulcers at both sites during the study period. A diagnosis with the modifiers of "possible," "probable," or "suggestive" was excluded.

Endoscopic criteria for peptic ulcers were based on the direct observation of an active or healed ulcer. "Erosion" diagnoses were not included. Surgical evidence was based on the observation of the surgeon. Cases with evidence of a past perforation with self-containment were not used.

Case Identification

Incident cases of peptic ulcers were located at the Sunset Medical Center by either the outpatient UGI x-ray logbook or from the hospital discharge listings for 1977 and 1980. Outpatient endoscopy records were not used since all are preceded by UGI x-rays. Most outpatient endoscopies were performed to monitor recurring ulcers and rule out gastric cancer when UGI x-rays were positive for gastric ulcer.

A total of 349 incident ulcer cases were located from outpatient and inpatient sources. The majority of duodenal (64 per cent) and pyloric canal (53 per cent) ulcer incident cases were located from the outpatient UGI x-ray logbooks, whereas the majority of gastric ulcer cases (70 per cent) were located from the hospital discharge listings.

Outpatient—The UGI x-ray logbook entries for 1977 and 1980 were examined for any diagnoses of ulcer disease. Radiology and clinic records of each person with a positive diagnosis were examined for evidence of a previous ulcer. Cases with no evidence of a previous ulcer were sent letters informing them of this study and contacted by telephone; at least three attempts were made for each case. Persons giving a clear history of a previous ulcer confirmed by radiology or endoscopy were eliminated.

A total of 2,681 UGI x-rays were performed in 1977 at the Sunset Medical Center and 3,139 in 1980. About 13 per cent of these had some mention of ulcer disease in the doctors' diagnoses which accompanied the UGI x-rays. Of the 266 total potential incident cases remaining after screening clinical records, 179 were contacted via telephone. For gastric ulcers 57 per cent and for duodenal ulcers 75 per cent of the potential cases reported no previously diagnosed ulcer. Assuming that those not contacted had the same

From the Department of Family Medicine, UC Irvine-San Bernardino County Medical Center, San Bernardino; Center for Ulcer Research and Education, UCLA School of Medicine and Public Health, Los Angeles; Southern California Kaiser Permanente Medical Group; and Kaiser Foundation Hospitals, Southern California. Address reprint requests to John Kurata, PhD, MPH, Department of Family Medicine, San Bernardino County Medical Center, 780 East Gilbert Street, San Bernardino, CA 92404. This paper, submitted to the Journal October 4, 1984, was revised and accepted for publication January 25, 1985.

incidence/prevalence rates as those contacted, we estimated the total numbers of incident cases. The total of 186 outpatient incidence cases included 143 duodenal, nine pyloric canal, 27 gastric, and seven combination ulcer cases. The sexes and races of the potential incident cases contacted by telephone did not differ from those not reached. However, fewer persons under age 40 were reached (45 per cent) than those age 40 and above (67 per cent). Fewer patients diagnosed in 1977 (53 per cent) were contacted than those diagnosed in 1980 (66 per cent), since more of the 1977 patients had moved.

Inpatient—All hospital discharges from the Sunset Medical Center with a mention of peptic ulcer disease for 1977 and 1980 were identified. The ICD discharge diagnoses used were 531-533 (Gastric, Duodenal, and Peptic ulcer, site unspecified) by the H-ICDA-2¹³ in 1977 and ICD-9-CM¹⁴ in 1980. Clinical and radiology records were reviewed and cases with history of a previous ulcer were excluded. Telephone interviews were not attempted since inpatient histories were usually detailed. Seventy-nine duodenal and eight pyloric canal ulcer cases were located from the inpatient data, as well as 62 gastric and 14 combined ulcer cases.

Rate Calculations

The denominators of the incidence rates calculated in this paper are based on the number of allocated members over age 15 for the Sunset Medical Center.

Results

Incidence Rates

The overall peptic ulcer incidence rate was 0.86 per 1,000 p-y age 15 and over; males 1.10, females 0.63.

The incidence rate of duodenal and pyloric canal ulcers was 0.58 per 1,000 p-y age 15 and above; males 0.76, females 0.40. The age-specific incidence rates (see Figure 1) increase rapidly with age.

The incidence rate for gastric ulcers was 0.21 per 1,000 p-y age 15 and over; males 0.23, females 0.18. These rates increase until the 50-59 age group where they plateau, then show a marked increase in the over age 80 group (see Figure 2).

Only 21 cases of combined ulcers were identified so these results should be interpreted cautiously. Eleven (57 per cent) of the combined ulcers were for co-existing ulcers (males 63 per cent, females 37 per cent); the rest were for ulcer of one site in which a previous diagnosis of the other site had been made. The estimated incidence rate of combined ulcer was 0.05 per 1,000 p-y in members age 15 and above (males 0.07 and females 0.02). For both males and females, rates increase with age, peaking at age 60-69.

Onset of Symptoms and Diagnostic Criteria

Duodenal or pyloric canal outpatient cases were asked during the telephone interview about the time of onset of ulcer-like symptoms. Forty-nine per cent of the cases were diagnosed within a year of onset of symptoms. Time of diagnosis of the remainder of the cases was distributed evenly over a 15-year time period prior to onset of symptoms. There was little difference in the pattern for males and females.

Table 1 shows the distribution of the diagnostic criteria for duodenal and pyloric canal ulcers. Sixty-five per cent of the ulcers were diagnosed on the basis of craters visualized by radiology or endoscopy and 32 per cent were diagnosed solely by deformity of the duodenal bulb seen in an UGI x-

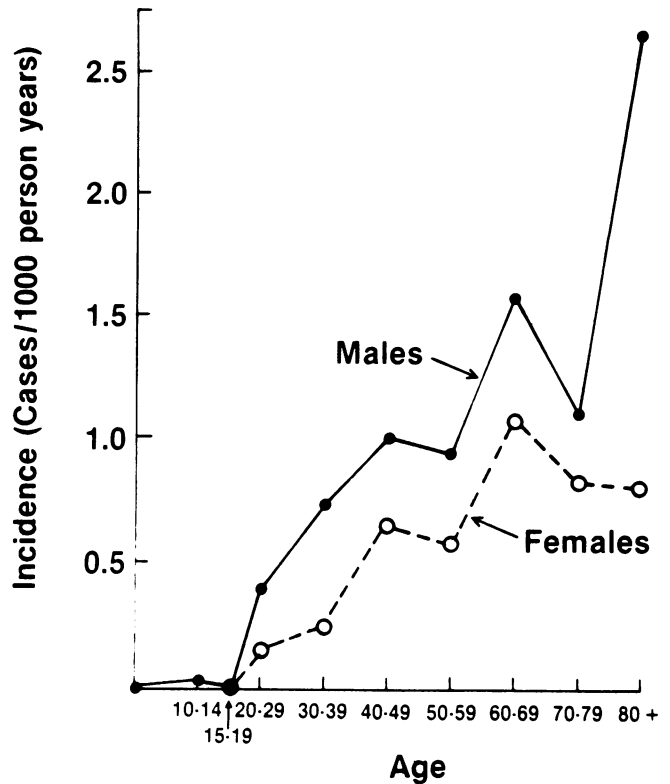


FIGURE 1—Age-specific Duodenal and Pyloric Canal Ulcer Incidence Rates for Males and Females 1977, 1980

ray examination. Since neither endoscopy nor surgical observation utilize the deformity criteria, this 2:1 crater to deformity ratio may reflect the frequency of nonradiologic examinations rather than true morphological differences. There were no major differences in the diagnostic criteria between sexes, races, or years of diagnoses.

Duodenal and Pyloric Canal to Gastric Ulcer Ratios

The duodenal and pyloric canal to gastric ulcer ratio was 2.7 for ages 15 and above (3.2 for males, and 2.1 for females). The age-specific ulcer ratios are shown in Figure 3. For both sexes, the strong decline with age is because the gastric ulcer rates increase faster with age than the duodenal and pyloric canal ulcer rates.

1977 and 1980 Gastric Ulcer Rates

There was a marked increase in the gastric ulcer rates between 1977 and 1980; males (0.16 per 1,000 p-y for 1977, 0.30 for 1980), females (0.11 per 1,000 p-y for 1977, 0.26 for 1980) age 15 and above. Data in Table 2 show that age-specific incidence rates were higher in 1980 than in 1977 for every age group except the 60-69 year old males. There is little overlap in the confidence intervals between 1977 and 1980. The observed increase in gastric ulcer incidence between time periods should be interpreted with caution since there were so few cases in the earlier time period.

Discussion

No previous United States study has used medical records and telephone interviews to verify the incidence of x-ray and/or endoscopy confirmed peptic ulcer disease. Two major concerns with such a study are the accuracy of the

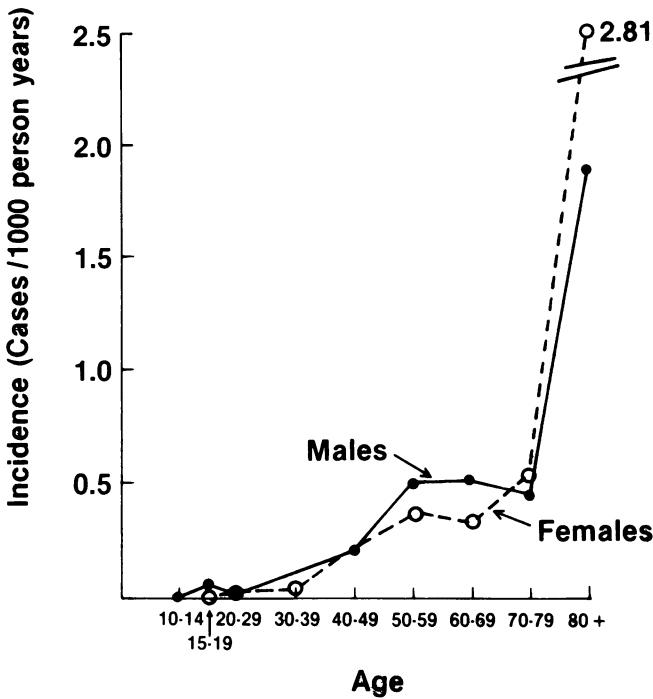


FIGURE 2—Age-specific Gastric Ulcer Incidence Rates for Males and Females 1977, 1980

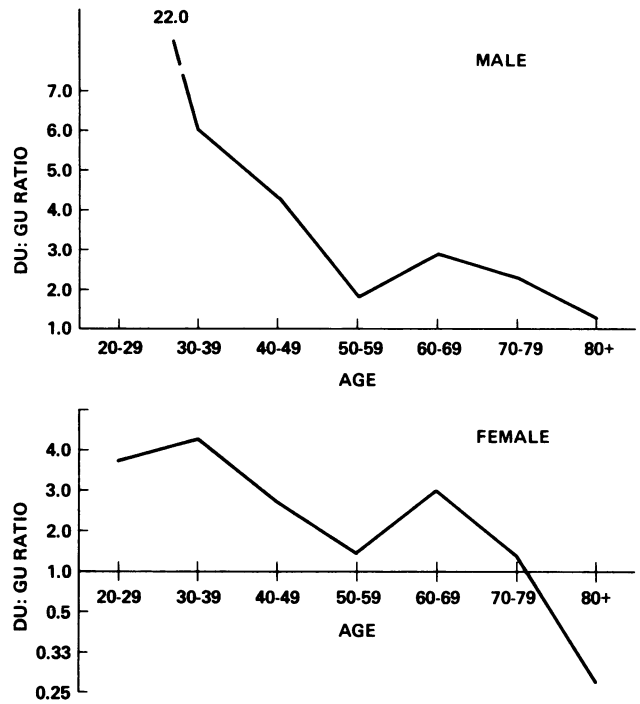


FIGURE 3—Duodenal/Pyloric Canal to Gastric Ulcer Ratio for Males and Females 1977, 1980

measure for this population (internal validity) and the generalizability of these measures to other populations (external validity).

Internal Validity

The internal validity of this study is dependent on having an accurate estimate of all diagnosed ulcer cases and the population at risk. These needs were facilitated by a centralized record keeping system and a computerized listing of hospital discharges by diagnoses.

Our measure of ulcer incidence is based on diagnosed cases; the actual incidence of peptic ulcers might be greater. Since peptic ulcers rarely result in complications or death, it is likely that some cases are never diagnosed.

The validity of the data in this study also depends on the sensitivity and specificity of the diagnostic instrument. The UGI x-rays were single contrast examinations which may have a false negative rate of 20–50 per cent.^{16,17} On the other hand, a diagnosis of deformity may have a high false positive rate because other (non-ulcer) conditions may cause this.¹⁸

The denominator for incidence rates should include only the population at risk of developing a disease, but this study included members with previous ulcers. This inclusion results in an underestimate of the rate, especially for older

TABLE 1—Diagnostic Criteria for Duodenal and Pyloric Canal Ulcers for 1977, 1980

Criteria	Number	Per Cent
Crater only	123	51.5
Crater and Deformity	33	13.8
Deformity only	75	31.4
Surgical Criteria	8	3.3
TOTAL	239	100.0

persons, since the lifetime probability of developing an ulcer increases with age.

External Validity

The external validity of this study depends on the comparison population. Since the racial composition of the KPMCP membership is not known, race-specific rates cannot be calculated.

External validity may also be affected by the self-selection of “healthier” individuals into an HMO. This issue has been studied previously with equivocal results.¹⁹ The age-adjusted hospitalization rates for peptic ulcer disease in the Southern California KPMCP were less than 50 per cent

TABLE 2—Incidence (cases/1,000 person years) for Gastric Ulcer for the Sunset Medical Center, Males and Females, 1977 and 1980

Age (years)	Males		Females	
	1977	1980	1977	1980
0–14	—	—	—	—
15–19	—	0.13	—	—
20–29	—	0.05	—	0.06
30–39	0.05	0.19	—	0.11
40–49	0.12	0.32	0.18	0.27
50–59	0.44	0.62	0.24	0.51
60–69	0.58	0.45	0.18	0.50
70–79	0.24	0.77	0.20	1.07
80+	1.02	3.10	2.54	3.52
Total	0.12	0.22	0.08	0.20
Age 15+	0.16	0.30	0.11	0.26
95% C.I.*	0.10	0.21	0.06	0.18
Number	0.25	0.42	0.18	0.37
	15	31	12	31

*The 95% confidence intervals are for rates (of age 15+) and are based on the formulas of Fleiss.¹⁵

TABLE 3—Summary of Previous Incidence Studies of Duodenal Ulcers

Location	Time	Incidence Rate Age 15+ per 1,000 Person Years			Sex Ratio
		Males	Females	Total	
York, England ¹²	1952–57	2.15	0.62	1.39	3.5
Copenhagen, Denmark ¹⁰	1963–68	1.83	0.84	1.32	2.2
Los Angeles, USA	1977, 1980	0.81	0.43	0.62	1.9

of those for the United States,²⁰ mainly due to the very low KPMCP hospitalization rate for uncomplicated cases. It was concluded that the low hospitalization rates for uncomplicated cases were primarily a reflection of the economic incentives for an HMO to reduce unnecessary hospitalizations. Hospitalizations for complicated cases (perforations and hemorrhages) in KPMCP were only 25 per cent lower than the national. This probably reflects a lower frequency of disease in the HMO membership. Other studies show that, in general, lower hospitalization rates are characteristic of HMOs.^{21,22} If ulcer complication rates are used to standardize ulcer disease risk, then the estimated incidence rates in this study should be multiplied by about 1.3 to obtain a crude estimate for the national rates.

Bonnevie's study in Copenhagen reported that duodenal deformities were diagnosed as frequently as craters.¹⁰ The present study found a higher rate for craters than deformity. This difference suggests different diagnostic criteria, less frequent use of endoscopy, or different manifestation of ulcer disease in Denmark than in KPMCP.

Duodenal ulcers were diagnosed 2.5 times more frequently than gastric ulcers. Bonnevie found an incidence rate four times higher for duodenal than for gastric ulcer.^{10,11} This finding is consistent with prevalence data which show that duodenal ulcer is more common than gastric ulcer.²³ Since gastric and duodenal ulcer hospitalization and mortality rates have been approximately equal since the late 1970s,²⁴ these data suggest that duodenal ulcer is diagnosed more frequently but is less severe than gastric ulcer. Southern California KPMCP data also show that the majority of duodenal ulcer cases are diagnosed for the first time as outpatients (64 per cent), while 70 per cent of gastric ulcer cases are first diagnosed as inpatients. Thus gastric ulcer seems to be a more severe disease than duodenal ulcer at the time of first diagnosis.

The crude ulcer incidence rates in this study were much lower than those reported in other studies (perhaps due to time and geographic differences), but the age and sex patterns were similar to those previously reported (Tables 3 and 4). Males are at greater risk than females for duodenal and

TABLE 4—Summary of Previous Incidence Studies of Gastric Ulcers

Location	Time	Incidence Rate Age 15+ per 1,000 Person Years			Sex Ratio
		Males	Females	Total	
York, England ¹²	1952–57	0.53	0.31	0.42	1.7
Copenhagen, Denmark ¹¹	1963–68	0.33	0.29	0.31	1.1
Los Angeles, USA	1977, 1980	0.26	0.21	0.24	1.2

gastric ulcer, and the incidence of this disease increases with age. The increase in duodenal and gastric ulcer rates with age does not fit the general belief that ulcers are a disease of middle age. This idea was probably based on the "number" rather than the "rate" of ulcer cases seen clinically. Because there are more people in the middle than in the older age groups, they have more actual cases of peptic ulcer even though their incidence rates are lower. Bonnevie also noted the increase of gastric and duodenal ulcer rates with age and suggested that this may reflect a cohort effect such as that described by Susser in gastric and duodenal mortality rates from England and Wales.⁹

The observed increase in gastric ulcer incidence for the Sunset Medical Center between 1977 and 1980 might be attributable to an increase in gastric ulcer incidence, a single year fluctuation, or an increase in diagnosed cases with no increase in the actual incidence rate.

Data for both this study and the National Hospital Discharge Survey indicate that gastric ulcer rates have increased over time. However, national data indicate that this increase is primarily in people over age 65 whereas in this study the increase occurs for all ages.

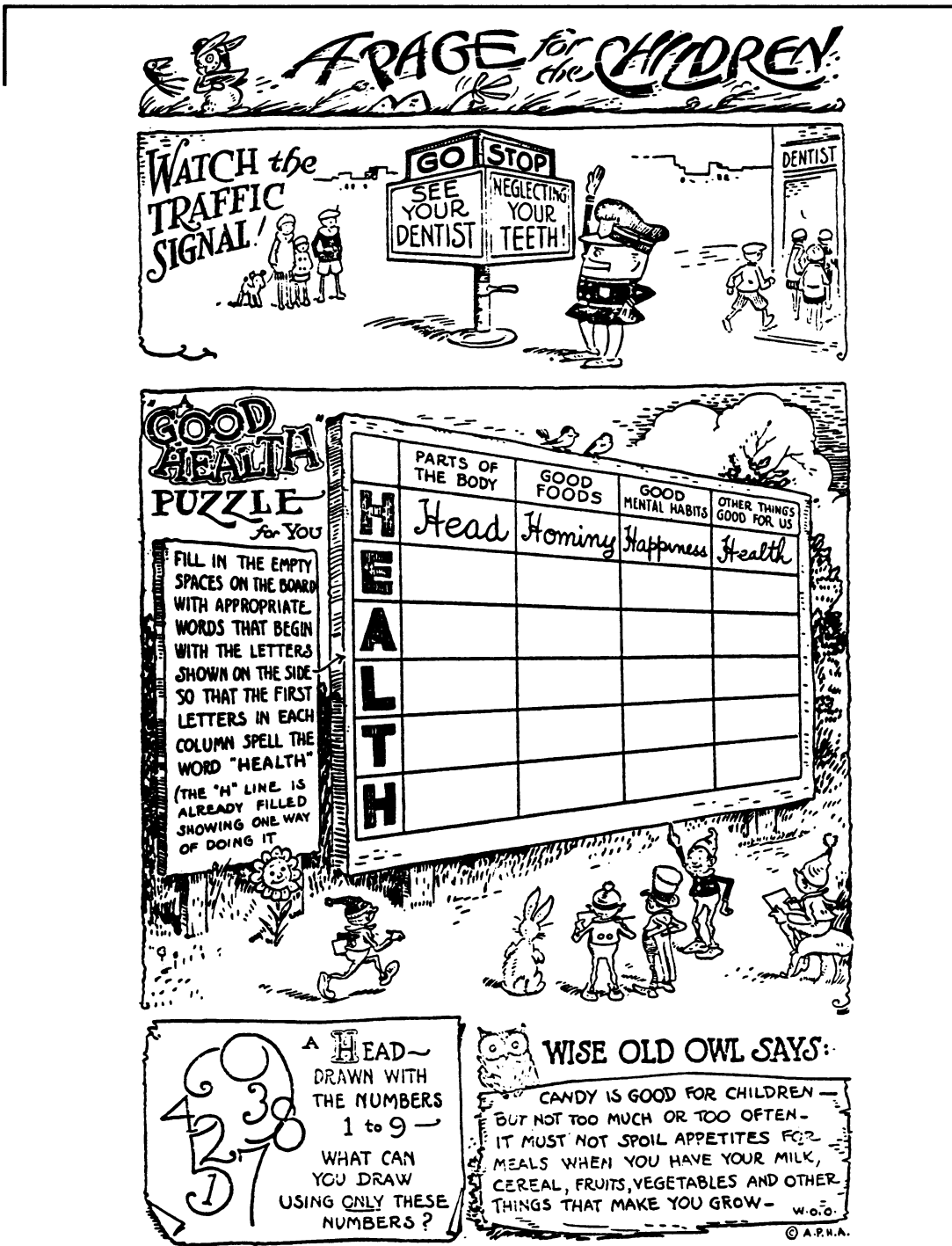
REFERENCES

1. Monson RR, MacMahon B: Peptic ulcer in Massachusetts physicians. *N Engl J Med* 1969; 281:11–15.
2. Elashoff JD, Grossman MI: Trends in hospital admissions and death rates for peptic ulcers in the United States from 1970 to 1978. *Gastroenterology* 1980; 78:280–285.
3. Coggon D, Lambert P, Langman MJS: 20 years of hospital admissions for peptic ulcer in England and Wales. *Lancet* 1981; 1:1302–1304.
4. Wylie CM: The complex wane of peptic ulcer: I. recent national trends in deaths and hospital care in the United States. *J Clin Gastroenterol* 1981; 3:327–332.
5. Wylie CM: The complex wane of peptic ulcer: II. trends in duodenal ulcer admissions to 790 hospitals, 1974–1979. *J Clin Gastroenterol* 1981; 3:333–339.
6. Vogt TM, Johnson RE: Recent changes in the incidence of duodenal and gastric ulcer. *Am J Epidemiol* 1980; 111:713–720.
7. Wylie JH, Williams JA, Kennedy TL, Clark CG, Bell PRF, Kirk RM, MacKary C: Effect of cimetidine on surgery for duodenal ulcer. *Lancet* 1981; 1:1307–1308.
8. Fineberg HV, Pearlman LA: Surgical treatment of peptic ulcer in the United States. *Lancet* 1981; 1:1305–1307.
9. Susser M: Period effects, generation effects and age effects in peptic ulcer mortality. *J Chronic Dis* 1982; 35:29–40.
10. Bonnevie O: The incidence of duodenal ulcer in Copenhagen County. *Scand J Gastroent* 1975; 10:385–393.
11. Bonnevie O: The incidence of gastric ulcer in Copenhagen County. *Scand J Gastroent* 1975; 10:231–239.
12. Pulvertaft CN: Peptic ulcer in town and country. *Br J Prev Soc Med* 1959; 13:131–138.
13. Commission on Professional and Hospital Activities: Hospital Adaptation of ICDA (H-ICDA), 2d. Ed. Ann Arbor: Commission on Professional and Hospital Activities, 1970.
14. Commission on Professional and Hospital Activities: International Classification of Diseases 9th Rev. Clinical Modifications (ICD-9-CM). Ann Arbor: Commission on Professional and Hospital Activities, 1978.
15. Fleiss JL: Statistical Methods for Rates and Proportions. New York: John Wiley, 1981.
16. Laufer I, Mullens JE, Hamilton J: The diagnostic accuracy of barium studies of the stomach and duodenum—correlation with endoscopy. *Radiology* 1975; 3:569–573.
17. Cotton PB: Fiberoptic endoscopy and the barium meal—results and implications. *Br Med J* 1973; 2:161–165.
18. Templeton FE: Roentgenologic diagnosis of duodenal ulcer. In: Sandeweiss DJ (ed): *Peptic Ulcer*. Philadelphia: Saunders, 1951.
19. Luft HS: How do health maintenance organizations achieve their savings? *N Engl J Med* 1978; 298:1336–1343.
20. Kurata JH, Honda GD, Frankl H: Hospitalization and mortality rates for peptic ulcers: a comparison of a large health maintenance organization and United States data. *Gastroenterology* 1982; 83:1008–1016.
21. Luft HS: Assessing the evidence of HMO performance. *Milbank Mem Fund Q* 1980; 58:501–533.
22. Gaus CR, Cooper BS, Hirschman CG: Contrasts in HMO and fee-for-

- service performance. Soc Secur Bull 1976; 39:3-14.
23. Ihamaki T, Varis K, Siurala M: Morphological, functional and immunological state of the gastric mucosa in gastric carcinoma families: comparison with a computer-matched family sample. Scand J Gastroent 1979; 14:801-812.
 24. Kurata JH, Elashoff JD, Haile BM, Honda GD: A reappraisal of time trends in ulcer disease: factors related to changes in ulcer hospitalization and mortality rates. Am J Public Health 1983; 73:1066-1072.

ACKNOWLEDGMENTS

This work was supported by NIAMDD Grant No. AM17328, Medical Research Service of the Veterans Administration, CURE (Center for Ulcer Research and Education) and Southern California Kaiser Permanente Medical Group Research Grant No. 01001-6461-6572. The authors would like to thank Dr. Janet Elashoff and Aki Nogawa for their helpful comments and criticisms. Portions of this paper were presented at the American Public Health Association 111th Annual Meeting, Houston, Texas, November 1983.



—From *The American Public Health News*, March 1931.