

Staff Meeting Bulletin  
Hospitals of the » » »  
University of Minnesota

Appendicitis  
In College Students

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IV. APPENDICITIS IN COLLEGE STUDENTS

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From the standpoint of preventive medicine and public health, the problem of appendicitis is one of the most pressing with which we have to deal. In the United States every year some 18,000 people die of appendicitis. This mortality is 70 per cent higher than in Germany, 99 per cent higher than in New Zealand, 110 per cent

higher than in England and Wales, and 313 per cent higher than in Italy.<sup>1</sup> Furthermore, the death rate from appendicitis in the country at large is exactly the same today as it was in 1917, 12.7 per 100,000 population, and appendicitis ranks second only to carcinoma of the stomach as a surgical cause of death<sup>2</sup>.

At the present time, appendicitis ranks fifteenth in the leading causes of death in the United States,

(See Table 1.)

Table 1<sup>(9)</sup>

Changes in the Leading Causes of Death in the United States Since 1900

Disease - 1900	Death Rate per 100,000 Population, All Ages	Disease - 1938	Death Rate per 100,000 Population, All Ages
Tuberculosis . . . . .	201.9	Heart Disease . . . . .	278.9
Pneumonia . . . . .	180.5	Cancer . . . . .	114.6
Diarrhea and enteritis . . . . .	133.2	Apoplexy . . . . .	85.7
Heart disease . . . . .	132.1	Nephritis . . . . .	77.2
Diseases of early infancy and congenital malformations . . . . .	91.8	Accidents . . . . .	72.0
Nephritis . . . . .	89.0	Pneumonia . . . . .	67.5
Unknown and ill-defined diseases . . . . .	73.8	Tuberculosis . . . . .	49.0
Apoplexy . . . . .	71.5	Diseases of early infancy and congenital malformations . . . . .	46.3
Accidents . . . . .	65.4	Diabetes . . . . .	23.8
Cancer . . . . .	65.0	Arteriosclerosis . . . . .	17.1
Bronchitis . . . . .	45.7	Suicide . . . . .	15.2
Diphtheria . . . . .	43.3	Diarrhea and enteritis . . . . .	14.2
Typhoid fever . . . . .	35.9	Unknown and ill-defined diseases . . . . .	13.6
Influenza . . . . .	22.9	Influenza . . . . .	12.7
Cirrhosis of the liver . . . . .	12.9	*Appendicitis . . . . .	11.0
Measles . . . . .	12.5	Hernia, Intestinal obstruction . . . . .	9.7
Hernia, Intestinal obstruction . . . . .	12.2	Syphilis . . . . .	9.7
Whooping cough . . . . .	12.1	Cirrhosis of the liver . . . . .	8.3
Suicide . . . . .	11.5	Diseases of pregnancy . . . . .	7.6
Scarlet fever . . . . .	10.2	Homicides . . . . .	6.8

But this table does not illustrate the true seriousness of appendicitis. Cancer kills at an average age of 60.7 years, nephritis at 62.2 years, and heart disease at 64.7 years. But appendicitis kills at an average age of 32.4 years, when the productivity of its victims is at its height.

This is graphically illustrated in Table 2, in which appendicitis is seen to be from the second to the ninth leading cause of death between the ages of 10 and 35. Between 35 per cent and 40 per cent of all cases are in the second decade of life. (See Table 2.)

Table 2<sup>(10)</sup>Leading Causes of Death under 45 Years of Age

Cause of Death	Deaths	Death Rate <sup>/</sup>	Cause of Death	Deaths	Death Rate <sup>/</sup>
<b>Under 1 year:</b>			<b>15 to 19 years:</b>		
Premature births, etc.	44,813	2,330.5	Accidents	5,232	49.7
Pneumonia	13,059	679.1	Tuberculosis	2,203	20.9
Injury at birth	8,812	458.3	Pneumonia	1,730	16.4
Diarrhea and enteritis	8,714	453.2	Heart Disease	1,420	13.5
Influenza	2,428	126.3	*Appendicitis	1,397	13.3
Whooping cough	2,322	120.8	Diseases of pregnancy	895	8.5
Accidents	1,653	86.0	<b>20 to 24 years:</b>		
Diseases of thymus	1,040	54.1	Accidents	6,259	63.6
Hernia and intestinal obstruction	879	45.7	Tuberculosis	4,521	45.9
Syphilis	768	39.9	Diseases of Pregnancy	2,110	21.4
<b>1 to 4 years:</b>			Pneumonia	1,927	19.6
Pneumonia	5,838	69.7	Heart disease	1,714	17.4
Accidents	4,142	49.5	*Appendicitis	1,107	11.2
Diarrhea and enteritis	2,853	34.1	Suicide	1,065	10.8
Diphtheria	1,788	21.4	<b>25 to 34 years:</b>		
Influenza	1,611	19.2	Accidents	10,084	58.3
Measles	1,453	17.4	Tuberculosis	9,963	57.6
Whooping cough	1,150	13.7	Heart disease	4,998	28.9
Tuberculosis	910	10.9	Pneumonia	4,842	28.0
Scarlet fever	810	9.7	Diseases of pregnancy	4,420	25.5
<b>5 to 9 years:</b>			Cancer	2,809	16.2
Accidents	3,492	30.6	Suicide	2,693	15.6
Pneumonia	1,813	15.9	Nephritis	1,974	11.4
*Appendicitis	1,077	9.4	*Appendicitis	1,819	10.5
Diphtheria	819	7.2	<b>35 to 44 years:</b>		
Scarlet fever	808	7.1	Heart disease	12,228	76.7
Heart disease	794	7.0	Accidents	10,114	63.4
Diseases of ear and mastoid	693	6.1	Tuberculosis	9,919	62.2
Measles	604	5.3	Cancer	9,251	58.0
<b>10 to 14 years:</b>			Pneumonia	7,176	45.0
Accidents	3,282	29.9	Nephritis	4,166	26.1
*Appendicitis	1,328	12.1	Suicide	3,265	20.5
Heart disease	1,312	12.0	Apoplexy	2,980	18.7
Pneumonia	1,215	11.1	Diseases of pregnancy	2,475	15.5
Tuberculosis	598	5.5	Appendicitis	1,940	12.2

<sup>/</sup>Rates per 100,000 white population in each age group for the United States as a whole in 1935.

The morbidity of appendicitis is difficult to measure with accuracy, but the best information we have is that it is the twenty-third leading cause of illness in

the United States, ranking ahead of pneumonia, gall bladder disease, tuberculosis, peptic ulcer, and cancer. (See Table 3.)

Table 3

Total Annual Incidence of Specific Conditions in 8,758 Surveyed  
Families in 18 States, 1928-1931.

The Major Causes of Illness <sup>(11)</sup>

Illness	Rate
Colds and bronchitis	158.1
Influenza and grippe	86.1
Accidental injuries	74.7
Tonsillitis, laryngitis, throat, except tonsillectomy	53.4
Gastritis, indigestion and other stomach conditions	41.7
Measles	24.4
Confinements, miscarriages and abortions	23.6
Ear and mastoid diseases	23.5
Rheumatism, neuralgia, neuritis, lumbago, myalgia, etc.	22.7
Tonsil and adenoid operations	21.8
Diarrhea and enteritis	21.5
Whooping cough	19.2
Nonvenereal diseases of the genital organs	17.5
Chickenpox	15.5
Diseases of the heart, arteriosclerosis, and high blood pressure	13.5
Mumps	12.1
Eye diseases	11.6
Teeth and gum conditions	11.6
Furuncles and abscesses	11.6
Sinusitis	10.2
Nervousness, neurasthenia and nervous breakdown	9.5
Kidney diseases	9.3
*Appendicitis	9.1
Pneumonia	8.2
Gall bladder and liver diseases	6.9
Debility, fatigue and loss of weight	6.6
Headache	6.3
Diseases of the bladder and urinary passages	6.2
Scarlet fever	6.0
Adnitis and other diseases of the lymphatic system	6.0
Hay fever and asthma	5.9
Local infection not otherwise defined	5.2
Tuberculosis, all forms including suspected	4.7
Eczema	4.2
Anemia, all forms	3.8
Impetigo	3.7
Thyroid diseases	3.5
Malaria	3.4
Benign tumors	3.3
Puerperal lacerations and displacements of the female organs	3.1
Pleurisy	3.0
Hemorrhoids	2.9
Scabies	2.9
Rash, unqualified	2.8
Hernia	2.8
Backache	2.8
Foot trouble, unqualified	2.7
Constipation	2.4

Table 3 - (Contd.)

Illness	Rate
Congenital malformations and diseases of early infancy.....	2.2
Diseases of the bones and joints.....	2.1
Ulcer of the stomach and duodenum.....	2.0
Vaccinia.....	2.0
Diabetes.....	1.9
Acidosis.....	1.8
Diphtheria.....	1.8
Urticaria and hives.....	1.8
Miscellaneous orthopedic conditions.....	1.7
Diseases of the mouth except teeth and gums.....	1.6
German measles.....	1.6
Cancer.....	1.4
Varicose veins.....	1.3
Convulsions.....	1.3
Intestinal parasites.....	1.1

With all these facts in mind, it is only natural that the diagnosis and treatment of appendicitis should be a matter of first importance to a Student Health Service. For this reason we have reviewed our experience with appendicitis over a ten-year period, beginning with the opening of the school year 1929-30, and ending with the close of the school year 1938-39.

In this survey we have attempted to answer the following questions:

1. What is the incidence of appendicitis in our student population?
2. In what percentage of the diagnosed cases has appendectomy been performed?
3. In the non-operated cases, why was appendectomy not done?
4. In the operated cases, how frequently was our pre-operative diagnosis correct?
5. What is the clinical picture of acute appendicitis as seen by a student health service staff, and what differences are there in the clinical pictures of those in whom the pre-operative diagnosis of appendicitis was correct, and in those in

whom it was incorrect?

6. What variations may be expected in the clinical picture of those cases of appendicitis in whom the appendix occupies an unusual location?

7. What has been the type of pathology found in the cases upon whom appendectomy was done?

8. What has been our fatality in appendicitis?

9. What has been our concept of the proper treatment of appendicitis?

10. What contributions, if any, can be made to the subject of appendicitis as a whole, from our experience with it in the Student Health Service, where it is seen under the most favorable circumstances of age, health, and intelligence of those affected?

- - - -

1. During the period of this study, the diagnosis of acute appendicitis was made in 594 students. Since the average student population is approximately 15,000 this represents an attack rate of about 4 per 1,000. This rate is less

than half of the average national rate, but this low morbidity is undoubtedly largely accounted for by the fact that many University students have their homes in the Twin Cities, and report to their own physicians rather than to the Health Service when they become ill.

2. In 284 cases, or 48 per cent, appendectomy was performed.

3. 310 cases, or 52 per cent, were not subjected to surgery at the Student Health Service for the following reasons:

Table 4

Reasons for Delay

Subsiding appendicitis	180 cases	58.1%
Referred to private physician	108 cases	34.8%
Subsiding, and associated with upper respiratory infection	10 cases	3.2%
Subsiding, and associated with heart disease	4 cases	1.3%
Appendicitis, with perforation and abscess, treated conservatively	3 cases	1.0%
Surgery advised, but refused	2 cases	.6%
Subsiding, and associated with kidney disease	1 case	.3%
Subsiding, and associated with pulmonary tuberculosis	1 case	.3%
Subsiding, and associated with hemophilia	1 case	.3%

The high incidence of referral to private physicians is the result of the Student Health Service policy of encouragement of students to seek private medical care whenever circumstances of residence and financial condition permit.

3a. Of the 284 cases in whom appendectomy was done, 25 were classified as interval appendectomies, performed at varying intervals of time following the subsidence of the acute attack. (These cases were not included in the non-operative group above.) The distribution of the pathology found at operation, and verified by pathologic diagnosis in this group is as follows:

Table 5

Pathology of Interval Appendicitis

Evidence of previous disease of appendix. (Adhesions, obliterations, previous abscess)	14 cases	56.0%
No pathology found	10 cases	40.0%
Tuberculous peritonitis	1 case	4.0%

4. The remaining 259 appendectomies were those in whom a preoperative diag-

nosis of acute appendicitis was made, and it is upon this group particularly that our attention has been focused. Of this number, the preoperative diagnosis of appendical disease was verified by operation and pathologic diagnosis in 222 cases, or 85.7%. (Pathologically Positive Group) In the remaining 37, or 14.3%, no pathology was found in the appendix.

(Pathologically Negative Group) We have separated these two groups in order to compare their clinical pictures. In addition, we have inserted, so far as possible, figures obtained by Sperling in his review of the experience of the Surgical Department of the University Hospital with appendicitis, for the purpose of comparison.

5.

Table 6Distribution by Age and Sex

	<u>Pathologically Positive</u>	<u>Pathologically Negative</u>	<u>U.H.<sup>3</sup></u>
Average Age	21.2	19.9	25.0
Age range	17-35	16-27	
% Males	<u>73.0</u>	<u>29.7</u>	57.0
% Females	<u>27.0</u>	<u>70.3</u>	43.0
University Sex Ratio Males to Females	2:1	2:1	

Thus it is seen that the striking difference here is in the reversal of the sex ratio between the acute and the inactive groups, a finding which is partially

but not completely explained by the diagnostic errors due to pelvic pathology in women. The diagnostic accuracy in males was 94%, in females 57%.

Table 7Distribution by Months

	<u>Pathologically Positive</u>	<u>Pathologically Negative</u>
January	14.9%	10.8%
February	8.1%	10.8%
March	11.7%	16.2%
April	11.7%	21.6%
May	10.8%	5.4%
June	4.5%	---
July	---	---
August	---	---
September	1.8%	---
October	14.0%	10.8%
November	13.5%	13.5%
December	9.0%	10.8%

The differences here are not striking. The low incidence during the summer months is due, of course, to the closure of the Health Service during this period.

Table 8

Distribution by School Years

	<u>Pathological Positive</u>	<u>Pathologically Negative</u>
1929-30	8.1%	10.8%
1930-31	13.1%	13.5%
1931-32	13.1%	8.1%
1932-33	9.0%	16.2%
1933-34	7.2%	10.8%
1934-35	9.9%	2.7%
1935-36	9.9%	8.1%
1936-37	7.2%	16.2%
1937-38	11.3%	5.4%
1938-39	11.3%	8.1%

Here again the differences do not appear to be significant.

Table 9

Distribution by History of Previous Attacks

	<u>Pathologically Positive</u>	<u>Pathologically Negative</u>	<u>UH.<sup>3</sup></u>
Previous history	34.9%	54.1%	60.%(Simple) (acute)
No previous history	65.1%	45.9%	40.%(group)

We are unable to attach any significance to these differences other than the lower incidence of previous attacks in our group is probably a result of the lower age level.

Table 10

Comparison of Elapsed Time Between Onset of Symptoms and Admission to Hospital

	<u>Pathologically Positive</u>	<u>Pathologically Negative</u>	<u>UH.<sup>3</sup></u>
Average time (hours)	24.1 hrs.	47.5 hrs.	(46% )
1-11 hours	34.8%	19.4%	(in )
12-13 hours	31.8%	12.9%	(48 hrs.)
24-47 hours	21.6%	22.6%	
Over 48 hours	11.8%	45.2%	

Two-thirds of the acute group were seen within 24 hours, and only one-third of the inactive group. 88.2 per cent of the active group were seen within 48

hours, as compared with only 46 per cent in the University Hospital group reported by Sperling.

Table 11

Comparison of Elapsed Time Between Onset of  
Symptoms and Operation

	<u>Pathologically Positive</u>	<u>Pathologically Negative</u>
Average time (hours)	<u>40.1 hrs.</u>	<u>104.2 hrs.</u>
1-11 hrs.	12.1%	0.0%
12-23 hrs.	39.1%	8.1%
24-47 hrs.	28.8%	18.9%
Over 48 hours	20.0%	73.0%

Eighty per cent of the active cases were operated within 48 hours of onset, as against only 27 per cent of the inactive. This difference is in all probability a reflection of the indecision

of the surgeon, because of the indeterminate character of the symptoms and signs in many instances in the inactive group.

Table 12

Comparison of First Symptoms

	<u>Pathologically Positive</u>	<u>Pathologically Negative</u>
Generallized abdominal pain	39.7%	27.0%
Pain RLQ	22.9%	32.4%
Pain, epigastrium	17.3%	13.5%
Pain, lower abdomen	7.0%	5.4%
Pain around umbilicus	6.5%	5.4%
Nausea or vomiting or both	4.2%	2.7%
Pain, upper abdomen	1.9%	8.1%
Pain, RUQ	.5%	.5%
Diarrhea	0.0%	2.7%

The differences here are not striking. 62.6 per cent of the acute group had pain, either generalized or in the right lower

quadrant as a first symptom, as opposed to 59.4% of the inactive group.

Table 12a

A further Comparison of Important Details of History  
Is as Follows:

	<u>Pathologically Positive</u>	<u>Pathologically Negative</u>	<u>UH. (simple, acute)</u>
Generalized abdominal pain	36.7%	21.6%	
Localized abdominal pain (In all cases, abdominal pain of some kind was present)	91.8%	89.2%	100%
Nausea	72.5%	78.4%	83%
Vomiting	45.9%	35.1%	55%
Diarrhea	6.9%	2.7%	7.7%
Diarrhea without history of catharsis	6.0%	2.7%	
G.U. symptoms	2.3%	10.8%	
Catharsis	8.0%	6.0%	15.0%

We conclude that the details of history are essentially similar in our two groups.

Table 13

Comparison of Findings on Physical Examination

	<u>Pathologically Positive</u>	<u>Pathologically Negative</u>	<u>UH. (simple, acute)</u>
Tenderness, RLQ	100%	100%	100%
Tenderness elsewhere	17.4%	24.3%	
Rebound tenderness RLQ	44.1%	21.6%	50%
Rebound tenderness elsewhere	5.6%	5.4%	
Rigidity RLQ	63.8%	64.9%	78%
Rigidity elsewhere	5.2%	16.2%	
Temperature (average)	98.9°	98.7°	99.2°
98.6° or less	47.2%	54.3%	
98.7° - 99.5°	28.7%	34.3%	
99.6° or more	24.1%	11.4%	

The differences here do not appear to be significant. It should be noted that the rather high incidence of rigidity and rebound tenderness is probably the result of the inexperience of many of the exam-

iners from whose notes some of these findings were compiled. The surgical consultant feels that their true incidence is much lower in our cases.

Table 14

A Comparison of the Laboratory Findings is as Follows:

	<u>Pathologically Positive</u>	<u>Pathologically Negative</u>	<u>UH. (Simple, Acute)</u>
Leucocytes (Median)	<u>15,000</u>	<u>10,000</u>	
Leucocytes (Average)	<u>15,362</u>	<u>9,900</u>	12,300
Under 5,000	.5%	5.7%	
5,000 - 9,000	5.9%	31.4%	
9,000 - 12,000	12.3%	40.0%	
12,000 - 18,000	55.9%	22.9%	
Over 18,000	25.5%	0.0%	
Range	4,850 - 29,000	4,650 - 17,000	
Abnormal urinary constituents	8.1%	5.7%	
Albumin	4%		
Many WBC	2%	2.5%	
Sugar	1%		
RBC	0.5%	2.5%	
RBC and WBC	0.5%		

The striking difference here is in the leucocyte count. Over three-quarters of the active cases had leucocyte counts above 12,000, and over three-quarters of the inactive cases were below 12,000; and it may be said that this difference plus the difference in sex distribution are the only variations of any consequence between the pathologically positive and pathologically negative groups.

In summary, our conception of the typical picture of early acute appendicitis is as follows:

We feel that the great majority of cases of acute suppurative non-perforated appendicitis may be diagnosed by three characteristic findings. These are (1) pain, (2) tenderness, (3) leucocytosis.

(1) Pain (Abdominal) This survey showed pain to be the first symptom in 95.8 per cent of the cases. We are of the opinion that even in the cases in which abdominal pain was not recorded as the first symptom, it followed so closely as to be almost simultaneous. For practical purposes, abdominal pain is the first symptom in 99.9 per cent of the cases. The pain is typically of sudden onset in a previously

and otherwise well individual. It is usually not severe, but rather an "ache." It is continuous and not intermittent.

(2) Tenderness, elicited by gentle palpation, is limited to the area beneath which the appendix lies.

(3) Leucocytosis. A leucocyte count when considered as one part of the whole clinical picture, is a very valuable and reliable diagnostic aid, but dependence upon it alone will often lead to disaster. Eighty-five per cent of these cases showed a leucocytosis of 12,000 to 18,000. If the clinical findings are questionable, a high or low leucocyte count may be the deciding factor. However, if the clinical findings are definite, a normal or low leucocyte count should never influence one to procrastinate.

Other symptoms and findings may be briefly mentioned chiefly to point out their negative value. Nausea or vomiting is of little diagnostic value. Constipation is not a factor. Diarrhea was present in only 6 per cent of our cases. Severe diarrhea usually means gastro-

enteritis. Temperature and pulse are usually normal. Rigidity should not be expected or waited for before making a diagnosis. Rectal tenderness has not been found to be of very great importance in the average case. A rectal examination is never a pleasant experience for any patient, and the acute appendix case is not an exception. Vaginal or recto-vaginal examination is essential and valuable for differentiating pelvic pathology from acute appendicitis in girls.

6. Two clinical types of appendicitis warrant special mention because of their confusing clinical pictures.

(1) Pelvic Appendicitis.

When the appendix is located in the pelvis, the symptoms and findings are masked and often very minimal until the pathological process is far advanced.

The pain is very mild and is located in the mid-abdomen or across the whole lower abdomen. It never localizes in the right lower quadrant. These cases often have frequent painful urination, and red blood cells are often found in the urine. Tenderness is minimal, difficult to elicit, and is located low in the midline. Strangely enough, unusual rectal tenderness has not been noted even in these low-lying appendices.

(2) A retro-cecal appendix often gives a similarly mild clinical picture but with the findings in the extreme right abdomen, right lumbar area, or right hypochondrium.

7. The findings at operation, confirmed by pathologic diagnosis, in the 37 pathologically negative cases may be summarized as follows:

Table 15

Pathology in Pathologically Negative Cases

No pathology found to explain symptoms	75.7%
Ovarian pathology (generally hemorrhage into simple cysts)	13.5%
Non-specific enteritis	2.7%
Meckel's diverticulum	2.7%
Ureteral stone	2.7%
Intestinal obstruction (adhesions)	2.7%

The findings of appendical disease, discovered at operation and confirmed by

pathologic diagnosis in the 222 pathologically positive cases may be summarized as follows:

Table 16

Pathology in Pathologically Positive Group

	<u>SHS</u>	<u>UH</u> <sup>4</sup>
Acute, suppurative appendicitis, not perforated*	91.9%	46.0%
Acute, suppurative appendicitis, perforated, with local peritonitis	4.1%	8.8%
Acute, suppurative peritonitis, perforated, with abscess	2.3%	25.0%
Acute, suppurative appendicitis, perforated, with generalized peritonitis	1.3%	19.4%
Carcinoid tumor of appendix	.4%	
Total perforated cases	7.7%	53.2%

\*Of these, 15, or 7%, were gangrenous.

The reasons for the differences in the Hospital series are to be found in the distribution of pathology between the following table:  
Student Health Service and the University

Table 17

Factors Influencing Perforation

	<u>Average hours Onset to admission</u>	<u>History of Catharsis</u>
Non-perforated, SHS	20.1	7.5%
Non-perforated, UH	57.6	6.5%
Perforated, SHS	82.2	28.6%
Perforated, UH	127.2	28.5%
Entire group, SHS	24.1	8.0%
Entire group, UH	84.2	15.0%

Further operative details are summarized in the following table:

Table 18

Operative Details

<u>Anesthesia</u>	<u>%</u>	<u>Incision</u>	<u>%</u>	<u>Drained</u>
Spinal	71.0%	Mod. McBurney	84.9%	
Spinal, reinforced	8.8%	Right Rectus	14.6%	15.1%
Inhalation	15.5%	Battle	.5%	
Not recorded	4.7%			

A summary of post-operative complications in the entire group of 284 pathologically positive, pathologically negative, and interval cases is as follows:

Table 19

Post-Operative Complications

Wound infections	5 cases	1.7%	<u>UH. 3</u> 2.0%
Broncho-pneumonia	3 cases	1.0%	0.3%
Mechanical intestinal obstruction	2 cases	0.6%	
Pleural Effusion	2 cases	0.6%	
Paralytic Ileus	1 case	0.3%	
Fecal Fistula	1 case	0.3%	
Hematoma	1 case	0.3%	
Total Complications	15 cases	5.0%	7.0%

The average duration of hospital stay was as follows:

Table 20

Duration of Hospital Stay

<u>Acute, non-perforated</u>	<u>Acute, perforated</u>	<u>Pathologically Negative</u>	<u>Non-perf. UH</u>	<u>Perf. UH</u>
10.9 days	24.3	10.9	9.75	22.5

8. The fatality in this entire series of 594 cases, both operated and non-operated, has been 0.0%. To our knowledge, only one University student has died of appendicitis during this ten-year period. This patient came to the Student Health Service with a four-day history of abdominal pain. A diagnosis of appendicitis with perforation and generalized peritonitis was made. He was admitted to the Health Service ward, but became a private patient of a surgeon who was not a member of the Health Service staff. An appendectomy was performed, and he died a few days later. The statistics of this case are not included in this series.

This fatality record, we feel is neither remarkable nor unique. For example,

in the series of 258 non-perforated cases reported from this University Hospital by Sperling, there was only 1 death, with a resultant fatality of 0.3 per cent. In a total of 1006 cases from the Student Health Services of Purdue, Michigan, Pennsylvania, Yale, Cornell and Duke, there have been four deaths, a fatality of 0.3%.<sup>5</sup> Furthermore, Schmidt and Joachim<sup>5</sup>, of the University of Wisconsin, have reported a series of cases from the Wisconsin General Hospital in which they contrasted the Students Health Service cases and the General Hospital cases in much the same manner that we have done here. Interest in this comparison is heightened by the fact that the same surgical staff was responsible for the care of these two groups.

Table 21

(Schmidt & Joachim)<sup>5</sup>

Comparison of Pertinent Factors in the  
Wisconsin General Hospital Group and in the Student Infirmary

	<u>Wisconsin Gen- eral Hospital</u>	<u>Student Infirmary</u>
Number of cases of acute appendicitis	688	615
Age of patients	30% under 10 yrs. or over 30	90% between 18 yrs. & 22 yrs.
Duration of illness (per cent admitted on first day of symptoms)	45%	75%
Self-medication	20%	Negligible
Ruptured appendix	19%	2%
Fatality:		
Uncomplicated cases	1.9%	
Ruptured appendix	20.0%	
Gross mortality	5.68%	0%

In this paper Schmidt and Joachim stress the three factors which they feel are most important in explaining the low fatality from appendicitis in a Student Health Service. These are: (1) Age, (2) Brief duration of illness, and (3) The relative lack of self-medication. Our evidence substantiates the importance of these factors, particularly the latter two. Bower has shown that in the country as a whole, of cases of appendicitis admitted within the first 24 hours, 1 in 61 dies; of those admitted within 48 hours, 1 in 24 dies; of those admitted within 72 hours, 1 in 17 dies, and of those admitted after 72 hours, 1 in 13 dies. Further, of those cases of appendicitis who have taken no laxatives, 1 in 62 dies; of those who have taken a laxative once, 1 in 19 dies; and of those who have taken a laxative more than once, 1 in 9 dies. And finally, 90% of those who develop spreading peritonitis have taken laxatives.

9. Our attitude concerning the treatment of acute appendicitis is as follows:

(1) Acute Suppurative Appendicitis  
(non-perforated)

All are agreed that immediate appendectomy is the only treatment for these cases.

Fifty-eight per cent of our series were not operated immediately because the condition was evidently very mild or subsiding when first seen. All such cases, however, are hospitalized and kept under closest observation, or referred to their family physicians. In all cases in which any doubt exists as to their subsiding character, immediate operation is advised, since it is in these cases that delay may be disastrous.

(2) Late Acute Suppurative or  
Questionably Early Perforated  
Cases

There is a considerable group of patients who appear after 48 to 72 hours of symptoms with findings indicating more advanced pathology. There may be some evidence of perforation and early spread-

ing peritonitis, such as slight distention, mild rigidity and rebound tenderness, elevated temperature, or more severe and generalized pain. These we feel are borderline cases and should be operated upon. Often one will find that they have not perforated, and we therefore prevent that unfortunate occurrence.

(3) Perforated Appendicitis

In our series of cases, we fortunately have had a very low incidence of this serious complication. We have also been more than fortunate in having no fatality in these cases. We believe this is due to the favorable factors of age and general health in our group. We feel that the treatment of each case must be individualized and that there is a place for both conservative and operative types of treatment in this group, depending upon the condition of the patient, the duration of the symptoms, and the experience of the surgeon.

Abscess cases we feel should be treated conservatively and operated upon later after the abscess has absorbed, or drained after sufficient time has elapsed for the process to be well walled off.

10. In conclusion, we think that a survey of this type contributes to the subject of appendicitis as a whole, in the sense that it substantiates again the fact that appendicitis can be a disease with an extremely low fatality. The factors responsible for low fatality on the one hand, and those favoring a higher one are reiterated here. It proves again, we feel, that the preventive aspects of the subject are far more important than any dispute as to the proper treatment of generalized peritonitis. How much can be accomplished in this fashion is illustrated by the work of Bower in Philadelphia. Galvanized into action by an excessively high mortality rate, the medical profession there began a campaign of lay education. Speakers went into the high schools to stress the importance of abdominal pain; druggists were urged to inquire carefully as to the presence of abdominal

pain before dispensing laxatives. As a result, the mortality from appendicitis has dropped 60 per cent since 1930 when the campaign was begun.

One final point may be drawn from this survey. Our fatality figures, in conjunction with those of many others, prove that the operative fatality in early appendicitis is negligible, while the fatality of appendical abscess is at least 5 per cent, and the fatality of generalized peritonitis at least 20 per cent. It is perhaps proper to wonder whether delay is justifiable in those cases in which the clinical picture is not entirely conclusive. This does not mean that any case of abdominal pain demands immediate exploration, but as Dr. Wangensteen has said, "If we are to reduce the mortality in acute appendicitis, we must operate on more cases of appendicitis."<sup>8</sup> Or as Dr. C. Gordon Heyd, the former president of the American Medical Association, has said, "In no other intra-abdominal condition are errors in commission so beneficial as in the removal of an appendix."<sup>9</sup>

While the clinical picture of acute appendicitis in the Students' Health Service is in most instances rather typical, certain cases may present marked diagnostic difficulties. To illustrate this point, we have appended several unusual case histories.

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#### Case Histories

1. This patient was a 22 year old white female nurse. She was first hospitalized in the Student Health Service in May, 1939, with the complaint at that time of generalized abdominal pain, of a crampy character, associated with nausea and diarrhea. She said that she had had many previous similar attacks since childhood. Examination at that time revealed only mild diffuse abdominal tenderness without rigidity. White blood cells were 9,600. The surgical consultant felt that the condition was not appendicitis, and the attack subsided in 12 hours.

On January 4, 1940 she was again admitted to the Health Service with the

complaint of generalized abdominal pain, crampy in character, with sudden onset. These symptoms, she felt, were entirely similar to those that she had noted in previous attacks. However, on this admission, a history of some relief of pain with food was obtained. In addition, she stated that she had had one tarry stool a month previously. Examination again revealed diffuse tenderness over the entire abdomen, most marked in the epigastrium. The surgical consultant felt that the process was an acute peptic ulcer, possible slowly perforating. White blood cell counts were 10,700, and 12,500. X-ray examination of the stomach and duodenum revealed a definite deformity of the duodenal bulb, with a probable crater.

The patient was treated by a modified Sippy regime, with prompt relief of symptoms, and was discharged 9 days after admission.

She remained well until March 27, 1940, when she had a sudden onset of severe, epigastric pain, which radiated to the back and to the lower abdomen. The pain was so severe that she writhed about in bed. Examination of the abdomen was difficult because of the extreme degree of tenderness throughout. The maximal tenderness, however, appeared to be in the right lower quadrant. The white blood count was 18,000. Immediate operation revealed an acute suppurative appendicitis.

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2. This 22 year old white male was first admitted to the Student Health Service on November 8, 1933, complaining of pain in the right flank of four days' duration. This was not severe, but was more noticeable on walking. There were no associated symptoms. Examination revealed only low-grade tenderness in the right flank. The white blood count was 13,000. Examination of the urine was negative. The pain quickly subsided and he was discharged in 2 days. The surgical consultant felt that the diagnosis was indeterminate, but that this process was probably not appendicitis.

On January 2, 1934 he was admitted to

the Health Service, complaining of pain in the right upper quadrant, dull, aching in character, made worse by movement, not associated with nausea and vomiting. As on the previous attack, this was of four days' duration. He had been constipated for three days. There had been no urinary symptoms. Examination revealed moderate tenderness and rigidity in the right upper quadrant extending into the right flank. The right lower quadrant was negative. The white blood count was 9,200, and the urine contained a few white blood cells and red blood cells, together with occasional hyaline and granular casts. The medical and surgical consultants agreed that the process was either an intra- or peri-renal lesion. A flat film of the urinary tract revealed a questionable enlargement of the right kidney, and a partial obliteration of the right psoas shadow. A policy of observation was instituted. Repeated urine examinations continued to show white blood cells, red blood cells, and occasional hyaline and granular casts, until January 8, six days after admission, when they became negative. At this time also, a vaguely outlined mass was palpable in the right flank. The temperature was ranging between 100 and 101 degrees. The urologic consultant saw the patient at this time, and stated that he felt the process to be suppuration within a high-lying retro-cecal appendix, rather than a lesion in the urinary tract. He suggested an intravenous urogram, which was negative. Following this, however, the urine again began to contain red blood cells, white blood cells, and casts. On January 12, a Graham-Cole series revealed a normally functioning gall-bladder. On January 17, another flat film of the urinary tract region again revealed the right psoas outline to be indistinct, but the kidney shadows were now felt to be normal. On the basis of these findings, the roentgenologist suggested that appendical abscess was now more likely than peri-nephritic abscess. The white blood counts during this period were fluctuating between 9,000 and 11,000. The urinary findings again disappeared, and on January 19, the urologic and surgical consultants agreed that appendicitis with probable perforation and abscess was the likely diagnosis. Accordingly, the

abdomen was explored on January 20. The appendix was found lying high behind the colon, extending to the lower border of the liver. A fibrino-purulent exudate was present on the lateral border of the colon. The appendix was not perforated, and there was no abscess. The pathologic diagnosis was acute and chronic inflammation of the appendix.

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3. This patient was a 22 year old white male, who was admitted to the Students' Health Service on January 13, 1940, complaining of mid-epigastric pain of 14 hours' duration, which radiated to the lower mid-line. This was associated with nausea, but no vomiting. There were no urinary symptoms. Examination revealed tenderness and slight rigidity in the mid-line, just over the bladder. Rectal examination was negative. The right lower quadrant was negative. The urine contained numerous red blood cells and occasional white blood cells. The white blood count was 10,900 on admission. Six hours later, it had fallen to 5,100. The surgical and urologic consultants both considered the possibility of a pelvic appendix, but felt that a thorough urologic examination was a prerequisite to surgery. Accordingly, a flat plate of the urinary tract, and intravenous pyelogram, and cystoscopy were done, but no abnormalities were found in the urinary tract. Immediate operation was then advised, but the patient's father, a physician, wished delay. The white blood count on January 15 fell further to 4,700, but the tenderness and rigidity persisted, and on that date appendectomy was performed. The appendix was found to be very long, lying in the pelvis, and acutely inflamed. It had not ruptured.

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4. This patient was a 20 year old white female who was admitted to the Student Health Service on Nov. 3, 1931, complaining of pain in the RUQ associated with nausea and vomiting. She stated that for the past year she had had attacks of a similar nature, which were usually provoked by the eating of fatty foods, or by vegetables such as cabbage and cauliflower. In addition, there was a history of several previous attacks of

acute rheumatic fever. Physical examination revealed rather marked tenderness in the RUQ, and slight tenderness in the RLQ. There was no rigidity, and no jaundice. Examination of the heart revealed evidence of aortic insufficiency. The medical consultant felt that the abdominal findings were probably on a rheumatic basis. The surgical consultant felt that gall-bladder disease was the most likely possibility, but also considered the possibility of acute appendicitis.

An x-ray examination of the stomach and duodenum had been reported as negative previously. On this admission, a Graham-Cole series revealed a normally functioning gall-bladder. The symptoms of right upper quadrant pain, nausea and vomiting persisted, together with tenderness in the RUQ, associated with slight tenderness in the RLQ. Accordingly, exploratory laparotomy was done on Nov. 24, 1931. The appendix was found to be retrocecal, and the pathologic diagnosis was a carcinoid tumor of the appendix.

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#### Summary

1. 594 cases of appendicitis seen over a 10-year period at the Students' Health Service of the University of Minnesota was reviewed.
2. 284 cases underwent appendectomy.
3. 25 cases were classified as interval appendectomies.
4. Of the remaining 259 cases, in 85.7 per cent the pre-operative diagnosis of appendical disease was verified.
5. The only differences between the clinical pictures of the pathologically positive and the pathologically negative group were a lower leucocyte count and a majority of females in the pathologically negative group.
6. As compared with a general hospital group, the duration of symptoms, the history of catharsis, and the incidence of perforation was seen to be much smaller

in the Students' Health Service cases.

7. The fatality of acute appendicitis in this group was 0.0 per cent.
8. This fatality reflects the favorable circumstances of age, brief duration of illness, and relative absence of catharsis in the Students' Health Service group.
9. The conclusion is drawn that the mortality from acute appendicitis, when seen under ideal circumstances, should be negligible, and that significant reduction of appendicitis mortality in the country at large will result chiefly from application of the principles of preventive medicine rather than from refinements in the treatment of late cases of appendicitis.

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V. GOSSIP

The Eighty-seventh Annual Session of the Minnesota State Medical Association, held at the Mayo Clinic Auditorium in Rochester, April 22, 23, and 24, is now history. Few state medical associations have a better meeting. It is balanced to meet the interests of all groups and is always well-attended, not only by physicians from Minnesota, but also by physicians from surrounding states. As a result of long experience, the executive direction has been simplified, thanks to the efficient corps built up by Executive Secretary R. R. Rosell and by his predecessor, E. A. Meyerding. Again the round table luncheons were the highlights. There were over nine hundred registrations at the thirty scheduled luncheon meetings. More could have been accommodated if space had been available. It appears that this popular feature will again have to be enlarged in order to meet the demands for this type of educational service. Other interesting features are the sponsored lectureships. They are now offered by the Minnesota Radiological Society, Northwestern Pediatric Society, Society of Internal Medicine, Northern Minnesota Medical Association, and the Trudeau Society. There are many other societies with excess funds in their treasuries, which could well sponsor lectures. The Mayo Clinic was again the grand host, entertaining all in their very sincere way. The smoker and floor show on Monday night was well-attended. Praise was heard on every hand for the accommodations now provided in the new Auditorium. The four cities in Minnesota -- Minneapolis, St. Paul, Rochester, and Duluth -- now entertain the Association in order and all provide effective meeting places and excellent scientific programs.....At the annual spring course for Safety Leaders, conducted by the Milwaukee Chamber of Commerce, more than 4,000 representatives of industry attended. Each spring a similar course is offered. Milwaukee is the home of the Safety Movement in America, having conducted instruction along this line since 1912. Prior to the session in the Auditorium, the faculty met at a dinner at the Plankinton Hotel. All of them were experienced teachers in this field, employed by U.S. Steel Corporation, Pennsylvania Railroad, Studebaker Corporation,

Insurance Companies, Chambers of Commerce, etc. At the seminars from 7:45 to 8:45, individual problems were discussed for those who worked in foundries, wood, textile, and leather factories, etc. including one section for the general trades, and a graduate section for those who had attended a certain number of courses. Individual leader cards were punched at the door in order to record attendance, as certificates will be issued later. At 8:45, all the groups assembled in the main auditorium for a band concert and the speech that I went down to give. Milwaukee's new 32-year old blond choral director mayor received an ovation. He is part of Milwaukee's new deal after twenty-five years of the former mayor. He has the same enthusiasm and energy of other young men who have interested themselves in civic and municipal affairs. He spoke the language of the group, as he had worked at many of the places that were represented there. Safety education and practice bids fair to crowd preventive medicine for its laurels in many respects. It is a scientific program which needs the enthusiastic, alert cooperation of all those involved. My fellow faculty members were past-masters at arousing crowd enthusiasm. Moran, Fitzgerald, and Mike Grady were there. Needless to say, many stories were told. Safety leaders gauge the success of their efforts by the number of man hours worked without an accident. Some shops go into huddles on company time first thing in the day in order to find out if everyone is ready. Tony, whose wife had a baby at 5:00 a.m. is sent home to sleep to avoid the possibility of accident. Frequent rest periods are practiced. Those who spoil the record may be made to wear a special armband for a mourning period of thirty days. During this time they must sit on special benches apart from the other members of their group. These innovations are of interest even though the police power of industry is brought into play. One fellow faculty member was a very effective mimic as he showed how the boys looked when they brought the flowers to the widow (if they had fixed the special valve, no flowers would have been necessary). It would be interesting if the rank and file could be made to take the same interest in preventive medicine.

VI. GOOD LUCK -- COME BACK AND SEE US

Milan V. Novak, Instructor in Bacteriology and Bacteriologist for the University of Minnesota Hospitals has resigned to accept a position on the Bacteriology Staff of the University of Illinois at the Illinois Research Hospital. Dr. Novak received his B.A. from Macalester in 1929 and the following degrees from the University of Minnesota: M.S., 1930, Ph.D.-1932, M.B. and M.D. - 1938. Dr. Novak is entitled to a great deal of credit for the work he has done in bacteriology in this Hospital over such a short period of time. He organized and developed the transfusion service. His studies on Skin Antiseptics not only saved our hospital a great deal of money but also has helped other institutions in this area. His investigations on surgical bacteriology are well on their way to practical solutions of other problems.

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Royal V. Sherman, Instructor in Preventive Medicine and Public Health and Physician in the Health Service, has resigned to accept a position with the Clinic in Red Wing. Dr. Sherman received his B.A. degree from William Jewell College, and his M.D. from the University of Minnesota, 1930. He has been a member of the Medical School Staff since October 1, 1937. Following his internship and graduate study in internal medicine, he went into practice. For a time he was connected with the Northwest Clinic at Crookston. In addition to his other duties, Dr. Sherman is investigating examination technics in Preventive Medicine as a further extension of studies originated by the Committee on Educational Research. His special project at the Health Service is a follow-up of students who showed abnormalities of the urine - chiefly albuminuria.

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Clarence B. Truog, Teaching Fellow in Radiology December 1, 1936, Medical Fellow in Radiology - 1938-39, Instructor in Radiology - 1939-40, resigned to accept a position of Radiologist at the Jackson Memorial Hospital, Miami, Florida. Dr. Truog graduated from the University of Minnesota Medical School - 1928. Formerly practiced at Lindstrom. He was on leave of absence during May, 1939 for special study at Kings County Hospital, Seattle. Dr. Truog has had both the diagnostic and treatment services at the University of Minnesota Hospitals.

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Bernard A. Watson, Assistant Professor of Preventive Medicine and Public Health and Physician of the Health Service, resigned to accept a position with a clinic in Battle Creek, Michigan. Dr. Watson has been connected with the University of Minnesota since September, 1931. Graduated from the University of Michigan in 1929. Took his internship at McGill where he became interested in metabolic studies. He has done original significant work in carbohydrate metabolism with special reference to significance of glycosuria, glucose tolerance and treatment of diabetes. Dr. Watson has also been interested in endocrine studies and nutrition. He has been associated with the nutrition service for students and has given special courses for preventive medicine and public health. Dr. Watson's studies will be continued in his new location. Among other organizations, he has been invited to address the American Medical Association at its meeting in the East this summer.

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