

Current Concepts on Control Of Diarrheal Disease

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THE URGENCY of meeting the public health challenge presented by diarrheal disease in States on both sides of the Mexican border was emphasized in a report prepared at the 1958 meeting of the U.S.-Mexico Border Public Health Association. That report enumerated available control measures and outlined the necessity for more precise delineation of problems and for development of more precise procedures against specific pathogens. The present paper is related especially to one of the points covered in the report: What assumptions regarding etiology and epidemiology allow us to proceed to a control program where laboratory facilities are missing? Some of the implications to control are suggested by results available thus far from studies on the etiology of diarrheal diseases at Phoenix, Ariz.

Recognized Pathogens

The work at Phoenix was designed to provide information on the current association of recognized pathogenic agents with diarrheal diseases. Previous studies in the southwest indicated the prominence of shigellae in the etiology of enteric infections. Investigations conducted by Hardy and Watt (1) from 1936 to 1938 indicated that these pathogens were isolated from 76 percent of the severe cases and 58 percent of the milder cases for all age groups. In recent years, cursory observations and a few studies specifically designed to determine what

etiological agents are currently responsible for diarrheal disease suggested that pathogens other than *Shigella* probably were of relatively more importance as causes of illness and death (2).

Infant deaths attributable to diarrheal disease in the United States receded from about 12,500 in 1941 to approximately 5,000 in 1956 (see chart). In the last few years, however, the rate of decline has diminished and the annual incidence appears to have stabilized at about 5,000 deaths. If this indicates that the maximum effectiveness of available control measures has been realized, further reductions in diarrheal diseases may depend upon development of more effective control methods or upon wider and more intensive application of existing measures. Prerequisite to either course is a redefinition of the problem based on knowledge of etiological agents currently responsible for diarrheal disease and of the appropriateness of available control measures for areas where problems are now most acute. Consequently, the first investigations at Phoenix were designed to determine the current association between recognized pathogens and diarrheal symptoms.

Results from initial studies, which were reported elsewhere in detail (3), may be summarized briefly. Intensive examinations for pathogenic enteric bacteria were made on specimens from 630 persons with symptoms of acute diarrheal disease for which treatment was sought. Approximately 67 percent of these persons were less than 1 year of age. Recognized bacterial pathogens were isolated by a single examination from 57 percent of the cases. *Shigella* organisms were recovered from 26 percent, enteropathogenic *Escherichia coli* from 31 percent, and *Salmonella* from 7 percent. About 90 percent of all enteropathogenic *E. coli* and 40 percent of the *Shigella* recovered were from infants less than 1 year old. The cases from which etiological agents were not recovered showed no characteristic distribution with respect to age of patient or month of occurrence.

The need for further research is indicated by the fact that no recognized pathogens were detected in approximately half of the acute cases studied. In addition to searching for unrecognized pathogens, attention must be given also to the possibility of etiology unrelated to infectious agents. Not only were the

Dr. Goodwin, who is chief of the Phoenix Field Station Section of the Communicable Disease Center, Public Health Service, summarizes in this paper material he presented to the U.S.-Mexico Border Public Health Association meeting on March 31, 1959, in Brownsville, Tex.

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Number of diarrheal deaths among infants under 2 years of age, in the United States, from 1941 to 1956



majority of acute cases in the Phoenix studies in infants less than a year old, but the highest mortality from diarrhea characteristically occurred among infants during the first few months of life. Data available do not indicate whether or not the inherent virulence of specific pathogens associated with diarrhea of these young children is responsible for the high mortality or whether unfavorable prognoses result from other circumstances, for example, the rapid dehydration, malnutrition, or synergistic effect of other organisms. Furthermore, accumulation of additional information on the epidemiology of certain pathogens, *E. coli*, for example, is necessary to enable development of specific control measures.

Control Measures

Obviously, continuing investigations and development of more effective control measures are necessary to achieve the ultimate goal of control and eradication of diarrheal diseases. Public health workers recognize, however, that much can be done in the meantime to meet current problems that should not wait until pro-

cedures are devised that assure attainment of the more remote objectives. Although its relative prominence has apparently diminished, *Shigella* still seems to be the dominant etiological agent of summer diarrhea in the areas investigated. Traditional control measures, such as provision of water supply within individual homes, general environmental sanitation, promotion of breast feeding, health education, and maternal and child care, are of proved value in reducing these infections. No new techniques are proposed on the basis of the work outlined here, but different methods for application of existing procedures are suggested which may enhance their effectiveness.

It should be remembered that as the amount of environmental contamination decreases, the relative importance of transmission by personal contacts apparently becomes more significant. While a great deal of further work is necessary to improve environmental conditions and reduce further the possibility of spread of diarrhea through inadequate excreta disposal and limited water supplies, it will be well to keep in mind that different techniques, many that are simple and easy to apply, may effec-

Table 1. Frequency distribution by families of diarrheal episodes reported and of *Shigella* isolated from residents of Sacaton, Ariz., May 1954 through December 1958

Number of episodes	Number of families	Cumulative number		Positive cultures for <i>Shigella</i>	Number of families	Cumulative number	
		Episodes	Families			Positive cultures	Families
50-----	1	50	1	20-----	1	20	1
41-----	1	91	2	17-----	2	54	3
36-37-----	2	164	4	15-----	1	69	4
				14-----	1	83	5
26-29-----	3	245	7	11-----	1	94	6
21-25-----	4	341	11	9-----	2	112	8
16-20-----	12	548	23	8-----	3	136	11
11-15-----	10	676	33	7-----	3	157	14
6-10-----	20	834	53	6-----	6	193	20
4-5-----	11	883	64	5-----	7	228	27
3-----	10	913	74	4-----	4	244	31
2-----	12	937	86	3-----	9	271	40
1-----	21	956	107	2-----	11	293	51
0-----	2		109	1-----	19	312	70
				0-----	39		109

tively decrease the amount of human contact with infectious material.

As the incidence of diarrhea is reduced, homogenous specific foci, which are evident even in areas of high incidence, become increasingly apparent. In any situation a small number of families in the community usually will be responsible for the majority of diarrheal diseases in a particular area. This is illustrated by data from Sacaton and Guadalupe, Ariz., where observations were made from May 1954 through December 1958 and from May 1954 through September 1957, respectively. The prevalence

of *Shigella* among children from 1 to 5 years of age was determined by monthly examination of fecal specimens collected by rectal swab. Data on morbidity experience of the entire population were obtained by monthly interrogation.

Tables 1 and 2 show the frequency with which episodes of diarrhea were reported and the rate of *Shigella* positive cultures in families of the communities. In Sacaton about 57 percent of the cases of diarrhea reported were from only 21 percent of the families. Approximately 62 percent of *Shigella* positive cultures were obtained from 18 percent of the families.

Table 2. Frequency distribution by families of diarrheal episodes reported and of *Shigella* isolated from residents of Guadalupe, Ariz., May 1954 through September 1957

Number of episodes	Number of families	Cumulative number		Number of positive cultures	Number of families	Cumulative number	
		Episodes	Families			Positive cultures	Families
44-----	1	44	1	22-----	1	22	1
33-----	1	77	2	10-----	1	32	2
29-31-----	2	137	4	8-----	2	48	4
21-25-----	12	412	16	6-----	3	66	7
16-20-----	8	555	24	5-----	6	96	13
11-15-----	21	820	45	4-----	12	144	25
6-10-----	55	1, 256	100	3-----	25	219	50
5-----	18	1, 346	118	2-----	33	285	83
4-----	25	1, 446	143	1-----	58	343	141
3-----	26	1, 524	169	0-----	155		296
2-----	42	1, 608	211				
1-----	78	1, 686	289				
0-----	7		296				

Similar patterns were apparent in Guadalupe. Here about 15 percent of the families reported approximately half of the diarrhea and 17 percent of the families provided 64 percent of the positive cultures. The vast majority of families had only a few episodes during the period of study. Obviously, the greatest effect of a community control program could be realized by working with the families having high rates. Programs of environmental sanitation particularly, and to some extent efforts to improve personal hygiene and provide health education, have been directed on a broad base to include all of the population. The same or less effort directed toward the relatively few families or premises that are infected most frequently, and consequently which probably contributed most of the infections, would probably achieve greater reduction in prevalence.

Families responsible for high rates can usually be singled out by public health and social workers after acquiring a superficial knowledge of the community. Further consideration of means for detecting the high rate in families may lead to development of more objective techniques.

The basic concept to emphasize is that regardless of the nature of control measures, it is usually possible to be selective in the places

of their application. The magnitude of the problem may often be discouraging when working with every premise or family in a community, but if the number can be reduced by a factor of 50 to 75 percent, the possibilities of achievement appear more realistic.

Conclusion

Studies on etiology of diarrheal diseases in the Phoenix area have disclosed where further investigations are needed. The importance of additional information on epidemiology and etiology is recognized, but the need is not yet acute. Of more immediate concern, the results reemphasize that more intensive application of available techniques should further reduce morbidity and mortality attributed to diarrheal disease.

REFERENCES

- (1) Hardy, A. V., and Watt, J.: Studies of the acute diarrheal diseases. XII. Etiology. *Pub. Health Rep.* 60: 57-66, Jan. 19, 1945.
- (2) Coleman, P. J., Richards, C. S., DeCapito, T. M., and Maier, P. P.: Observations on the etiology of diarrhea in two Arizona communities. (In press.)
- (3) Goodwin, M. H., Jr., Mackel, D. C., Ganelin, R. S., Weaver, R. E., and Payne, F. J.: Observation on etiology of diarrheal diseases in Arizona. (In press.)

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