An Outbreak of Gastroenteritis in an Airmobile Unit

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SUMMARY: An infantry battalion as part of an Airmobile Brigade took part in a field exercise in Germany during mid summer 1984. During the exercise the battalion suffered from an outbreak of gastroenteritis which affected at least 64 men, some 10% of its total strength. The follow up investigation revealed that it was likely that the origin of the outbreak was uncontrolled drinking of polluted water from two streams. This paper seeks to underline the lesson that poor water discipline can have serious consequences for units in the field.

Introduction

An infantry battalion, as part of an Airmobile Brigade, took part in a field exercise in Germany during the summer of 1984. During the exercise the battalion suffered from a significant outbreak of gastroenteritis which affected at least 64 men, some 10% of its total strength.

An airmobile brigade’s role involves rapid deployment within a wide operational area. It is unlikely to remain in any one location for more than a short time.

The battalion has three rifle companies, a support company and a HQ Company. The rifle companies, support company and a small Tac HQ are fully airmobile and can be airlifted by helicopter. The bulk of HQ Company forms two echelons which contain the QM element, the LAD and other supporting services. These are largely road vehicle borne and thus are not generally airlifted.

The exercise was intended to practise the Brigade in its role. During the first phase from 6-8 July it was based at a hutted camp. The second phase, which entailed considerable movement by air and road, took place during 8-12 July in the area of the Rothaar Gebirge feature in the Sauerland.

Resupply during this type of exercise poses extra logistical problems, amongst which is the provision of a potable water supply.

The first notification of a possible outbreak of disease was by NOTICAS Signal on 13 July 1984 just following the end of the second phase of the exercise. This signal referred to three casualties admitted to a Krankenhaus on 11 July 1984. The suggested diagnosis on the signal was Salmonellosis secondary to a contaminated water supply. This initial diagnosis was not confirmed and was considered unlikely at the time, as Salmonella is not normally waterborne. Nonetheless the signal alerted the Divisional Environmental Health Team (EHT) who discovered by early questioning of unit medical staff that a considerable number of cases of diarrhoea and vomiting had already occurred. This led to the instigation of a communicable disease investigation.

Management of the Outbreak

Management of the outbreak was simplified as Endex had already occurred when the first casualties were notified. All personnel had already returned to their peace locations.

Advice was given that all soldiers with symptoms should be sent off duty to their married quarters or be closely supervised in their billets. This was carried out and the outbreak rapidly subsided. Hospital cases were discharged within two or three days.

Management in the field would have created great problems, as isolation of cases combined with the need for a high standard of hygiene required to control an epidemic are difficult to achieve in these circumstances. The operational effectiveness of the unit would have been seriously degraded. Frequent diarrhoea, vomiting and abdominal cramps are not compatible with a high work rate or the wearing of NBC protective equipment.
Investigation of the Outbreak

The investigation was undertaken by two members of a Div EHT plus an Environmental Health Assistant (EHA) seconded from another Division.

The first aim of the team was to define the extent of the outbreak and the second to seek a common causative factor. In order to do this the team visited garrison, hospital and exercise locations and questioned as many unit staff, medical staff and afflicted personnel as possible. Brigade medical personnel had noted an increase in the number of soldiers with diarrhoea and vomiting (D and V) in the days up to 13 July. However specific action had not been taken to establish a source.

A battalion sweep revealed that 64 men had been affected, seven of whom had been admitted to hospital. Of these 64 men, 34 were interviewed using established techniques in an attempt to find common factors.

The predominant symptom suffered was diarrhoea which was subsequently calculated as occurring 12 to 24 hours after ingestion of contaminated water.

Three soldiers were sufficiently ill to be admitted to the local Krankenhaus from the exercise. A further four were admitted to a BMH also directly from the exercise.

Many more would probably have had either to be returned to unit or placed in hospital if the exercise had not ended at that time.

In most the symptoms lasted between 24 and 36 hours. A few had residual diarrhoea for up to 72 hours.

Treatment was by homecare, fluids and short term isolation from their fellows.

Epidemiology

Information obtained from the cases indicated strongly that the source was water-connected. 'Compo' ration packs were not obviously implicated but, as is often the case, were under suspicion by the afflicted and unit alike.

Field Investigations

a. Phase One 6-8 July.

(1) During Phase One at Base Camp fresh rations were provided.

(2) Water was taken directly from the municipal system.

b. Phase Two 8-12 July.

(1) Rations were in the form of 24 hr packs. The last fresh rations were taken at 1200 hrs 8 July just prior to Phase Two of the exercise.

(2) Water supply became a company responsibility. All companies moved to the exercise area with full capacity holdings of water from base camp. This when used only for drinking, cooking and personal ablutions is, even with good husbandry, a maximum of one day's supply.

Rations

a. Fresh. There were no indications during the initial phase of the exercise or during the investigations that fresh rations played any role in the outbreak of diarrhoea and vomiting.

b. Compo 24 hour ration packs. In the early stages of the investigation the unit suspected the source of the outbreak to be linked with compo rations. Bacon grill and bacon burgers were highlighted. An immediate suspension of issue of the batch in question was carried out. Samples of the compo with the battalion and of that in stock were sent for food analysis. Nil of pathological significance was subsequently discovered by physical, chemical or bacteriological testing.

Water Supply

During discussions with the CO and Ops Officer it soon became evident that water resupply had been a problem during the FTX. There had not been any central direction for water provision and water was obtained from such diverse sources as fire stations, farms and a stream.

At 0300 hrs on the 9 July the Battalion requested Brigade to provide a brigade water point. This was not forthcoming so it became a responsibility of the battalion to obtain its own water. This responsibility was further delegated to the companies for the remainder of the exercise. It should be noted that the first cases arose during the evening of 9 July with increasing numbers ui to Endex (Fig 1) and a few beyond.

Company supply points were of necessity dispersed over a wide area and reflect the role of the Brigade. In addition some soldiers refilled from a stream near Lz Green 2 from where the Brigade was being heli-lifted.

No purification or chlorination was carried out by the CQMS's, regimental or water-trained personnel on the bulk water supplies acquired from any source.

Stream water used by individuals was not filtered in any case. A few soldiers used puritabs, usually incorrectly. The puritabs had not been issued for the exercise but were personal holdings for a variety of reasons.

Field Conditions

The exercise took place during the warmest three days of 1984. Daily temperatures in the valleys were between 32 and 33°C. Even on the highest peak in the region, the Alt Kahler Asten, 29°C was reached on 9 July. Daytime humidity varied between 38 and 44%. Winds were light and there was little cloud cover.

Laboratory Investigations

Stool samples had not been taken from any of the patients prior to the investigation but 16 samples were obtained from cases on the 13 July 1984.

All samples were screened for: Salmonella spp., Shigella spp., Campylobacter spp., Clostridia spp., Staph aureus, Intestinal protozoa, Yersinia spp. None of these were isolated. Eight samples of water were obtained from sources used in the exercise location.
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Fig. 1. Case Incidence for Battalion

Number of Cases

STARTEX 7 8 9 10 11 12 13 14 15

Fig. 2. Battalion Morbidity

Officers Mess 1
Tac HQ
Sp
A Coy
C Coy
B Coy

Total Number of Cases = 64
HQ Coy had no cases

(1). Three produced a heavy growth of coliform organisms, another two produced growth of coliform organisms, unacceptable for potable water. This was the first substantial indication that water had played a role in the subject outbreak. All stool samples were referred to the David Bruce Laboratories for enterotoxin testing.

The enterotoxin testing of these isolates produced a positive result in the ELISA (Enzyme Linked Immune Sorbent Assay) test for heat labile enterotoxin. However doubt was raised whether these were true positive results. Further work was carried out to determine whether the coliforms contained plasmid coding for toxin producers in order to verify this. Although all the samples screened contained *E. coli* the ELISA result obtained did not in fact refer to *E. coli*. After considerable further investigation it was concluded that a link could not be substantiated between the positive result and the isolates.

All stool specimens was forwarded for viral studies. No pathologically significant viruses were isolated.

Three water samples were obtained from various locations (Table 1) and forwarded to the Landwirtschaftskammer for chemical analysis. Although sample three shows a nitrate level above the recommended criteria this is not considered a significant factor in this outbreak of gastroenteritis. Nitrate levels are frequently raised due to run off from agricultural land. Levels of other ions including sulphate were within acceptable limits with the exception of the ammonium in sample two which were moderately raised, which could indicate breakdown of nitrogen compounds, for example urea in urine.
Table 1
Water Sources Quality and Usage

<table>
<thead>
<tr>
<th>Serial</th>
<th>Water Source</th>
<th>Coliform Count – per Colonies 100ml</th>
<th>Contamination HQ</th>
<th>TAC HQ</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>SP</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>(b)</td>
<td>(c)</td>
<td>(d)</td>
<td>(e)</td>
<td>(f)</td>
<td>(g)</td>
<td>(h)</td>
<td>(j)</td>
<td>(k)</td>
</tr>
<tr>
<td>1</td>
<td>Farm Hosepipe</td>
<td>4</td>
<td>0</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>chemical analysis acceptable</td>
</tr>
<tr>
<td>2</td>
<td>Farm Dairy Supply</td>
<td>0</td>
<td>0</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Fire Hydrant</td>
<td>178</td>
<td>+</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>House Kitchen Tap</td>
<td>0</td>
<td>0</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Fire Station Tap</td>
<td>88</td>
<td>+</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Stream Near Farm</td>
<td>Grossly Contaminated</td>
<td>++++</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Stream, beside LZ Green 2</td>
<td>Grossly Contaminated</td>
<td>++++</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>chemical analysis acceptable</td>
</tr>
<tr>
<td>8</td>
<td>Tributary of Stream in Serial 7</td>
<td>Grossly Contaminated</td>
<td>++++</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Nitrates raised (Fertilizer)</td>
<td></td>
</tr>
</tbody>
</table>

Samples of the 24 hour composites were sent to a food chemist. Bacteriological, chemical and physical screening revealed nothing of note.

Cases
A piechart (Fig 2) indicates the distribution of men affected by diarrhoea and vomiting. This suggests that B Coy (less Tac HQ) was largely unaffected by the outbreak.

The number of cases presenting in companies is shown at Fig 3. Here it can be seen that no cases occurred prior to Phase Two of the exercise but the majority of cases occurred within 48 hours of being airlifted from LZ Green 2. The number of cases in Sp Coy arising on 13 July may not be directly related to drinking water at LZ Green 2 but may have been due to bacterial contamination of the water carriage packs. This is likely to occur when they are re-used frequently without sterilization or proper cleansing (vide below).

Discussion
Under normal and peacetime conditions outbreaks of gastroenteritis can often be traced to tainted food. Very little raw water is used by the population although waterborne outbreaks of diarrhoea are not uncommon on recreational camping sites during hot summers due to makeshift water standpipes or jerry rigged extensions. Bacteria or bacterial toxins are commonly found in food, vomitus or faeces and a connection can frequently be made.

Waterborne outbreaks in western Europe are commonly due to faecal contamination with coliforms although a direct link between those present in the ingested water and those in vomitus or faeces is often difficult to find. Coliforms are not excreted over a continuing period as are the Shigella or Salmonella species and indeed the differentiation into pathological and non-pathological types is not straightforward. The link must be made by exclusion and depends on incriminating evidence obtained during a field survey.

The EEC Surface Water Directive sets standards for potable water which are that 95% of samples should have less than one coliform organism per 100 mls water. None should have greater than 10 colonies per 100 mls. This standard is necessarily strict and it is likely that most fit men could safely ingest water with minor levels of contamination. The contamination levels shown in Table 1 at serials 3 and 5 could be considered minor in this context. Clinical incidence is partly dose-related in that the greater the contamination of the source the more people that are likely to be affected by a specific level of contamination.

The stream at Serial 7 flows approximately westwards having passed through a village 2 km to the East. The tributary at Serial 8 flows under a railway bridge and as raw sewage is splash-dispersed on the track it is likely that coliforms of faecal origin are carried in the watershed to the stream.

It can be seen from Table 1 that B and HQ Coy (less Tac HQ) were alone in not ingesting grossly contaminated water at Serials 7 and 8. They had but two cases between them.

It should be noted also in Table 2 that members of
Tac HQ drew water from two completely different contaminated sources i.e. at the steams at Serial 6 and at Serials 7 and 8. Tac HQ had five out of 15 personnel affected which is serious when their role is considered.

It would appear that B Company avoided the outbreaks because it was their role to secure LZ Green 2 and thus they were in positions too far away to be able to drink the polluted water.

HQ Company (less Tac HQ) Echelon consists largely of road vehicles which are not airlifted; thus few of the personnel were actually at LZ Green 2 in proximity to the polluted streams and so had no opportunity to drink there.

Definite confirmation of having drunk water from the contaminated streams was obtained in 15 of the 34 affected personnel who were questioned.

Table 1, Serials 3 and 5 show a slightly contaminated water source but, as this was stored in bulk in Water Carriage Packs (WCP) which were refilled without cleansing of the WCP or purification of the water, conditions existed for the bacteria to multiply. The rate of multiplication depends on the particulate matter present (as a food source) and the ambient temperature. It is possible that water drawn from the WCP caused some of the later cases of diarrhoea. (Fig 3.)

In summary, the evidence points to this outbreak of gastroenteritis being due to the ingestion of water from the three stream sources listed in Table 1, Serials 6, 7 and 8. Those individuals and companies who were supplied from other sources only were not affected.

The extremely warm weather conditions at the time of the exercise have already been noted. The requirement of water for drinking and food preparation alone would have been in excess of 10 litres per day so perhaps it is not surprising that uncontrolled drinking took place from a stream which was cool, fast flowing and appeared to be free of contamination.

It is at times like these when knowledge and practice of water discipline is vital if disease capable of causing severe degradation of a unit's efficiency is to be avoided.

Acknowledgements

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REFERENCES

3. EEC Commission. The Surface Water Directive No 75/440/FEC.