

Enhanced surveillance during a large outbreak of bloody diarrhoea and haemolytic uraemic syndrome caused by Shiga toxin/verotoxin-producing *Escherichia coli* in Germany, May to June 2011

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Germany has a well established broad statutory surveillance system for infectious diseases. In the context of the current outbreak of bloody diarrhoea and haemolytic uraemic syndrome caused by Shiga toxin/verotoxin-producing *Escherichia coli* in Germany it became clear that the provisions of the routine surveillance system were not sufficient for an adequate response. This article describes the timeline and concepts of the enhanced surveillance implemented during this public health emergency.

On Thursday, 19 May 2011, the Robert Koch Institute (RKI) was informed about a cluster of cases of haemolytic uraemic syndrome (HUS) due to Shiga toxin/verotoxin-producing *Escherichia coli* (STEC/VTEC) O104:H4 in the area of Hamburg, Germany. An RKI investigation team visited the affected area the following day. In the face of rapidly rising case numbers, a need for enhanced surveillance was identified on 23 May. We describe here the timeline and concepts of the enhanced surveillance implemented during this massive outbreak of bloody diarrhoea and HUS in May and June 2011 in Germany.

Routine surveillance system

In Germany, STEC/VTEC and HUS have been statutorily notifiable since 2001 according to the Protection against Infection Act (Infektionsschutzgesetz, IfSG [1]). While STEC/VTEC surveillance is based on laboratory analyses, HUS surveillance relies on physicians. Heads of laboratories and physicians must report cases to the local health authorities within 24 hours. The incoming data is validated by the local health authorities and documented electronically. Cases fulfilling the

surveillance case definition as issued by RKI [2] are transmitted in anonymous form to the state health authorities by the third working day of the following week. The state health authorities again validate incoming cases and transmit the data to the RKI within the following week. Hence, transferring information on a case from the local to the national health authority may take from a few days up to 16 days.

Epidemiological information is fed back from RKI at least weekly to the stakeholders, e.g. responsible authorities, physicians and laboratories. Information exchange includes teleconferences, reports in the RKI's weekly *Epidemiological Bulletin* and the internet database SurvStat [3].

Enhanced surveillance system

In the context of the outbreak it became immediately clear that the provisions of the routine surveillance system were not sufficient for an adequate response. Hence, the following amendments were implemented:

- Centralising the epidemiological information exchange,
- Accelerating the data flow to the national level,
- Implementing a syndromic surveillance system for bloody diarrhoea in emergency departments,
- Assessing the capacities for HUS-treatment in Germany,
- Initiating active laboratory surveillance.

An overview of routine and newly implemented surveillance systems is given in Figure 1.

Centralising the epidemiological information exchange

On 23 May 2011, the 'Lagezentrum' at the RKI was activated as a central emergency operations centre. A large number of RKI staff was involved in coordinating the collection of epidemiologic information and organising the public health response. From 23 May onwards, teleconferences were conducted almost daily with the responsible state, national and international authorities. Starting on 24 May, epidemiological reports were distributed daily to the responsible authorities, physicians and laboratories to feed back relevant information. Several outbreak-related articles were published in *Eurosurveillance* [4,5] and the German *Epidemiological Bulletin*. The public was regularly informed about the outbreak situation via the RKI website starting on 23 May, press releases were issued on 3 and 10 June. The Federal Centre for Health Education (Bundeszentrale

für Gesundheitliche Aufklärung, BZGA), has provided outbreak-related public health advice to the public since 24 May.

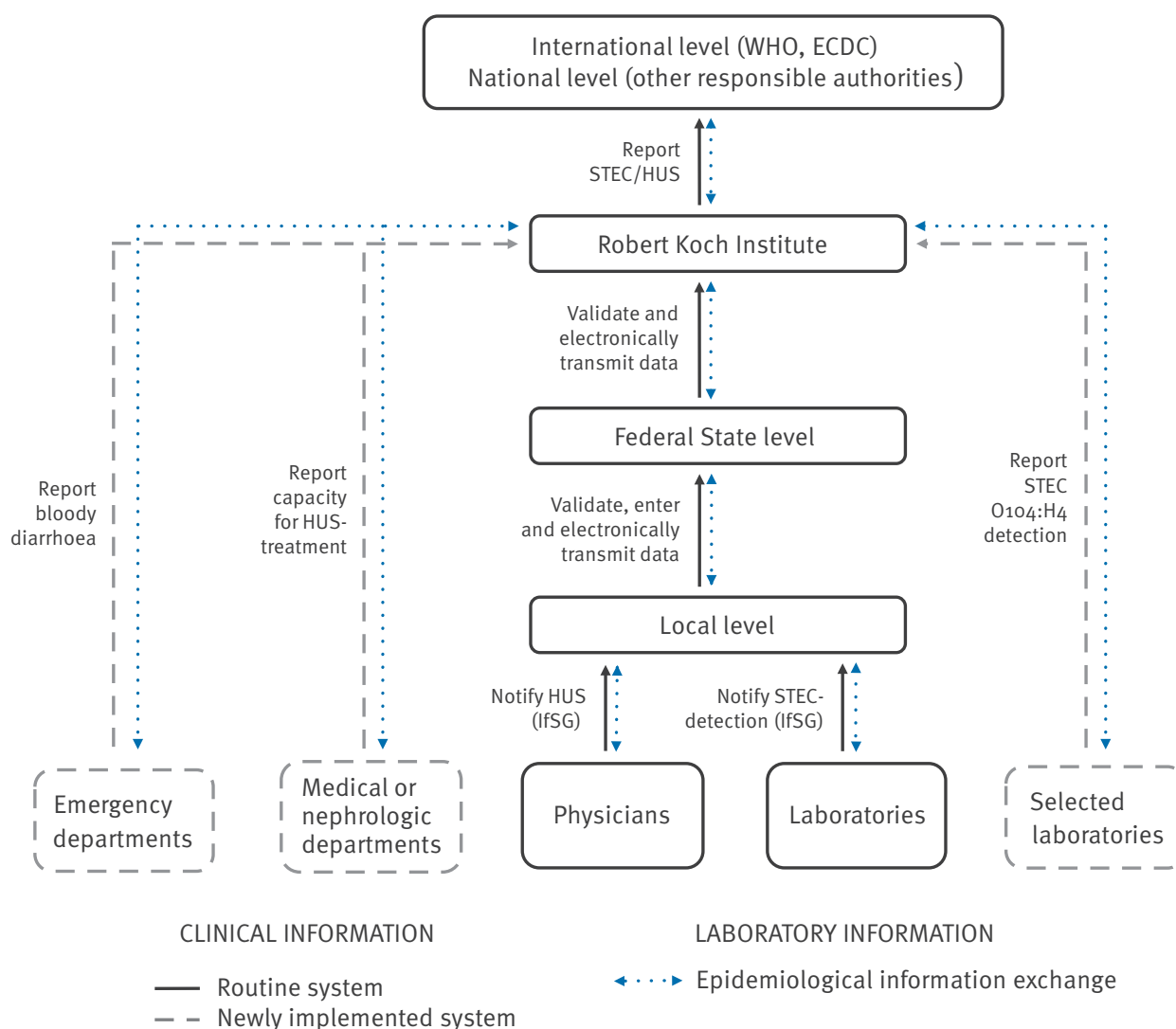
Accelerating the data flow to the national level

From 23 to 27 May 2011, state health authorities were asked to transmit aggregated data via email on a daily basis to the RKI. Concurrently, health authorities were urged to enter and transmit the IfSG data via the electronic surveillance system daily, so that case by case reporting could overtake the aggregated reporting on 27 May. A specific reporting form was published on 26 May to facilitate notification of HUS cases by physicians.

In addition, the existing RKI surveillance case definition was adapted to the outbreak situation to ensure systematic data collection. Modifications included

FIGURE 1

Data and information flow to and from the Robert Koch Institute during the period of enhanced surveillance, STEC/HUS outbreak, Germany, spring 2011



ECDC: European Centre for Disease Prevention and Control; HUS: haemolytic uraemic syndrome; IfSG: German Protection against Infection Act; STEC: Shiga toxin-producing *Escherichia coli*; WHO: World Health Organization.

limitations of time (onset of disease from 1 May 2011), place (epidemiological link to Germany) and person (e.g. consumption of a food item that was acquired in Germany) concerning exposure as well as inclusion of suspected cases [6].

One challenge was counting outbreak-related cases of STEC/VTEC O104:H4 separately from other STEC/VTEC cases, of which a mean of 992 cases annually had been reported to the RKI between 2001 and 2010. In the absence of comprehensive laboratory data for a majority of reported cases, the case definition was revised in a way that listed as exclusion criteria all specific laboratory test results that were not consistent with the characteristics of the outbreak strain.

As of June 12, a total of 3,228 STEC/VTEC and HUS cases in Germany have been associated with the outbreak (Figure 2). The majority of cases (51%) fell ill between 18 and 25 May. The place of exposure was suspected to lie in north-western parts of Germany for most cases (Figure 3). Of the 781 reported HUS cases, 69% were female and 88% were 20 years of age or older. Overall, 22 notified HUS cases have died. Among all 2,447 STEC/VTEC cases, 59% were female and 87% were 20 years of age or older. Thirteen notified STEC/VTEC cases have died.

Figure 4 shows the transmission delay in days from the local to the national level during the STEC/HUS outbreak period among HUS cases. Among the 740 HUS cases (96%) with known date of notification to the local health authorities, the median transmission delay was two days (25th–75th percentile: 1–4 days, minimum–maximum: 0–18 days). The first HUS-case was reported to the RKI through the electronic surveillance system on 18 May. Another three HUS cases were reported on 23 May. Thereafter, the accelerated

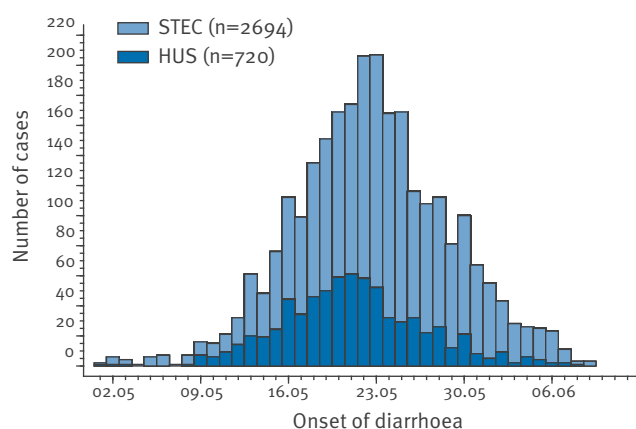
data flow became evident, for instance, 47 HUS cases were reported to the RKI on 24 May, 50 HUS cases on 25 May, 100 HUS cases on 26 May and 116 HUS cases on 27 May.

Implementing a syndromic surveillance system for bloody diarrhoea in emergency departments

Since STEC patients often present with bloody diarrhoea, emergency departments (ED) constitute appropriate facilities for the assessment of the temporal trend of an STEC-outbreak. We implemented the surveillance of patients with and without bloody diarrhoea in ED on 27 May.

Participating ED were located in all federal states of Germany, both in areas affected and not affected by the STEC/HUS outbreak (see Figure 4). Data collection covered the total number of new patients in participating ED and the number of patients presenting with bloody diarrhoea by sex and age group (<20 years, ≥20 years). The data were transferred to the RKI by email or fax every day.

FIGURE 2
Reported STEC/VTEC and HUS cases, by date of onset of diarrhoea^a, Germany, May–June 2011 (n=2,694)

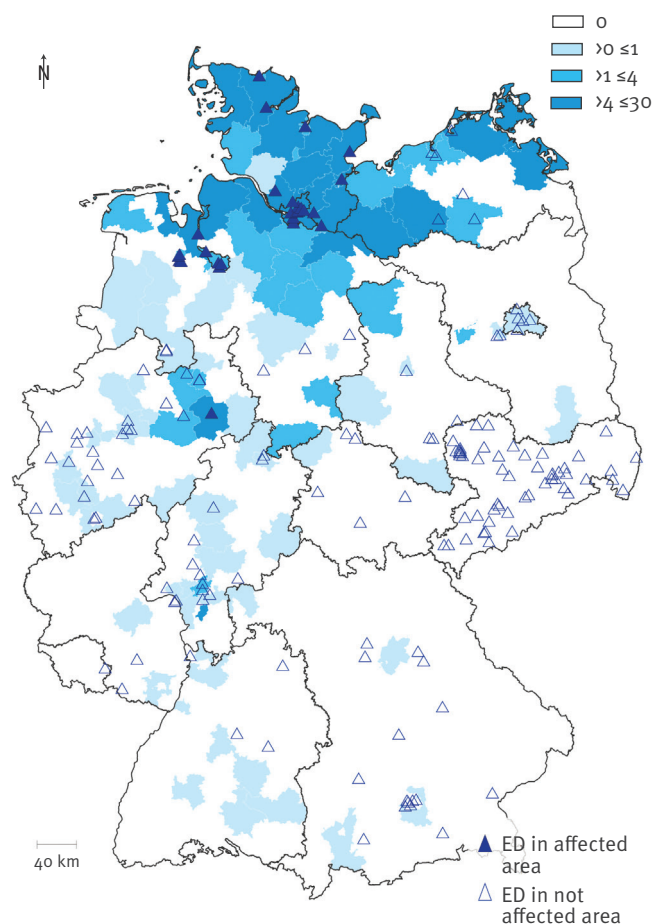


ED: Emergency department; HUS: haemolytic uraemic syndrome; STEC: Shiga toxin-producing *Escherichia coli*.

^a Only cases with a notified date of onset since 1 May 2011.

FIGURE 3
Cumulative incidence of HUS cases per suspected county of exposure and emergency departments actively participating in the syndromic surveillance system, Germany, May–June 2011

HUS incidence per suspected county of exposure (case/100,000 pop.)

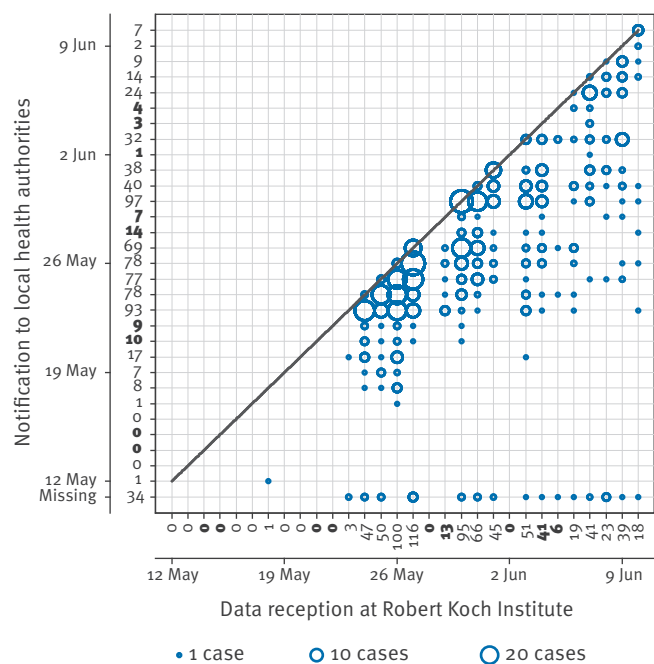


ED: Emergency department; HUS: haemolytic uraemic syndrome; STEC: Shiga toxin-producing *Escherichia coli*.

As of 12 June, a total of 174 ED have participated in the syndromic surveillance system; 27 of which were located within affected areas. The number of ED actively reporting varied from day to day. Thus results

FIGURE 4

Date of notification of HUS cases to local health authority in relation to date of reception at Robert Koch Institute, Germany, May–June 2011



HUS: haemolytic uraemic syndrome; PH: public holiday; STEC: Shiga toxin-producing *Escherichia coli*; WE: weekend.

Weekends and public holidays in bold; the x- and y-axis additionally show the number of reports received.

The size of the circle is equivalent to the number of cases (examples for 1, 10 and 20 cases shown in the legend).

may change as further, re-tro-spective, reports are received from ED. Between 28 May and 12 June, 4.7% (744/15,884) of all patients presenting to ED in affected regions were reported as having bloody diarrhoea (Figure 5); this proportion was 0.8% (464/55,255) in non-affected regions. Figure 5 shows the sex and age distribution of patients with BD as well as the number of participating ED in affected areas. Women were affected more often than men, with a decreasing proportion of female cases observed after 30 May. Since 6 June, the proportion of all patients with bloody diarrhoea among the patients presenting to emergency departments has remained on an average of 3.6%.

Assessing the capacities for treatment of haemolytic uraemic syndrome in Germany

From 30 May onwards, the German Society for Nephrology collected data on the HUS treatment capacities in Germany and reported these regularly via e mail to the RKI. During the outbreak period, 79 hospitals, located in 15 of the 16 federal states, provided almost daily information: all but two confirmed having sufficient capacities for treating HUS patients.

Initiating active laboratory surveillance

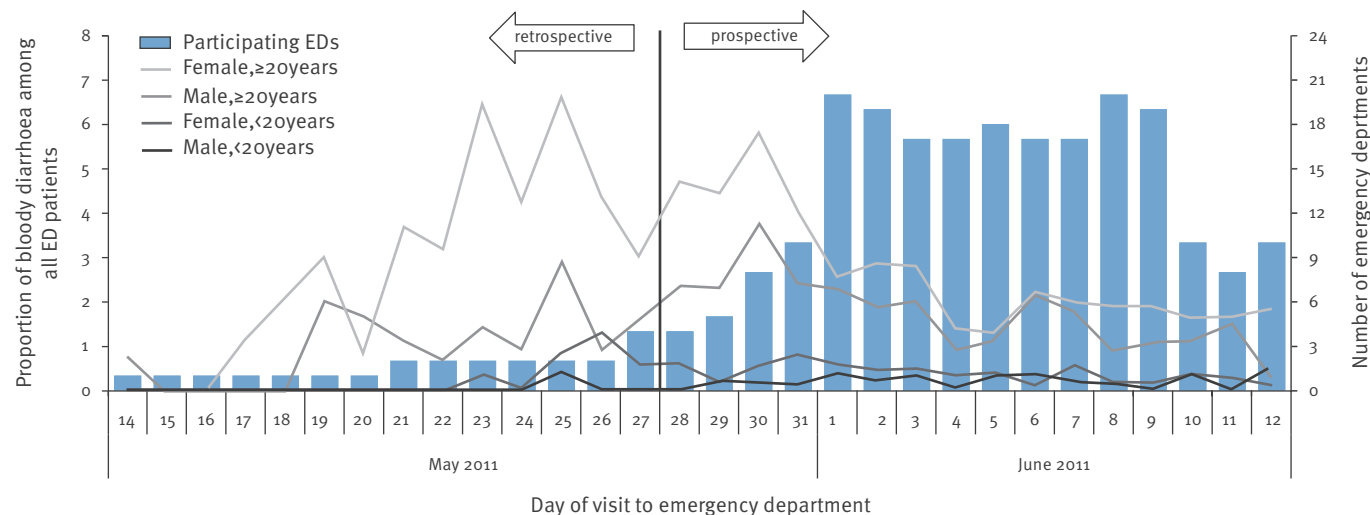
Since 25 May, the RKI has asked four laboratories for daily data transfer per email or telephone. As of 12 June, a total of 195 (6%) of all 3,228 STEC/HUS cases have been confirmed through the routine mandatory system as caused by the outbreak strain STEC/VTEC O104, whereas the active system provided evidence that at least 335 patient samples were related to the outbreak strain.

Reports to the European Union and the World Health Organization

Following international law, Germany informed the European Union (EU) of the STEC/HUS outbreak via

FIGURE 5

Proportions of patients with bloody diarrhoea among all patients presenting to emergency departments, by age and sex, in areas affected by the STEC/HUS outbreak, Germany, May–June 2011 (n=744)



D: emergency department; HUS: haemolytic uraemic syndrome; STEC: Shiga toxin-producing *Escherichia coli*.

the Early Warning and Response System (EWRS) on 22 May 2011, and notified the event as a potential public health emergency of international concern within the framework of the International Health Regulations (IHR) 2005 on 24 May. The RKI sent updates on the situation to EWRS, the Epidemic Intelligence Information System (EPIS) and the World Health Organization (WHO) on a daily basis.

Both the European Centre for Disease Prevention and Control (ECDC) and the WHO immediately supported the outbreak investigations by staying in close contact with Germany and other countries and reporting imported STEC/HUS cases (in travellers) associated with the outbreak.

Conclusions

Germany has a well established broad statutory surveillance system for infectious diseases. However, the rather long time limits permitted for communicating information on cases from the local to the state/national level led to delayed recognition of this outbreak: The first report at the national level was received on 18 May 2011, while the first outbreak-associated cases fell ill on 1 May, with a sharp increase in case numbers on 9 May. This is a limitation requiring further evaluation. In this specific outbreak situation, the mandatory surveillance system required enhancement that was rapidly and effectively implemented. Physicians, laboratories, local and state health authorities supported the acceleration and extension of the system extraordinarily well. Feedback to the public, the responsible authorities, physicians and laboratories was ensured daily, e.g. by updates on websites, teleconferences and reports.

The additional surveillance instruments were voluntary and allowed for more timely monitoring of this public health emergency. Laboratory surveillance permitted assessment of the actual number of laboratory-confirmed outbreak cases particularly in the early stages. Monitoring capacity for treating HUS patients in German hospitals allowed us to evaluate whether or not international help would be needed. Syndromic surveillance in ED permitted us to follow the temporal trend of bloody diarrhoea patients as a proxy for potentially new STEC/VTEC cases.

We conclude that infectious disease surveillance in Germany can rapidly be adapted to specific outbreak situations. Nevertheless, data flow within the statutory surveillance system should be accelerated, e.g. by use of an electronic notification system by physicians and laboratories, and a common central data base. We recommend continuing syndromic surveillance in ED for at least the next three months to ensure timely detection of possible new trends.

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HUS surveillance and laboratory team

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