



## Hepatitis A outbreak among MSM in Berlin due to low vaccination coverage: Epidemiology, management, and successful interventions



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### ABSTRACT

**Objectives:** To describe the characteristics of a large hepatitis A virus (HAV) outbreak among men who have sex with men (MSM) in Berlin and to assess the impact of measures implemented.

**Methods:** Cases of laboratory-confirmed, symptomatic HAV infection notified in Berlin, Germany between August 2016 and February 2018 were analysed using routine and enhanced surveillance data including genotyping results. Several studies involving different groups of participants were conducted to further investigate the outbreak, including surveys on knowledge and practices of HAV vaccination among physicians and vaccination coverage and determinants of vaccination status among MSM. The measures implemented were categorized by target group in a Gantt chart. To assess their impact, health insurance data on HAV vaccination uptake were analysed, comparing Berlin and other federal states.

**Results:** During the outbreak period, a total of 222 cases were reported (of which 91 were sequence-confirmed), with a peak in case numbers in January 2017. Physicians were aware of the existing vaccination recommendations, but vaccination coverage among 756 MSM was low, with 32.7% being completely vaccinated and 17.3% being incompletely vaccinated before 2017. HAV vaccination before 2017 was associated with being born in Germany (odds ratio 2.36) and HIV-positive (odds ratio 1.80). HAV monovalent vaccination uptake increased by 164% from 2016 to 2017 among males in Berlin, compared to 7% in other federal states.

**Conclusions:** Multiple measures targeting the MSM community, physicians, and public health to increase HAV vaccination uptake were successfully implemented. To prevent future HAV outbreaks, we recommend monitoring vaccination coverage among MSM, promoting awareness of existing recommendations among physicians, and ensuring access for foreign-born and young MSM.

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### Introduction

Hepatitis A virus (HAV) is transmitted via the faecal–oral route, through direct person-to-person contact, or through contaminated

food or water. Germany has a low incidence of hepatitis A, and infection is often associated with travel to endemic countries. Outbreaks of hepatitis A among men who have sex with men (MSM) have occurred sporadically in cities across Europe (Sfetcu et al., 2011; Tortajada et al., 2012; Dabrowska et al., 2011) and have been associated with casual sex with multiple partners (Mazick et al., 2005; Beebeejaun et al., 2017). A safe and effective vaccine has been available since the 1990s and is also recommended in Germany for individuals at increased risk due to sexual activity, including MSM (Robert Koch-Institut (RKI), 2016).

In December 2016, an increase in the number of hepatitis A cases in Berlin was observed by the Berlin State Office for Health and Social Affairs (SOHSA), with 92% of affected individuals being male. Enhanced surveillance at the regional level showed that a large proportion of the individuals were MSM (Werber et al., 2017). An increase in cases of hepatitis A among MSM following the EuroPride festival in Amsterdam in 2016 had previously been reported from the United Kingdom (Plunkett et al., 2019; Beebeejaun et al., 2017) and the Netherlands (Freidl et al., 2017) via the European Union (EU) Early Warning and Response System (EWRS) and the Epidemic Intelligence Information System for Food and Waterborne Diseases and Zoonoses (EPIS-FWD) of the European Centre for Disease Prevention and Control (ECDC) (Ndumbi et al., 2018). A total of 4475 confirmed cases infected with one of three HAV genotype Ia outbreak strains (VRD\_521\_2016, RIVM-HAV16-090, V16-25801) were reported from 22 European countries between June 2016 and September 2018 (European Centre for Disease Prevention and Control, 2018).

In early January 2017, notifications of new cases among MSM continued at an unusually high level in Berlin, and treating physicians raised concerns about possible breakthrough infections among vaccinated individuals. In Germany and particularly in Berlin, a significant proportion of MSM receive their routine care from physicians with specialist expertise in HIV and infectious diseases. HIV-specialist physicians in Berlin are organized in a working group (Arbeitskreis AIDS (AK AIDS)), which ensures continuing specialist education with regular lectures (<http://www.ak-aids-berlin.de/>). Among German cities, Berlin features the largest MSM population ( $n = 80\,000$  MSM (95% confidence interval 74 000–104 000) aged 20–59 years as of 2009) (Marcus et al., 2009; Scholz et al., 2019), with a high concentration of gay clubs, shops, and other venues in some quarters of central Berlin, and a gay party scene highly interconnected to other large European cities. Nearly half (91 of 200) of all sequence-confirmed cases in the outbreak in Germany were notified in Berlin.

In order to investigate and control the outbreak, an interdisciplinary team including experts from the RKI, SOHSA, the local public health authorities, and medical doctors as representatives of AK AIDS was set up. Several studies involving different groups of participants were conducted.

Early case interviews showed that mostly young and middle-aged men self-identifying as MSM were affected and revealed a high proportion of individuals who were born abroad (63%) and HIV-positive (56%). Overall, the affected individuals reported good access to healthcare; 92% were covered by health insurance and 90% had a primary healthcare provider. Most MSM reported that their healthcare provider was aware that they were MSM (87%). They reported frequent use of dating apps to find sex partners and visits to gay saunas or venues where sex on site with multiple, anonymous partners was common. Knowledge of HAV risks and prevention including vaccination recommendation was poor among affected MSM, with less than 20% of them being aware of the recommendation (Thoulass et al., 2018).

Specific aspects of this outbreak in several countries have already been published (Freidl et al., 2017; European Centre for Disease Prevention and Control (ECDC), 2016; European Centre for

Disease Prevention and Control, 2017a; Ndumbi et al., 2018; Charre et al., 2017). Publications referring to the German outbreak have included (1) an early description in a rapid communication (Werber et al., 2017), (2) results of a cross-sectional study among hepatitis A cases and a case cohort study comparing a subgroup of these cases to a reference cohort of MSM to characterize the affected population and investigate risk factors (Thoulass et al., 2018), and (3) results of a social media campaign using dating apps to raise awareness among the MSM community (Ruscher et al., 2019).

This article brings together the different strands of the outbreak investigation and management to fully describe the characteristics of the Berlin outbreak among MSM, including already published and not yet published data, and to discuss causes and the impact of prevention measures in order to make recommendations for future prevention.

## Methods

Hepatitis A has been a notifiable disease in Germany since 2001. A descriptive analysis of data from routine and enhanced surveillance and HAV genotyping was conducted. Information from routine notification data included patient age and sex, symptoms, and dates of notification, diagnosis, and disease onset. In a subset of cases, enhanced surveillance by the local public health departments revealed information on MSM status, whether the patient had sex with men in the likely period of infection, sex outside the patient's household (e.g., clubs), hepatitis B vaccination status, and recreational drug use in the likely period of infection.

HAV genotyping is not done routinely in Germany. During the outbreak, public health authorities, laboratories, and physicians were asked to submit samples (plasma, serum, or stool) for HAV sequencing to the National Consultant Laboratory for Hepatitis A and Hepatitis E in Regensburg. Nucleic acid isolation, quantitative reverse transcription PCR (RT-qPCR), and sequencing were conducted as described elsewhere (Harries et al., 2014; Marosevic et al., 2019).

A confirmed case was defined as a laboratory-confirmed symptomatic HAV infection with one of the specific outbreak strains (VRD\_521\_2016, RIVM-HAV16-090, V16-25801) notified in Berlin, and a date of symptom onset (or if missing, date of diagnosis) after July 31, 2016. A probable case was defined as a laboratory-confirmed symptomatic HAV infection (without sequencing information) notified in Berlin, with symptom onset (or if missing, date of diagnosis) after July 31, 2016 in a person who self-identified as MSM. A possible case was defined as a laboratory-confirmed symptomatic HAV infection in a male patient between 18 and 65 years of age notified in Berlin, for whom sequence data were not available and who did not self-identify as MSM.

The period of the outbreak was defined as beginning August 1, 2016 (coinciding with the beginning of a 6-month continuous rise in monthly hepatitis A cases in males) and ending February 28, 2018 (two full calendar months without confirmed or probable cases notified in Berlin).

In order to investigate different aspects of the outbreak, several studies were conducted, two of them among healthcare providers. The first was a survey among healthcare providers on knowledge and practices of HAV vaccination (KAP survey). This cross-sectional survey on knowledge and practices of HAV vaccination was conducted among specialist HIV physicians of AK AIDS in Berlin from February to March 2017. Anonymous questionnaires were sent out to 60 physicians, which included 15 questions on sources of information used regarding the hepatitis A outbreak, number of patients with acute HAV infection since November 2016, breakthrough infections in immunized patients, post exposure prophylaxis (PEP) of contact persons, awareness of hepatitis A vaccination

recommendations for MSM, vaccines used, and vaccine acceptance of the patients in the respective practice. A descriptive analysis of returned questionnaires was performed using standard spreadsheet software.

The second study was a vaccination coverage study. To estimate the hepatitis A and B vaccination coverage among MSM in Berlin, a cross-sectional study was conducted from mid-May to mid-June 2017. Data were collected through HIV-specialist physicians and other physicians who also treated outbreak patients. Physicians were asked to collect anonymized information on hepatitis A and B vaccination status (including dates of vaccination), history of HAV infection, HIV status, age, and country of birth for each MSM patient aged 18 years and older consulting them on a single day of observation during the study period. For sample size calculation, an underlying vaccination rate of 50% was presumed, and it was determined that a statistically significant difference between groups of 20% would be meaningful in terms of the impact it might have on future interventions. Estimation for a two-sample proportion test with  $\alpha = 0.05$  and power 90% resulted in a sample size of 270. In order to allow for stratification by age and country of birth (born in Germany versus born abroad), a sample size of 1080 in total was calculated.

Data were collected using a paper-based questionnaire and sent to the RKI. Data were entered into EpiData software (EpiData Association, Odense, Denmark; <http://www.epidata.dk>) and analysed using Stata SE15 (StataCorp, College Station, TX, USA). Descriptive analyses on last HAV vaccination by year and on completeness of vaccination status were performed. In univariable and multivariable logistic regression (excluding those with a history of HAV infection), associations between having been HAV vaccinated before 2017 and age, HIV status, and country of birth were examined.

#### Overview of all activities to investigate and control the outbreak

An overview of the activities undertaken to investigate and manage the outbreak is provided. All measures undertaken between January 2017 and March 2018 were categorized by target group (healthcare providers, MSM community in Berlin, including gay clubs and venues in Berlin, the public health community, and the broader public); these were then summarized in a Gantt chart. A detailed list of all activities is included in the Supplementary Material.

#### Analysis of health insurance refund claims on HAV vaccination uptake

All 17 regional Associations of Statutory Health Insurance Physicians (ASHIPs) receive insurance refund claims from physicians for ambulatory medical services including vaccinations given to individuals with statutory health insurance (approximately 85% of the population in Germany) (Rieck et al., 2014). Within the vaccination monitoring system 'KV-Impfsurveillance', pseudonymized data including sex, year and month of birth, vaccine type,

and date of vaccination are collected in a central database at the RKI. Based on these data, HAV vaccine uptake was calculated by number of doses given to adults 18–59 years of age, stratified by sex, vaccine type (monovalent or HAV/hepatitis B virus (HBV) bivalent vaccine), and ASHIP administrative region (these are aligned to the federal states, with the exception of the federal state of North Rhine-Westphalia which has two ASHIPs). HAV vaccine uptake in Berlin was compared to the mean uptake of 10 other ASHIP regions for which data were available for the years 2016 and 2017 to evaluate the impact of our activities on vaccine uptake. For a detailed analysis of the vaccine uptake before, during and after the outbreak, HAV monovalent vaccine uptake was also calculated for Berlin per month for the period January 2016 to March 2019.

## Results

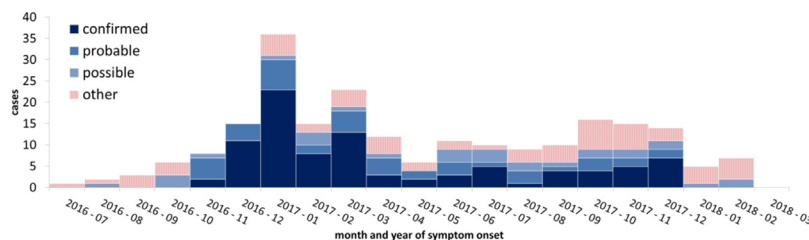
### Outbreak description

Between August 1, 2016 and February 28, 2018, a total of 222 cases of hepatitis A were notified in Berlin. Among these, 91 (41.0%) fulfilled the definition of a confirmed case (sequencing revealed one of the three outbreak strains). Among the sequence confirmed cases, the most common sequence was V16-25801 (44.0%,  $n = 40$ ), followed by VRD\_521 (33.0%,  $n = 30$ ) and RIVM-HAV16-090 (23.1%,  $n = 21$ ). The mean age of the individuals was 34.7 years (range 17–65 years) and they were predominantly male ( $n = 87/91$ , 95.6%). Among those who could be interviewed by local health authorities in the context of enhanced case surveillance, 61/72 (84.7%) self-identified as MSM and/or reported having had sex with men 15–50 days before symptom onset. Recreational, non-intravenous drug use was reported by 5/61 (8.2%). Nine of the 91 individuals (9.9%) had a history of travel outside Germany during the assumed period of infection. Twenty-five of 38 with available information (65.8%) reported having had sex in venues (i.e., clubs, gay saunas, etc.). Most (69/83, 83.1%) were not vaccinated against HAV. Of the remaining 14 individuals, 11 had received only one dose and one had received two doses of HAV/HBV bivalent vaccine; the number of doses and type of vaccine was unknown for two cases.

In addition to the confirmed cases, 44 male hepatitis A patients who self-identified as MSM during interviews were notified without sequencing information. These were classified as probable cases. The epidemic curve in Figure 1 shows that the month of disease onset of confirmed and probable cases ranged between November 2016 and December 2017, with a peak in January 2017. The latest date of onset of a confirmed or probable case was December 28, 2017.

### KAP survey among healthcare providers

Of 60 HIV specialist physicians in Berlin who were invited to participate, 43 responded (71.7%), with a similar distribution of family medicine (51%) and internal medicine doctors (49%). Of the respondents, 48.8% ( $n = 21$ ) had diagnosed acute HAV infections



**Figure 1.** Notified cases of hepatitis A by year and month of disease onset and case definition; Berlin, Germany, July 2016 to March 2018. 'Other' represents notified cases of hepatitis A that did not fulfil any of the outbreak case definitions for a confirmed, probable, or possible case.

among their patients since November 2016; in total, 80 patients had been diagnosed by the responding MDs (mean 3.8 patients, range 1–14 patients per MD). Six physicians reported possible breakthrough infections among vaccinated patients; however among notified cases of HAV, no breakthrough infections could be confirmed. All physicians indicated generally offering HAV vaccination to patients (100%), and 93.0% ( $n = 40$ ) knew that HAV vaccination is recommended for MSM. More than half of the physicians ( $n = 23$ ; 53.5%) reported that some patients had refused recommended vaccinations. The most common reasons for vaccine refusal were fear of side effects, a general reluctance to be vaccinated, and assumingly not being at risk of infection. Since the start of the outbreak, three respondents had provided HAV-PEP to contacts of cases.

#### Vaccination coverage study

Of 69 HIV-specialist physicians who were invited to participate in the study, 38 from 23 practices responded, resulting in a response of 55.1%. Data were collected from 756 MSM with a median age of 43 years (interquartile range 34–52 years). Overall, 69% were born in Germany and 28% were born abroad. Among those born in Germany, 65% were HIV-positive compared with 51% among those born abroad ( $p < 0.0001$ ). Of 756 MSM, 12 (1.6%) had a current HAV infection and 113 (14.9%) reported a history of HAV infection before 2017.

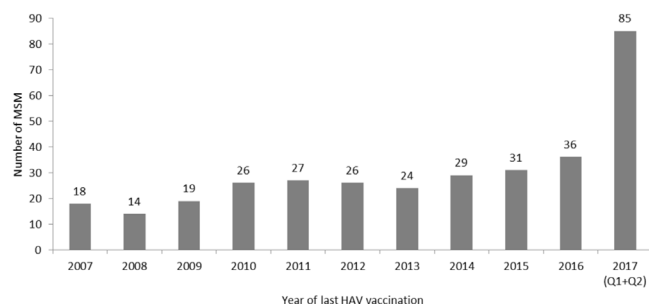
Figure 2 shows the number of MSM vaccinated by time of the last dose. Almost three times more HAV vaccinations were provided to MSM during the first two quarters of 2017 ( $n = 85$ ) as compared to the mean number of the previous five years 2012–2016 ( $n = 29$ ). In total, 12 HAV vaccination doses were provided on the respective study days.

Before 2017, complete HAV vaccination coverage was 32.7% and incomplete coverage was 17.3%, and these increased to 38.2% and 20.3%, respectively, by the time of the study (mid-2017). In addition, HAV vaccination was reported but with unknown completeness in 21.8% of MSM before 2017 and in 21.4% in mid-2017.

After adjusting for age, a higher chance of being vaccinated against HAV before 2017 was found in those born in Germany (odds ratio 2.36) and HIV-positive (odds ratio 1.80) compared to those born abroad and HIV-negative. Details can be found in Table 1.

#### Outbreak investigation and control activities

All outbreak investigation and control activities are presented in a Gantt chart in Figure 3. A detailed list of all measures is included in the Supplementary Material (Table S1).



**Figure 2.** Number of MSM who received at least one dose of hepatitis A virus (HAV) vaccine by year of last dose, years 2007–2017, total  $N = 335$ . Vaccination coverage study, Berlin 2017.

**Table 1**

Determinants of vaccination status before 2017 among MSM: results of multivariable logistic regression analysis—vaccination coverage study, Berlin, 2017 ( $n = 524$ ).

Variable	Number	Vaccinated, $n$ (%)	OR	$p$ -Value	95% CI
Place of birth					
Abroad	135	95 (70.4)	Ref.		
Germany	389	337 (95.1)	2.36	0.002*	1.38–4.04
HIV status					
Negative	183	138 (75.4)	Ref.		
Positive	327	287 (87.8)	1.80	0.024*	1.08–3.00
Unknown	14	7 (0.5)	0.23	0.013*	0.07–0.74
Age group (years)					
<30	84	55 (65.5)	Ref.		
30–39	152	124 (81.6)	2.38	0.008*	1.25–4.52
40–49	131	120 (91.6)	4.37	<0.001*	1.95–9.76
50–59	118	103 (87.3)	2.21	0.046*	1.02–4.82
60+	39	30 (76.9)	1.04	0.930	0.41–2.67

MSM, men who have sex with men; OR, odds ratio; CI, confidence interval.  $p < 0.05$ .

#### Assessment of the impact of activities: HAV vaccine uptake

The annual number of monovalent HAV vaccinations provided to adults increased from 2016 to 2017 in Berlin, by 163.8% for males and 26.3% for females. Regarding hepatitis A/B bivalent vaccinations, the increase was 26.5% for males and 6.5% for females. In all other analysed ASHIP regions, monovalent vaccinations increased by 7.4% and 3.3%, and bivalent vaccinations decreased by 2.2% and 3.8%, in males and females, respectively (Table 2).

Over the course of the year 2016, the monthly numbers of monovalent vaccinations were stable, with a mean number of 105 (range 82–118) doses per month in males and 83 (range 65–112) in females. Over the year 2017, the increase in monthly monovalent vaccinations among adult males in Berlin in comparison to females started in January 2017, with a first peak in March ( $n = 237$ ) and a second peak in July 2017 ( $n = 380$ ). This was followed by an overall decrease until May 2018, and an average number of 186 in the following months, thus remaining above the baseline level before the outbreak. Vaccination numbers in females also increased in 2017, but at a lower level (peak in July 2018,  $n = 144$ ) (Figure 4).

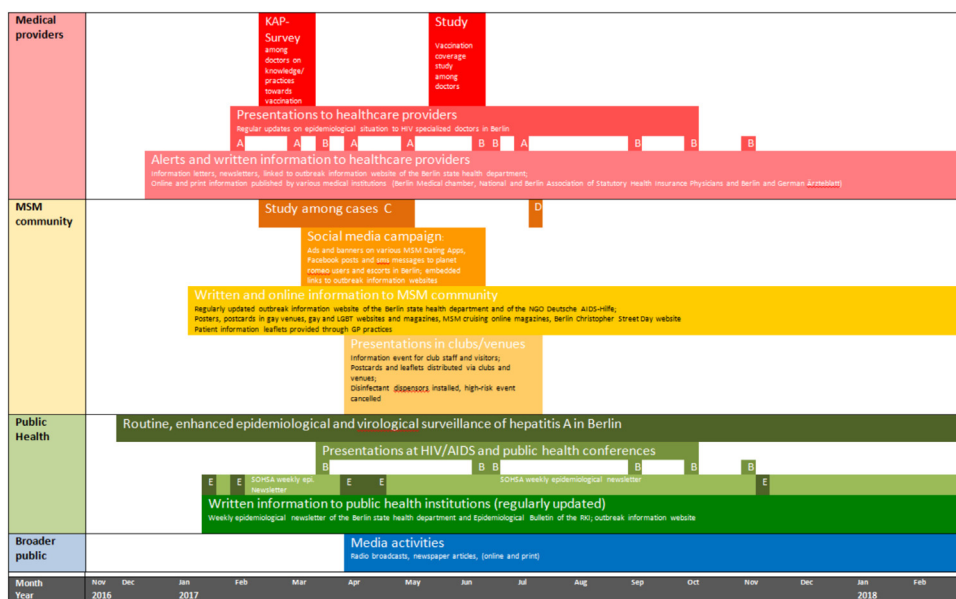
A comparable increase in vaccinated males in 2017 compared to 2016, in particular with monovalent vaccination, was not observed in any other federal state (Table 2).

#### Discussion

Following the EuroPride festival in Amsterdam in 2016, several European countries were affected by a large outbreak of hepatitis A among MSM (Freidl et al., 2017; European Centre for Disease Prevention and Control (ECDC), 2016; European Centre for Disease Prevention and Control, 2017a; Ndumbi et al., 2018). In Berlin, the outbreak peaked in 2017 and patient interviews revealed that mostly non-vaccinated individuals were affected who had practised high risk behaviours such as having frequently changing sex partners or sex with multiple (anonymous) partners in sex-on-site venues or through online dating (Werber et al., 2017), similar to reports from other countries (Plunkett et al., 2019; Ndumbi et al., 2018).

Given that Germany recommends hepatitis A vaccination for persons at increased risk due to sexual activity (Robert Koch-Institut (RKI), 2016), the present investigation focused on two key areas: (1) why were levels of vaccination suboptimal and (2) what measures were effective in improving vaccine uptake?

The KAP survey among HIV-specialized doctors in Berlin conducted at the beginning of the outbreak showed that physicians were generally well informed about the HAV vaccination

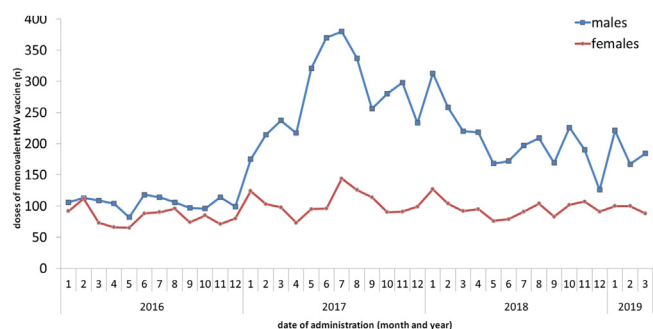


**Figure 3.** Gantt chart of the outbreak investigation and control activities in Berlin, November 2016 to February 2018.  
 A Presentations during meetings of the formal HIV working group of medical doctors in Berlin (AK AIDS): regular updates on epidemiological situation to HIV specialized doctors in Berlin.  
 B Presentation at various national/international conferences and meetings of HIV/Viral hepatitis specialized doctors & medical society/Public Health.  
 C Cross-sectional study among outbreak cases (22.02.–02.05.2017), aim: to characterize the affected population, telephone interviews with structures questionnaire on sociodemographic information, symptoms, health, vaccination, risk factors, contacts and knowledge about hepatitis A risk factors and protective measures. Further information: (Thoulass et al., 2018).  
 D Information booth and survey among visitors of the Gay & Lesbian street festival Berlin (15–17 July, 2017), to assess their knowledge regarding the outbreak and vaccination. Further information: (Ruscher et al., 2019).  
 E Publications (German and English), see references: (Werber et al., 2017; Hillienhof, 2017); SOHSA weekly epidemiological newsletter; Article in Deutsches Ärzteblatt (“News”): <https://www.aerzteblatt.de/nachrichten/74045/Hepatitis-A-Ausbruch-in-Berlin-Impfluecken-befuerchtet>; RKI Epidemiological Bulletin.  
 For more detailed information of activities, see Table S1 in supplementary material.

**Table 2**  
 Yearly number of HAV monovalent and hepatitis AB bivalent vaccinations in male and female individuals 18–59 years of age and the percentage increase in Berlin versus the mean of 10 other ASHIP regions<sup>a</sup>, 2016 and 2017.

Sex	ASHIP region	HAV monovalent vaccinations			Hepatitis AB bivalent vaccinations		
		2016	2017	Increase (%)	2016	2017	Increase (%)
Male	Berlin	1258	3318	163.8	3659	4628	26.5
	Other <sup>a</sup> (mean)	1417.4	1522.8	7.4	8190.0	8013.8	–2.2
Female	Berlin	992	1253	26.3	2385	2539	6.5
	Other <sup>a</sup> (mean)	1927.0	1991.0	3.3	10 128.8	9741.1	–3.8

HAV, hepatitis A virus; ASHIP, Associations of Statutory Health Insurance Physicians.  
<sup>a</sup> Other ASHIP regions include those with available data, as of November 6, 2019: Baden-Württemberg, Bavaria, Brandenburg, Bremen, Mecklenburg-Western Pomerania, Northrhine, Saarland, Saxony-Anhalt, Schleswig-Holstein, Thuringia.



**Figure 4.** Doses of monovalent HAV vaccination administered to adults 18–59 years of age by sex and date of administration, Berlin, January 2016 to March 2019.

recommendation including patients with sexual risk factors. However, queried later in the vaccination coverage study, the same doctors indicated that HAV vaccination was not regularly provided to MSM or to HIV patients. Only one third of the MSM population attended by doctors on the survey days were fully vaccinated against HAV, although all were covered by health insurance and therefore could have been vaccinated free of charge. There are several possible explanations. The risk and severity of HAV infection might have been underestimated by physicians and therefore vaccination may not have been offered. A previous study showed that the majority of eligible MSM who were not HAV vaccinated had not been offered the vaccine by their physician; in addition, for more than half of them, no reason was stated for them not having received the vaccine (Burrell et al., 2019). Doctors who participated in the current study survey reported that a subgroup

of patients refused HAV vaccination or vaccination in general, similar to [Burrell et al. \(2019\)](#). General vaccine hesitancy was found in 23% of participants in a representative survey in Germany ([Horstkötter et al., 2019](#)). Another study found that MSM accepted vaccination more frequently when HAV vaccination was offered free of charge versus paid (89% versus 11%, respectively;  $p < 0.001$ ) ([Alberts et al., 2019](#)). It may not always be known that for MSM the vaccination against hepatitis A is effectively free, as it is reimbursed by the Statutory Health Insurance. As shown by the case interviews, MSM had limited awareness of the vaccination recommendation. Doctors, however, seem to play a crucial role in engaging their patients: MSM who were informed by their physician about the HAV outbreak were more likely to be vaccinated as compared to those informed by other sources ([Ruscher et al., 2019](#)). Doctors' advice was the strongest motivation for vaccination in another study ([Horstkötter et al., 2019](#)). It is furthermore likely that the HIV-specialized doctors in Berlin were already sensitized because they had previously been involved in an outbreak of invasive meningococcal serogroup C disease among MSM in Berlin ([Koch et al., 2016](#)).

Similar to other studies ([Burrell et al., 2019](#)), the present study also showed that the chance of being vaccinated against HAV before 2017 was lower in MSM under 30 years of age, those born abroad, and the HIV-negative. The higher vaccination rates among HIV-positive individuals can be explained by the fact that they have an additional indication to be vaccinated ([Robert Koch-Institut \(RKI\), 2016](#)) and probably are regularly followed up by HIV specialists. We hypothesize that MSM over 30 years of age may have had a higher chance of vaccination due to previous travel to endemic countries, better knowledge of the importance of vaccination, and more frequent medical consultations compared to younger men. A high incidence of HAV infections among young males was also shown in the Italian HAV outbreak in 2016–2017 ([Lanini et al., 2017](#)), hinting at insufficient vaccination coverage and/or riskier behaviour in this subpopulation. Higher vaccination rates among German-born MSM compared to those born abroad could be related to better and more frequent access to health care. Access to health care could be limited for foreign-born individuals due to language barriers and lack of knowledge of the health system. The subgroup of young HIV-negative men born abroad might be reached better in the future with increasing numbers of HIV pre-exposure prophylaxis (PrEP) users, as shown in a recent study on HAV vaccine uptake among MSM in Melbourne ([Burrell et al., 2019](#)).

Low vaccination rates in the context of existing free vaccination were addressed through (1) increasing community demand for HAV vaccination, and (2) initiating provider-based interventions. To increase the demand for vaccination, we promoted HAV awareness and vaccine uptake in the MSM community through a widespread bilingual (German and English) information campaign, including print and social media ([Ruscher et al., 2019](#)). Measures aimed at reducing the spread of HAV were instituted in sex venues, including an information event with the outbreak team, installation of hand disinfectant dispensers, and cancellation of an international scat party, with the aim of preventing the further spread of HAV.

Provider-based interventions were targeted at HIV-specialist doctors in Berlin. They were alerted and informed by e-mail, letter, and in person during their regular meetings. Although the two doctors' studies were conducted to assess vaccination practices and coverage, they also likely had an impact on vaccination rates. The number of vaccinations among MSM under the care of HIV-specialized doctors increased sharply following the two studies in 2017, with some vaccinations being provided on the day of the survey.

Confirmed, probable, and possible cases had already decreased in April 2017, coinciding with increasing numbers of vaccinated

males. The increase in vaccination numbers was confirmed by analyses conducted from health insurance refund claims, showing an increase in HAV vaccinations among men during the second quarter of 2017 in comparison to 2016 and a marked increase in HAV monovalent vaccinations among men in Berlin, in comparison to females and to other federal states of Germany. Case numbers even decreased in July–August 2017, when we would have expected a new peak in transmission due to several gay community events in Berlin (e.g., Christopher Street Day, Gay and Lesbian Street Festival, some high risk events at sex venues) and international events ([European Centre for Disease Prevention and Control, 2017b](#)). In contrast, in other European countries affected by the outbreak, the peak in case numbers was observed from March through June 2017, and the decline only started in July ([European Centre for Disease Prevention and Control, 2018](#)). Hepatitis A incidence in Berlin returned to normal at the beginning of 2018.

According to records of health insurance claims, the higher rate of HAV monovalent vaccinations among males in Berlin was even sustained 2 years after the outbreak, indicating a lasting increase in awareness of medical doctors and the community. However, incomplete vaccinations need to be completed, and vaccination coverage needs to reach at least 70% to ensure protection through herd immunity and to prevent future outbreaks ([Regan et al., 2016](#)). Of importance, vaccination should be installed at sexually transmitted infection checkpoints and other low threshold facilities accessed by MSM who are not using the traditional health care system.

Some limitations of the results shown in this article need to be taken into account: self-reported data may be biased towards socially expected answers, and we may have overestimated the doctors' knowledge of the vaccination recommendation. Further, the HIV-specialist doctors who responded are likely to have been those who were most engaged, and we do not have any information on other general practitioners regarding their knowledge and practices. However, since participating doctors treated the majority of outbreak cases, they are likely representative of the physicians who provide care to this population. Finally, a detailed assessment as to the effect and usefulness of the different components of this outbreak investigation would be desirable to make recommendations for similar situations in the future. However, as shown, several measures were implemented in parallel, and actual behavioural effects in the population are multifactorial and difficult to measure. The relative contribution of each single activity remains unknown.

### Conclusions and recommendations

The outbreak of hepatitis A among MSM in Berlin was likely caused by several introductions of HAV into Berlin's international and interconnected MSM community, which at the time was insufficiently vaccinated and at high risk due to sexual practices. The main reasons for low vaccination coverage were insufficient awareness of medical care providers and limited knowledge of HAV risks and measures to prevent infection and transmission among MSM. In particular, young MSM, those born abroad, and HIV-negatives were at higher risk of not being vaccinated. This is all the more important when sexual risk behaviour increases in PrEP users ([Charre et al., 2017](#)).

A rapidly established range of measures was implemented to address these factors and was followed by a significant increase in HAV vaccinations among male adults in Berlin, which was an essential component of managing the outbreak. The outbreak investigation benefitted greatly from synergistic effects due to close collaboration of teams from different backgrounds including local, federal, and national public health authorities, health care,

non-governmental organizations, venues and clubs in Berlin, and the MSM community. We recommend monitoring HAV vaccination coverage among MSM, ensuring high levels of awareness of existing recommendations among physicians, and facilitating access for foreign-born and young MSM.

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## Ethical approval

The investigations described in this article were conducted in the framework of an outbreak investigation and surveillance activities according to the infection protection act. Approval by an ethics committee was thus not required.

## Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.ijid.2020.11.133>.

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