Sentinel Surveillance of Hepatitis Testing in England

-

Hepatitis B and D 2010 Report

Analysis of testing between 2007 and 2010

Health Protection Agency

Colindale

August 2011

Prepared by:

Sam Lattimore and Sarah Collins
Immunisation, Hepatitis and Blood Safety Dept.
Health Protection Agency,
Health Protection Services, Colindale

Executive Summary

This is the seventh annual HBV report, and the first HDV report from the sentinel surveillance of hepatitis testing study in England. This year, the focus is on trends in testing over the past four years (January 2007 to December 2010). For HBV, data from 21 of the 27 sentinel centres, which contributed complete data between 2007 and 2010, were used (see Appendix 2 for details) as this represented the longest continual data collection period for the largest number of centres participating in the study. For HDV, all sites submitting testing data between 2007 and 2010 were used. Methods have previously been described in detail [1]; recent changes are outlined in Appendix 1.

In 2010, 192,664 individuals underwent first-line testing for HBsAg (excluding antenatal screening), of whom 1.6% tested positive. The demographic profile of these individuals was similar to previous years [2]. Slightly more males were tested, and the odds of males testing positive was two-thirds higher than females. Individuals aged between 15 and 44 years accounted for almost half of those tested and 61% of those testing positive. Individuals identified as being of South Asian origin accounted for 13% of all individuals tested with an odds of testing positive two-thirds higher compared with non-South Asians.

Routine testing of HBsAg increased between 2007 and 2009, but decreased slightly in 2010. The annual frequency of new diagnoses among individuals undergoing routine testing for HBsAg has continued to decline from 18.53 per 100,000 individuals in 2007 to 12.97 per 100,000 individuals in 2010.The demographics of individuals tested over the last five years have remained relatively consistent. Overall, almost two-thirds of HBsAg positive individuals were identified through testing by primary care services with testing by general practice consistently identifying the greatest number of HBsAg positive individuals.

The number of women undergoing routine antenatal HBsAg screening declined year on year between 2007 and 2010. Overall, the odds of a women undergoing antenatal screening testing positive for HBsAg was less two-thirds less than women undergoing non-antenatal testing.

Data from dried blood spot (DBS) testing, performed in 2 sentinel laboratories were available for 2010. A total of 1,602 individuals were tested by DBS, of whom 0.7% tested positive. The low positivity rate may be due to individuals of relatively high risk for HCV being opportunistically tested for HBV. An additional 62,968 women underwent antenatal screening; of whom 0.5% tested positive.

The number of individuals tested for HDV has increased since 2007. Overall, excluding antenatal testing, 1,639 individuals were tested for HDV during 2010, 4.6% of whom tested positive. A higher proportion of men (63.3%) were tested, however, there was no significant difference in the proportion of males and females among those who tested positive. Where ethnicity data was available, almost two-thirds (61.1%) of those who were tested were of white or white British ethnicity. However, the proportion positive was highest among those of Asian or Asian British ethnicity (6.2%), and the odds of these individuals testing positive was 50% higher than those of white or white British ethnicity.

Contents

1.0 Overview of HBV and HDV testing among all centres in 2010 5
1.1 Routine HBsAg testing excluding antenatal testing 5
1.1 Antenatal HBsAg testing 6
1.2 Dried blood-spot testing 6
1.3 Hospitals referring all samples for HBsAg testing 7
1.4 Confirmatory HBsAg testing 7
1.4 HDV testing 7
2.0 Trends in HBV testing between 2007 and 2010 9
2.1 Demographics 9
2.2 Monthly trends in testing 10
2.3 Trends in reported risk factors 11
2.4 Trends in testing among individuals of South Asian origin 13
2.5 Trends in testing by ethnic group 16
2.6 Trends in testing by service type 19
2.6.1 Trends in testing in primary services 21
2.6.1 Trends in testing in secondary services 21
2.7 Trends in antenatal screening between 2007 and 2010 22
2.8 Trends in antenatal screening of South Asian women 23
3.0 Trends in HDV testing between 2007 and 2010 25
3.1 Demographics 25
3.2 Quarterly trends in testing 26
3.3 Testing by service type 27
3.4 Trends in antenatal testing between 2007 and 2010 29
4.0 Discussion 30
4.1 Hepatitis B testing 30
4.2 Hepatitis D testing 33
Acknowledgements 34
References 35
Appendix 1: Methods 36
Appendix 2: List of participating laboratories and periods of data collection 39
Appendix 3: Sentinel surveillance study participants 40

1.0 Overview of HBV and HDV testing among all centres in 2010

1.1 Routine HBsAg testing excluding antenatal testing

During 2010, a total of 192,664 individuals underwent first line testing for HBsAg by venipuncture in 22 sentinel centres; of whom 1.6% (n=3,108) tested positive and 7.0% (n=219) were classified as having an acute infection (see Appendix 1). Slightly more males were tested (51.9%) than females and the odds of males testing positive was two-thirds higher than females (aOR $_{\text{age group}}$ = 1.67; 95% CI 1.55 – 1.57; p<0.001). Individuals aged between 25 and 44 years accounted for 48.7% of those tested and 61.0% of those testing positive. The mean age of those tested was 38.6 years (range 0.0 - 103.3 years), the mean age of those tested positive was 36.6 years (range 0.0 – 93.1 years). These results are similar to those observed in previous years [2]

Where known, general practice tested 29.6% of individuals, with a further 23.9% tested in GUM clinics and 15.5% in other known hospital wards (e.g. cardiology, dermatology, etc.). The highest proportion positive was observed in specialist HIV services (3.6%; n=6), specialist liver services (2.6; n=115), and general practice (2.1%; n=1,161). Overall in 2010, the 58.9% (1,829) of all positive individuals tested through GPs and GUM clinics

Names were available for use in ethnicity analyses for 74.4% of people tested (n=143,428), of whom 13.2% (n=18,997) were identified as South Asian; 2.6% of these individuals tested positive (n=501). Nearly half of all South Asian individuals (48.1% n=9,141) were tested by general practice. The highest proportion positive was identified in specialist liver services (4.1%; n=22) and GPs (3.2%; n=291). The mean age of South Asian individuals tested was 36.0 years (range 0.0 – 100.1 years); 5.8 years younger than non-South Asians (t-test=5.82, 95% CI=5.57 – 1.78, p>0.001). There was no significant difference between mean age of South Asian individuals testing positive (mean 37.2 years; range 0.2 - 93.1) and non-South Asians (mean 37.5; range 0.0 - 89.3). The odds of individuals of South Asians origin testing positive was almost two thirds greater than non-South Asians (aOR $_{\text{age group, gender}}$= 1.61; 95% CI 1.45 – 1.78; p<0.001).

Using combined ethnicity data, available for 73.5% (141,640/192,664) of individuals undergoing testing in 2010, over three quarters (77.8.2%) of all individuals were of white or white British ethnicity, compared to 15.1% of Asian or Asian British ethnicity, 4.3% of other and/or mixed ethnicity and 2.6% of black or black British ethnicity. The proportion positive varied by ethnic group, with the highest proportion positive among those of other and/or mixed ethnicity (8.8%) followed by those of black or black British ethnicity (7.4%), Asian or

Asian British (2.6%). The lowest proportion positive were among those of white or white British ethnicity (0.84%).

As reported last year few clinical details giving risk factors/and or reasons for testing were available (32.1% available)[2]. Where available, injecting drug use (IDU) was reported for 1.7% of all individuals tested for HBsAg and 0.5% of individuals testing positive. Sexual exposure was reported for 7.1% of individuals tested and 4.3% of individuals testing positive.

1.1 Antenatal HBsAg testing

During 2010, a total of 62,968 women aged between 10 and 50 were identified as undergoing routine antenatal screening for HBsAg in 22 participating sentinel laboratories; of whom 0.5% (n=342) were positive. These antenatal women represent one-quarter of all individuals tested for HBsAg in sentinel laboratories in 2010. The mean age was 28.8 years (range 12.2 – 49.9 years) for women tested and 28.3 years (range 12.9 – 44.0 years) for women testing positive. Names were available for >99.9% of women (n= 62,945), of whom 10.1% (n=6,381) were identified as South Asian. Overall in 2010, a similar proportion of women of South Asian origin and non-South Asian origin tested positive, 0.56% (36/6,381) and 0.54% (305/56,564). There was no significant difference in the odds of a woman of South Asian origin testing positive compared to non-South Asian women despite adjusting for age group. The odds of women undergoing antenatal screening testing positive was more than two-thirds lower compared to women undergoing testing for any other reason ($aOR_{age\text{-}group}$=0.30, 95% CI=0.27-0.34, p<0.001). Using combined ethnicity data, 3.9% of individuals of black or Black British and individuals of mixed or other ethnicity tested positive. This compared to 0.5% and 0.3% among individuals of Asian or Asian British, and white or white British origin, respectively.

In addition, of the 342 HBsAg positive women identified, data on hepatitis B e-antigen (HBeAg) status was available for 324 (94.7%); 46 (14.2%) were HBeAg positive. Although not statistically significant, the proportion of women who tested positive varied by ethnicity, with 14.7% (43/291) of non-south Asians testing positive, compared to 9.4% (3/32) among south Asians.

1.2 Dried blood-spot testing

Results from dried blood spot (DBS) testing were available from 2 participating laboratories in 2010. In total 1,602 individuals were tested at least once for HBsAg by DBS testing, of

whom 0.7% (n=11) of individuals tested positive. More males were tested than females (74.1% males), most of the individuals testing positive were male (9/11). The mean age of individuals tested was 33.2 years (range 0.1 - 80.0 years); the mean age of those testing positive was 41.2 (range 33.6 – 64.8 years).

1.3 Hospitals referring all samples for HBsAg testing

An additional 10,297 individuals were tested for HBsAg by hospitals that referred all samples to a sentinel laboratory, 1.8% of whom tested positive. More females were tested than males (56.5% female) suggesting this group includes women who underwent routine antenatal testing (where antenatal testing could not be specifically identified). The mean age was 42.4 years (range 0.0 – 99.1years) for individuals tested for HBsAg and 36.2 years (range 0.2 – 78.2 years) for individuals testing positive. A greater proportion of males tested positive (2.1% vs.1.5% females) and the odds of males testing positive was twice that of females ($OR_{(adj\ age\text{-}group,\ ethnicity)}$=0.49 95% CI=0.35 – 0.70 p<0.001). Names were available for use in ethnicity analyses for 86.6%of people tested (n=8,922), of whom 10.3% (n=920) were identified as South Asian; 3.3% of these individuals tested positive (n=30).

1.4 Confirmatory HBsAg testing

During 2010, a further 12,354 individuals over one year of age underwent confirmatory testing of samples referred to 23 participating laboratories; 20.5% (n= 2,527) of whom tested positive. The mean age of those tested was 36.2 years (range 0.0 to 100.5 years); whereas the mean age of those tested positive was 36.0 years (range 0 to 100.0 years). Slightly more females underwent reference testing than males (62.4% females), with a higher proportion of males testing positive compared to females (27.9% vs. 15.5% respectively).

1.4 HDV testing

During 2010, excluding antenatal testing, a total of 1,639 individuals underwent testing for HDV by venepuncture in 3 sentinel centres; of whom 4.2% (n=69) tested positive. More males were tested (63.3%), than females, however, the proportion positive was similar among both males (0.45%) and females (0.36%). Individuals aged between 25 and 44 years accounted for 62.4% of those tested and 64.8% of those testing positive.The mean age of individuals tested was 37.1 years (range 0.0 – 94.4) and the mean age of individuals testing positive was 36.5 years (range 2.6 – 72.2).

Ethnicity data were available for 80.4% (n=1318) of individuals tested. Where known, individuals of white or white British origin accounted for 45.6%) of all individuals tested for HDV, compared to 22.1% among individuals of mixed or other origin, 19.1% among Asian or Asian British origin and 13.1% among individual of Black or Black British origin. There was no significant difference in the proportion of proportion of individuals positive by broad ethnic group, ranging from 3.95% among individuals of Asian or Asian British origin, to 4.65% among individuals of white or white British origin. Similarly, when classified into individuals of South Asian origin and non-South Asian origin, the proportion positive was not significantly different (4.0% and 4.1%, respectively).

Few women were tested antenatally for HDV (n=244), however the number of women tested each year increased by 75% between 2007 and 2010. Women tested were on average 28.6 years, and was not significantly different from the mean age of those who tested positive. Overall, 2.9% of women tested were positive, with no significant difference in the proportion positive among non-South Asians when compared to South Asians.

2.0 Trends in HBV testing between 2007 and 2010

Between 2007 and 2010, 687,321 individuals were tested for HBsAg in the network of 21 laboratories that contributed data consistently for the 4 year period (trend centres), of whom 1.6% (n=11,155) tested positive (Table 1).

2.1 Demographics

- The number of individuals tested each year increased by 11.4% between 2007 and 2009, then decreased slightly in 2010.
- Gender and age were well reported (98.9%).
- The ratio of males to females tested was stable over time, with the proportion of males tested ranging from 47.4% to 49.6%.
- The mean age of individuals being tested, and those testing positive varied little over time.
- Half of all individuals tested (49.3%) were aged between 15-34, whereas 58.9% of those who tested positive were aged 25-44.
- The odds of males testing positive was 88% higher compared to females (aOR $_{\text{age group, ethnicity, year of test}}$ = 1.88; 95% CI 1.79-1.96; p<0.001).
- The annual frequency of new HBsAg declined each year between 2007 and 2009, and levelled off in 2010. In 2010, the odds of an individual testing positive was 20% lower compared to individuals tested in 2005 (aOR $_{\text{age group, gender, ethnicity}}$ = 0.80; 95% CI 0.75-0.85; p<0.001).
- The proportion of HBaAg positive infections that were classified as acute decreased from 11.4% in 2007 to 7.3% in 2010
- The annual frequency of new diagnoses among individuals undergoing routine testing declined from 15.38 per 100,000 in 2007 to 12.97 per 100,000 in 2010.

Table 1. Trends in individuals tested and testing positive for HBsAg, excluding antenatal testing, among trend centres between 2007 and 2010[+].

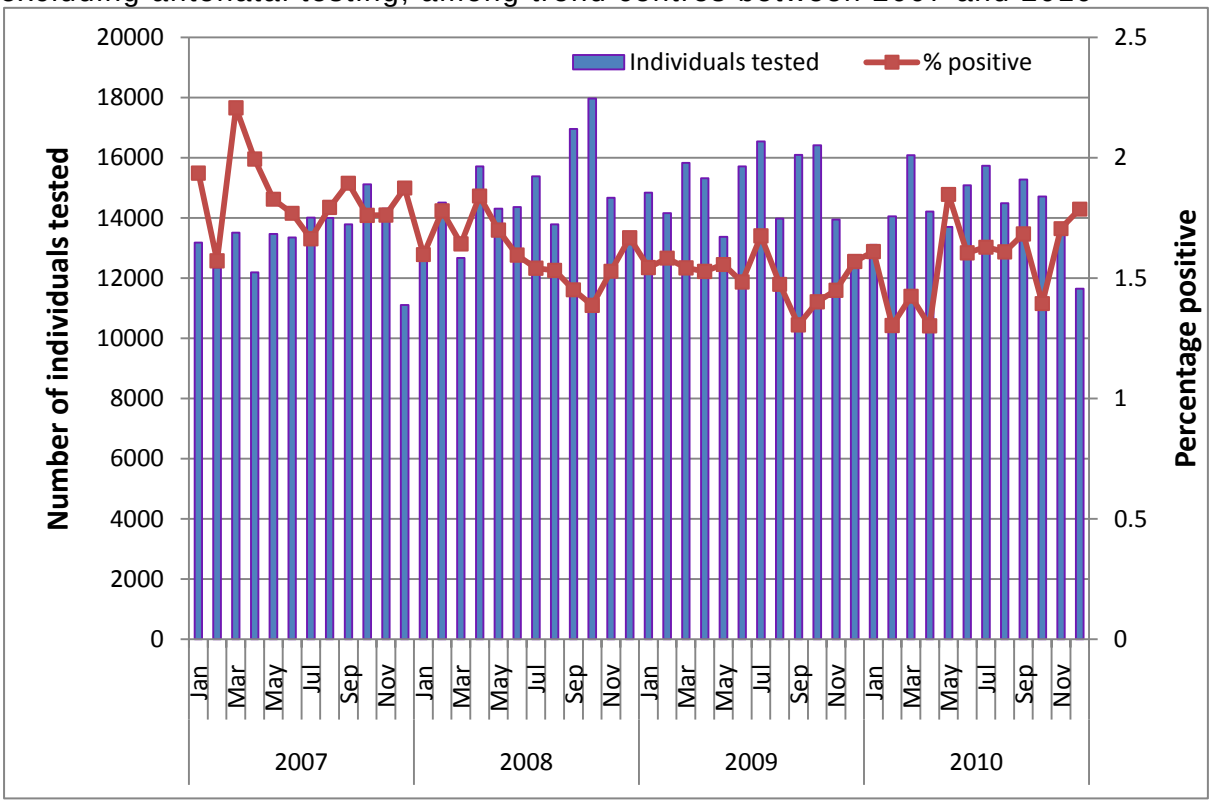
	2007	2008	2009	2010
All individuals tested				
Number	160,330	176,554	178,597	171,840
Mean age in years	38.75	37.99	38.03	38.63
Number male (%)	75,981 (47.4)	84,137 (47.7)	86,504 (48.4)	85,184 (49.6)
Number S. Asian (%)	15,584 (9.7)	16,436 (9.3)	17,000 (9.5)	17,226 (10.0)
Mean age of S. Asian	34.46	34.36	34.82	35.34
Positive individuals				
Number (%)	2,943 (1.8)	2,823 (1.6)	2,692 (1.5)	2,697 (1.6)
Number acute (%)*	336 (11.4)	321 (10.9)	260 (8.8)	214 (7.3)
Mean age in years	38.19	37.14	36.26	36.54
Number male (%)	1,734 (58.9)	1,727 (61.2)	1,706 (63.4)	1,693 (62.8)
Number S. Asian (%)	526 (17.9)	491 (17.4)	485 (18.0)	458 (17.0)
Mean age of S. Asian	38.25	37.59	36.38	36.55
Rate of new diagnoses per 100,000[#]	18.53 (17.86 – 19.21)	14.71 (14.10 – 15.36)	14.58 (13.96 – 15.23)	12.97 (12.39 - 13.58

+ At the 21 centres for which full data are available 2007-2010. Excludes dried blood spot testing, antenatal testing, reference testing, and testing from hospitals referring all samples. Data are de-duplicated subject to availability of date of birth, soundex and first initial. All data are provisional.
[#] See appendix 1 for methods

2.2 Monthly trends in testing

- The number of individuals tested for HBsAg in the 21 trend centres, varied by month, with noticeable troughs in the Christmas/New Year and Easter holiday periods (Figure 1).
- The number of individuals testing positive each month fluctuated between 11,101 to 17,958).
- The proportion of individuals testing positive each month declined between 2007 and 2009, and levelled off in 2010.
- Several peaks in testing appear to correspond to troughs in the proportion of positive individuals, suggesting increased testing of individuals at relatively lower risk of infections. Conversely, several troughs in testing correspond to peaks in the proportion of HBsAg positive individuals, which may suggest more targeted testing to individuals or higher risk of infection.

Figure 1. Individuals tested and percentage positive for HBsAg by month, excluding antenatal testing, among trend centres between 2007 and 2010



* At the 21 centres for which full data are available 2007-2010. Excludes dried blood spot testing, antenatal testing, reference testing, and testing from hospitals referring all samples. Data are de-duplicated subject to availability of date of birth, soundex and first initial. All data are provisional.

2.3 Trends in reported risk factors

- Overall, two-thirds (67.4%; 463,579/687,321) of records did not have a valid entry in the clinical details field, i.e. a risk factor and/or a reason for test. However, the proportion of individuals tested for HBsAg with a valid entry in the clinical details field increased year on year between 2007 and 2010, from 30.0% to 35.9% respectively (Table 2).
- Where individuals had risk factors and/or reasons for test available, the proportion of individuals reported as being injecting drug users declined year on year from 2.6% in 2007 to 1.7% in 2010. The proportion of IDUs testing positive for HBsAg also declined from 1.5% to 0.4%.
- As reported previously, the number of individuals testing through specialist drug services was greater than the number of individuals reported as IDUs[2]. Of those reported as IDUs, 78.2% (3,531/4,518) of individuals were tested though services other than through specialist drug services. Most frequently these included general

practice (38.6%; 1,745/4,518), prisons (10.6%; 480/4,518) and GUM clinics (9.6%; 435/4518).

- Overall, where information as available, 7.2% of individuals were reported as being tested as a result of sexual exposure, of whom 0.72% tested positive. Almost three quarters (72%; 11,595/16,094) of those tested as a result of sexual exposure were tested through GUM services.

Table 2. Trends in the reporting and testing of risk factors‡, trend centres 2007 to 2010*

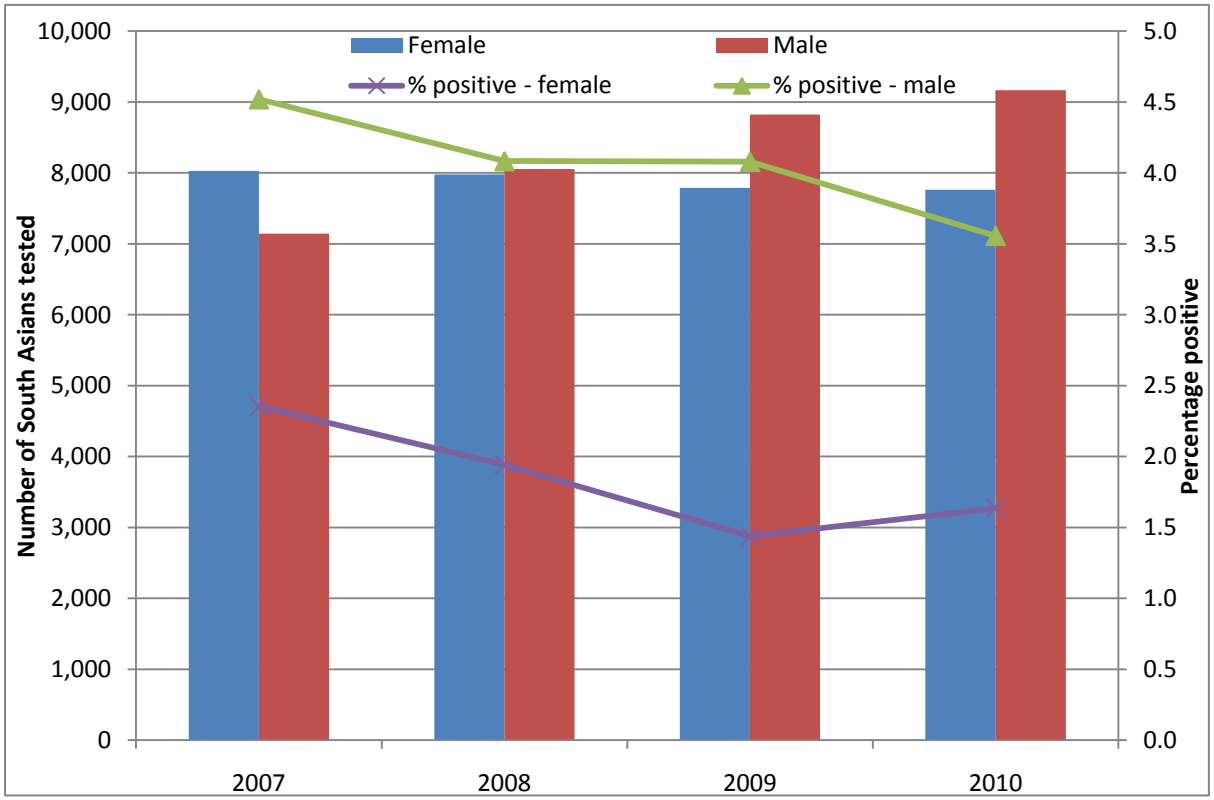
	2007	2008	2009	2010
All individuals				
Number tested	160,330	176,554	178,597	171,840
Number known clinical details (%)	48,176 (30.0)	56,859 (32.2)	56,961 (31.9)	61,746 (35.9)
Positive individuals				
Number positive	2,943	2,823	2,692	2,697
Number known clinical details (%)	650 (22.1)	578 (20.5)	580 (21.5)	682 (25.3)
Where risk reported as IDU				
Number where risk was IDU (%)+	1,245 (2.6)	1,170 (2.1)	1,040 (1.8)	1,063 (1.7)
Number positive (%)	19 (1.5)	8 (0.7)	10 (1.0)	4 (0.4)
Where risk reported as Sex				
Number where risk was sex (%)+	2,757 (5.7)	4,079 (7.2)	4,810 (8.4)	4,448 (7.2)
Number positive (%)	28 (1.0)	32 (0.8)	27 (0.6)	30 (0.7)
Testing in specialist drug services				
Number tested	1,698	1,615	2,038	2,003
Number positive (%)	27 (0.6)	15 (0.9)	21 (1.0)	22 (1.1)
Testing in specialist GUM clinics				
Number tested	35,654	43,150	43,019	38,765
Number positive (%)	631 (1.8)	609 (1.4)	566 (1.3)	528 (1.4)

* At the 21 centres for which full data are available 2007-2010. Excludes dried blood spot testing, antenatal testing, reference testing, and testing from hospitals referring all samples. Data are de-duplicated subject to availability of date of birth, soundex and first initial. All data are provisional.
‡ Data on risk factors and/or reason for testing were taken from a freetext clinical details field.
+ Proportion where risk reported.

2.4 Trends in testing among individuals of South Asian origin

- The availability of names has remained stable year on year, between 2007 (78.5%) and 2010 (77.2%).
- Overall, names were available for 77.2% (530,294/687,321) of individuals tested between 2007 and 2010, of which, 12.5% (n=66,246) were identified as being of South Asian origin (Table 1 and Figure 1).
- The number of individuals tested who were of South Asian origin has increased year on year from 15,584 in 2007 to 17,226 in 2010. This has been largely driven by an increase in the number of men being tested which has increased by 28.3% between 2007 and 2010 (Figure 2).
- The greatest proportion of individuals of South Asian origin were tested through general practice (47.5%), other known hospital services (12.8%), and occupational health (11.0%) (Table 3).
- Individuals of South Asian origin were an average of 6.7 years younger than non-South Asians when tested (t.test = 6.58; 95% CI = 6.58-6.84; p<0.001).
- On average, individuals of South Asian origin testing positive were one year younger than non-South Asians (t.test = 1.05; 95% CI = 0.34-1.77; p=0.003).
- Among those individuals identified as being of South Asian origin, the proportion testing positive decreased from 3.3% (526/15,584) in 2007, to 2.7% (458/17,226) in 2010 (Table 1).
- Overall, the percentage of HBsAg positive South Asian males decreased from 4.5% in 2007 to 4.1% in 2008 and 2009, then decreased again to 3.6% in 2010. Females decreased from2.4% in 2007 to 1.4% in 2009, then increased to 1.6% in 2010 (Figure 2).The odds of a South Asian male testing positive was twice that of a south Asian female (aOR $_{\text{year of test, age group}}$ = 2.18; 95% CI 1.98-2.41; p<0.001).
- The odds of an Individual of a South Asian origin testing positive for HBsAg in 2010 was 26% less that in 2007 (aOR $_{\text{gender, age group}}$ = 0.74; 95% CI 0.65 - 0.84; p<0.001). This varied by gender (Males aOR $_{\text{age group}}$ = 0.74; 95% CI 0.65 - 0.90; p<0.001 Females aOR $_{\text{age group}}$ = 0.67; 95% CI 0.53 - 0.84; p<0.001)

Figure 2. Trends in the number of South Asian individuals tested, and the proportion HBsAg positive by gender, excluding antenatal testing, trend centres 2007 to 2010



* At the 21 centres for which full data are available 2007-2010. Excludes reference testing and testing from hospitals referring all samples. Data are de-duplicated subject to availability of date of birth, soundex and first initial. All data are provisional.

Table 3. Number of individuals tested and proportion positive by service type, among individuals of South Asian and non-South Asian origin, trend centres 2007 to 2010*

	Non-south Asian		South Asian		Unknown ethnic group	
	Number tested	Number positive (%)	Number tested	Number positive (%)	Number tested	Number positive (%)
Primary care						
Accident and emergency	5,343	113 (2.1)	677	31 (4.6)	8	2 (25.0)
Drug dependency services	5,908	65 (1.1)	615	13 (2.1)	831	7 (0.8)
General practitioner	171,203	3,105 (1.8)	31,263	1,092 (3.5)	2,039	21 (1.0)
GUM clinic	24,980	406 (1.6)	2,370	37 (1.6)	133,238	1,891 (1.4)
Occupational health	48,919	270 (0.6)	7,252	62 (0.9)	6,480	40 (0.6)
Prison services	4,850	72 (1.5)	309	7 (2.3)	4,542	50 (1.1)
Total primary care	**261,203**	**4,031 (1.5)**	**42,486**	**1,242 (2.9)**	**147,138**	**2011 (1.4)**
Secondary care						
Antenatal	758	8 (1.1)	109	3 (2.8)	2	0 (0.0)
Fertility services	29,454	176 (0.6)	5,040	68 (1.3)	88	1 (1.1)
General medical / surgical	22,818	389 (1.7)	2,077	103 (5.0)	80	2 (2.5)
Obstetrics and gynaecology	15,320	128 (0.8)	1,982	22 (1.1)	56	16 (28.6)
Other ward type (known service)†	78,981	1,216 (1.5)	8,435	276 (3.3)	1,312	6 (0.5)
Paediatric services	7,636	59 (0.8)	1,345	14 (1.0)	499	0 (0.0)
Renal units	19,138	111 (0.6)	1,677	28 (1.7)	19	1 (5.3)
Specialist HIV services	1,462	47 (3.2)	137	6 (4.4)	17	1 (5.9)
Specialist liver services‡	14,246	500 (3.5)	1,922	146 (7.6)	63	2 (3.2)
Unspecified ward§	7,852	251 (3.2)	633	35 (5.5)	3,554	145 (4.1)
Total secondary care	**197,665**	**2,885 (1.5)**	**23,357**	**701 (3.0)**	**5,690**	**174 (3.1)**
Unknown service type						
Total Unknown#	**5,180**	**81 (1.6)**	**403**	**17 (4.2)**	**4,199**	**13 (0.3)**
Total tested	**464,048**	**6,997 (1.5)**	**66,246**	**1,960 (3.0)**	**157,027**	**2,198 (1.4)**

* At the 21 centres for which full data are available 2007-2010. Excludes dried blood spot testing, antenatal testing, reference testing and testing from hospitals referring all samples. ,Data are de-duplicated subject to availability of date of birth, soundex and first initial. All data are provisional.

†This refers to all other hospital services not specified here: for example, it may include respiratory medicine, orthopaedics, care of the elderly, dermatology or cardiology departments.

‡ This refers to infectious disease services, hepatology departments and gastroenterology departments.

§ These are hospital services which are currently being investigated to identify specific service type, and may include any of the secondary care services mentioned above.

These services are currently being investigated to identify specific service type, where possible

2.5 Trends in testing by ethnic group

- Three quarters (n=525,042) of individuals tested for HBsAg between 2007 and 2010 were classified as belonging to a broad ethnic group based on multiple data sources (Table 4)
- Where known, the majority of individuals tested were of white or white British ethnicity (79.0%). A further 14.3% were of Asian or Asian British ethnicity, 4.0% of other or mixed ethnicity, and 2.7% of black or black British ethnicity (Table 5).
- Between 2007 and 2010 the number of individuals of Asian or Asian British ethnicity increased by an overall 9.1%. This compares to an overall increase of 12.7% among those of other or mixed ethnicity, 6.6% among those of black or black British ethnicity and 4.1% among those of white or white British ethnicity.
- Although the proportion of males and females tested was largely similar among all ethnic groups, the proportion of females tested was consistently higher than males.
- The mean ages of individuals tested between 2007 and 2010 within each ethnic group was stable over time. However, individuals of white ethnicity were consistently, and significantly higher with an average overall age of 40.3 years compared to 37.1, 36.2 and 35.6 years among those of Asian or Asian British, mixed and black or black British ethnicities, respectively ($p<0.001$).
- The average age of those individuals testing positive was lower than the average age of those testing among each ethic group. However, individuals of white or white British wer significantly and consistently higher with an average agee of 38.6 years, compared to 36.9, 36.2 and 35.0 years among those of Asian, mixed and black or black British ethnicities ($p<0.001$).
- The proportion of individuals of black or black British and other mixed ethic origin who tested positive for HBsAg decreased between 2007 and 2009, but increased slightly in 2010.
- Among individuals of Asian or Asian British and those of white or white British ethnic origin decreased between 2007 and 2010.
- Among all ethnic groups, including those of unknown ethnic origin, a greater proportion of males tested positive than females.

Table 4. Number of individuals tested and proportion positive by service type and ethnic group, trend centres 2007 to 2010*

	Asian or Asian British		Black or Black British		Other and/or Mixed ethnic group		White or White British		Unknown ethnic group	
	Number tested	Number positive (%)	Number tested	Number positive (%)	Number tested	Number positive (%)	Number tested	Number positive (%)	Number tested	Number positive (%)
Primary care										
Accident and emergency	743	34 (4.6)	176	12 (6.8)	171	15 (8.8)	4,863	80 (1.6)	75	5 (6.7)
Drug dependency services	647	16 (2.5)	43	0 (0.0)	86	7 (8.1)	5675	52 (0.9)	903	10 (1.1)
General practitioner	34,894	1,178 (3.4)	6,267	482 (7.7)	9,496	1,085 (11.4)	149,727	1,323 (0.9)	4,121	150 (3.6)
GUM clinic	2780	44 (1.6)	1173	43 (3.7)	2219	83 (3.7)	20453	243 (1.2)	13,3963	1,921 (1.4)
Occupational health	9,176	64 (0.7)	1,637	67 (4.1)	2,365	29 (1.2)	42,287	162 (0.4)	7,186	50 (0.7)
Prison services	337	8 (2.4)	90	8 (8.9)	141	28 (19.9)	4,552	32 (0.7)	4,581	53 (1.2)
Total primary care	**48,577**	**1,344 (2.8)**	**9,386**	**612 (6.5)**	**14,478**	**1,247 (8.6)**	**227,557**	**1892 (0.8)**	**150,829**	**2,189 (1.5)**
Secondary care										
Antenatal	121	3 (2.5)	30	1 (3.3)	42	4 (9.5)	662	3 (0.5)	14	0 (0.0)
Fertility services	5,668	73 (1.3)	833	43 (5.2)	1,121	42 (3.7)	26,597	81 (0.3)	363	6 (1.7)
General medical / surgical	2,290	110 (4.8)	399	47 (11.8)	494	86 (17.4)	21,593	243 (1.1)	199	8 (4.0)
Obstetrics and gynaecology	2,342	28 (1.2)	476	21 (4.4)	747	40 (5.4)	13,564	54 (0.4)	229	23 (10.0)
Other ward type (known service)†	9,329	300 (3.2)	1,631	159 (9.7)	2,185	258 (11.8)	73,781	733 (1.0)	1,802	48 (2.7)
Paediatric services	1,506	16 (1.1)	429	3 (0.7)	439	16 (3.6)	6,490	35 (0.5)	616	3 (0.5)
Renal units	1,860	33 (1.8)	326	14 (4.3)	270	13 (4.8)	18,281	75 (0.4)	97	5 (5.2)
Specialist HIV services	151	6 (0.0)	146	2 (1.4)	64	2 (3.1)	1,181	38 (3.2)	74	6 (8.1)
Specialist liver services‡	2,091	154 (7.4)	408	57 (14.0)	499	141 (28.3)	13,049	277 (2.1)	184	19 (10.3)
Unspecified ward§	712	38 (5.3)	235	41 (17.4)	269	71 (26.4)	7,191	121 (1.7)	3632	160 (4.4)
Total secondary care	**26,070**	**761 (2.9)**	**4,913**	**388 (7.9)**	**6,130**	**673 (11.0)**	**182,389**	**1,660 (0.9)**	**7,210**	**278 (3.9)**
Unknown service type										
Total Unknown#	**454**	**21 (4.6)**	**115**	**10 (8.7)**	**168**	**20 (11.9)**	**4,805**	**39 (0.8)**	**4,240**	**21 (0.5)**
Total tested	**75,101**	**2,126 (2.8)**	**14,414**	**1,010 (7.0)**	**20,776**	**1,940 (9.3)**	**414,751**	**3,591 (0.9)**	**162,279**	**2,488 (1.5)**

* At the 21 centres for which full data are available 2007-2010. Excludes dried blood spot testing, antenatal testing, reference testing and testing from hospitals referring all samples.Data are de-duplicated subject to availability of date of birth, soundex and first initial. All data are provisional.

†This refers to all other hospital services not specified here: for example, it may include respiratory medicine, orthopaedics, care of the elderly, dermatology or cardiology departments.

‡ This refers to infectious disease services, hepatology departments and gastroenterology departments.

§ These are hospital services which are currently being investigated to identify specific service type, and may include any of the secondary care services mentioned above.

These services are currently being investigated to identify specific service type, where possible

Table 5. Trends in individuals tested and testing positive by ethnic group[#] (trend centres 2007-2010)*

	2007	2008	2009	2010	Total
Individuals of Asian or Asian British origin					
Number tested (% known ethnicity)	17,761 (14.3)	18,642 (13.8)	19,320 (14.4)	19,378 (14.8)	75,101 (14.3)
Mean age tested	34.2	34.1	34.5	35.1	34.5
Males tested (% known gender)	7,951 (46.1)	8,885 (48.9)	9,721 (51.5)	10,076 (53.0)	36,633 (50.0)
Females tested (% known gender)	9,315 (53.9)	9,291 (51.1)	9,144 (48.5)	8,945 (47.0)	36,695 (50.0)
Number positive (% known ethnicity)	559 (24.1)	538 (24.5)	526 (25.2)	503 (24.4)	2,126 (24.5)
% positive	3.1	2.9	2.7	2.6	2.8
Mean age positive	38.0	37.2	36.3	36.5	37.0
Number males positive (%)	342 (4.3)	351 (4.0)	380 (3.9)	354 (3.5)	1,427 (3.9)
Number females positive (%)	202 (2.2)	178 (1.9)	133 (1.5)	144 (1.6)	657 (1.8)
Individuals of Black or Black British origin					
Number tested (% known ethnicity)	3,378 (2.7)	3,678 (2.7)	3,758 (2.8)	3,600 (2.7)	14,414 (2.7)
Mean age tested	34.8	34.1	34.3	35.2	34.6
Males tested (% known gender)	1,266 (38.8)	1,494 (41.9)	1,618 (44.2)	1,663 (47.1)	6,041 (43.1)
Females tested (% known gender)	2,000 (61.2)	2,071 (58.1)	2,045 (55.8)	1,869 (52.9)	7,985 (56.9)
Number positive (% known ethnicity)	256 (11.1)	235 (10.7)	246 (11.8)	273 (13.2)	1,010 (11.7)
% positive	7.6	6.4	6.5	7.6	7.0
Mean age positive	36.6	36.1	36.2	37.1	36.5
Number males positive (%)	150 (11.8)	133 (8.9)	146 (9.0)	174 (10.5)	603 (10.0)
Number females positive (%)	95 (4.8)	96 (4.6)	96 (4.7)	92 (4.9)	379 (4.7)
Individuals of Other and/or mixed ethnic origin					
Number tested (% known ethnicity)	4,753 (3.8)	5,290 (3.9)	5,383 (4.0)	5,350 (4.1)	20,776 (4.0)
Mean age tested	33.9	33.5	33.2	33.4	33.5
Males tested (% known gender)	1,893 (41.3)	2,153 (42.1)	2,191 (41.7)	2,314 (44.2)	8,551 (42.3)
Females tested (% known gender)	2,689 (58.7)	2,965 (57.9)	3,063 (58.3)	2,925 (55.8)	11,642 (57.7)
Number positive (% known ethnicity)	512 (22.1)	503 (22.9)	453 (21.7)	472 (22.9)	1,940 (22.4)
% positive	10.8	9.5	8.4	8.8	9.3
Mean age positive	37.2	35.9	34.8	36.3	36.1
Number males positive (%)	252 (13.3)	249 (11.6)	237 (10.8)	255 (11.0)	993 (11.6)
Number females positive (%)	237 (8.8)	232 (7.8)	205 (6.7)	207 (7.1)	881 (7.6)
Individuals of White or White British origin					
Number tested (% known ethnicity)	98,719 (79.2)	107,173 (79.5)	106,033 (78.8)	102,826 (78.4)	414,751 (79.0)
Mean age tested	42.8	42.0	42.2	42.7	42.4
Males tested (% known gender)	45,675 (47.0)	49,806 (46.9)	50,346 (47.9)	50,190 (49.2)	196,017 (47.7)
Females tested (% known gender)	51,568 (53.0)	56,437 (53.1)	54,776 (52.1)	51,916 (50.8)	214,697 (52.3)
Number positive (% known ethnicity)	988 (42.7)	921 (41.9)	865 (41.4)	817 (39.6)	3,591 (41.4)
% positive	1.0	0.9	0.8	0.8	0.9
Mean age positive	42.5	40.8	39.5	39.0	40.6
Number males positive (%)	573 (1.3)	579 (1.2)	526 (1.0)	505 (1.0)	2,183 (1.1)
Number females positive (%)	393 (0.8)	329 (0.6)	324 (0.6)	300 (0.6)	1,346 (0.6)
Individuals of unknown ethnic origin					
Number tested (% all tested)	35,719 (22.3)	41,771 (23.7)	44,103 (24.7)	40,686 (23.7)	162,279 (23.6)
Mean age tested	30.7	30.2	30.2	30.7	30.4
Males tested (% known gender)	19,196 (55.7)	21,799 (53.7)	22,628 (53.7)	20,941 (53.8)	84,564 (54.1)
Females tested (% known gender)	15,283 (44.3)	18,767 (46.3)	19,541 (46.3)	18,019 (46.3)	71,610 (45.9)
Number positive (% all tested)	628 (21.3)	626 (22.2)	602 (22.4)	632 (23.4)	2,488 (22.3)
% positive	1.8	1.5	1.4	1.6	1.5
Mean age positive	33.1	33.1	32.7	33.3	33.1
Number males positive (%)	417 (2.2)	415 (1.9)	417 (1.8)	405 (1.9)	1654 (2.0)
Number females positive (%)	188 (1.2)	192 (1.0)	168 (0.9)	205 (1.1)	753 (1.1)

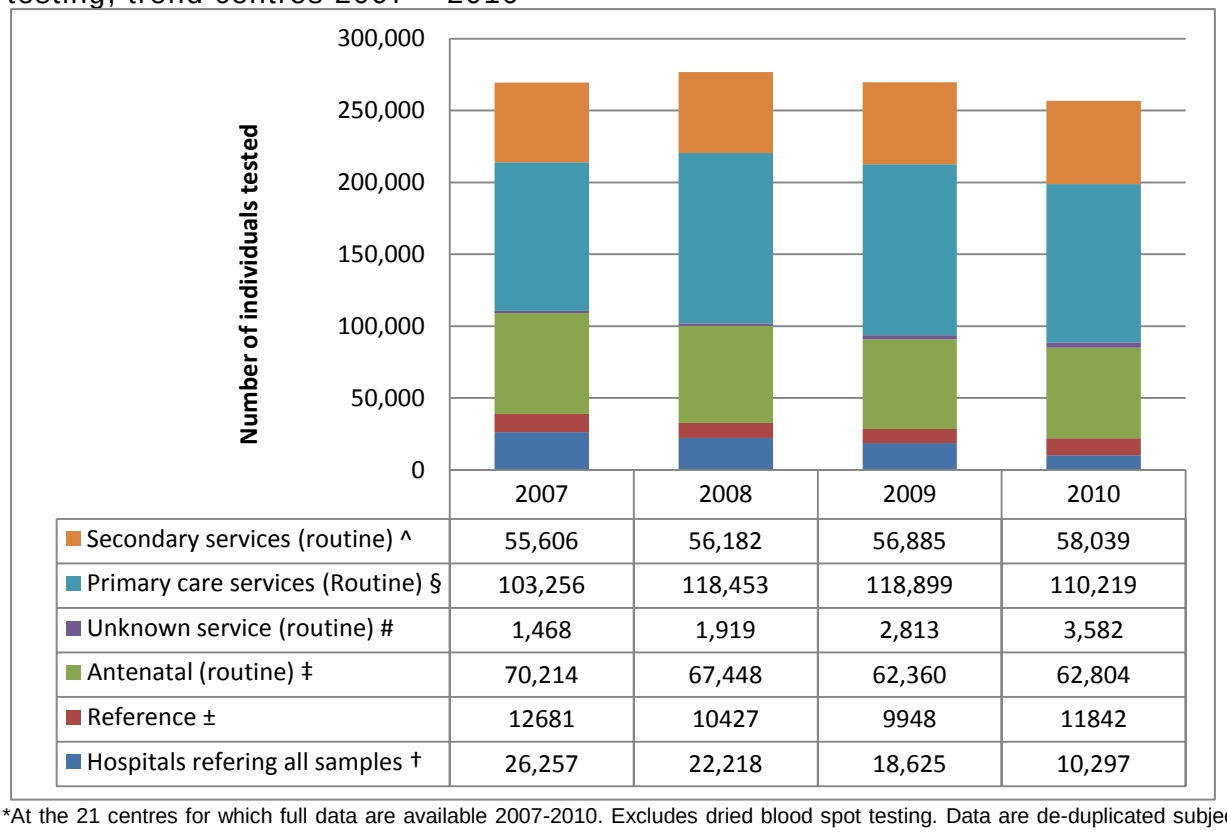
See appendix 1 for methods

* At the 21 centres for which full data are available 2007-2010. Excludes dried blood spot testing, antenatal testing, reference testing and testing from hospitals referring all samples. Data are de-duplicated subject to availability of date of birth, soundex and first initial. All data are provisional.

2.6 Trends in testing by service type

- Combining all service types (routine testing, antenatal screening, hospital referring all samples, and reference testing) the overall level of HBsAg testing increased from 269,482 in 2007, to 276,647 in 2008, before decreasing in 2009 and in 2010 to 269,530 and 256,783, respectively.
- The number of individuals tested in primary settings increased between 2007 and 2008 from 103,256 to 118,453, remained largely stable until 2009, and declined to 110,219 in 2010 (Figure 3).
- Testing in secondary services has shown little variation over time.
- The decline in the number of hospitals referring all their samples to one of the sentinel laboratories has continued. In 2010, compared with 2007, the number of individuals being tested in hospitals referring all their samples more than halved.
- The number of individuals undergoing reference testing declined by a fifth between 2007 and 2009, and increased by a similar proportion in 2010.

Figure 3. Trends in routine testing, hospitals referring all samples and reference testing, trend centres 2007 – 2010*



	2007	2008	2009	2010
Secondary services (routine) ^	55,606	56,182	56,885	58,039
Primary care services (Routine) §	103,256	118,453	118,899	110,219
Unknown service (routine) #	1,468	1,919	2,813	3,582
Antenatal (routine) ‡	70,214	67,448	62,360	62,804
Reference ±	12681	10427	9948	11842
Hospitals refering all samples †	26,257	22,218	18,625	10,297

*At the 21 centres for which full data are available 2007-2010. Excludes dried blood spot testing. Data are de-duplicated subject to availability of date of birth, soundex and first initial. All data are provisional.
± This refers to all samples sent to a sentinel laboratory for reference testing. It is not known what proportion of positive or negative samples from routine samples are referred. However, reference testing may be biased towards positive samples.
† This refers to hospitals that send all samples for testing to the sentinel laboratory, but where specific service type cannot be identified.
# These services are currently being investigated to identify specific service type, where possible.
^ This refers to all hospital services: for example, it may include specialist liver services, renal units, paediatric wards, general medical and surgical wards etc.
‡ This includes the antenatal testing of women aged between 10-50 years old, identified by the service type and/or clinical details.
§ Includes accident and emergency departments, general practice, GUM clinics, occupational health services, prison and specialist drug services.

Table 6. Number and individuals tested, and percentage positive for HBsAg by service type, excluding antenatal testing, trend centres 2007 – 2010*

	2007		2008		2009		2010		Total	
	Number tested	Number positive (%)	Number tested	Number positive (%)	Number tested	Number positive (%)	Number tested	Number positive (%)	Number tested	Number positive (%)
Primary Care										
Accident and emergency	1,540	48 (3.1)	1,491	43 (2.9)	1,464	34 (2.3)	1,533	21 (1.4)	6,028	146 (2.4)
Drug dependancy services	1,698	27 (1.6)	1,615	15 (0.9)	2,038	21 (1.0)	2,003	22 (1.1)	7,354	85 (1.2)
General practitioner	47,895	1,002 (2.1)	52,517	1,044 (2.0)	52,612	1,090 (2.1)	51,481	1,082 (2.1)	204,505	4,218 (2.1)
GUM clinic	35,654	631 (1.8)	43,150	609 (1.4)	43,019	566 (1.3)	38,765	528 (1.4)	160,588	2,334 (1.5)
Occupational health	14,502	94 (0.6)	17,421	89 (0.5)	16,932	102 (0.6)	13,796	87 (0.6)	62,651	372 (0.6)
Prison services	1,967	30 (1.5)	2,259	36 (1.6)	2,834	38 (1.3)	2,641	25 (0.9)	9,701	129 (1.3)
Total primary care	**103,256**	**1832 (1.8)**	**118,453**	**1836 (1.5)**	**118,899**	**1851 (1.6)**	**110,219**	**1,765 (1.6)**	**450,827**	**7,284 (1.6)**
Secondary care										
Fertility services	8,640	69 (0.8)	9,067	72 (0.8)	8,394	48 (0.6)	8,481	56 (0.7)	34,582	245 (0.7)
General medical / surgical	6,315	163 (2.6)	6,333	149 (2.4)	6,270	119 (1.9)	6,057	63 (1.0)	24,975	494 (2.0)
Obstetrics & gynaecology	3,996	35 (0.9)	4,284	57 (1.3)	4,201	34 (0.8)	4,877	40 (0.8)	17,358	166 (1.0)
Other ward (known type)†	21,306	446 (2.1)	22,302	412 (1.8)	23,689	347 (1.5)	22,300	347 (1.6)	89,597	1,509 (1.7)
Paediatric services	1,986	15 (0.8)	2,382	13 (0.5)	2,484	27 (1.1)	2,628	18 (0.7)	9,480	73 (0.8)
Renal units	6,104	55 (0.9)	5,143	25 (0.5)	4,775	29 (0.6)	4,812	31 (0.6)	20,834	140 (0.7)
Specialist liver services	4,140	225 (5.4)	3,969	166 (4.2)	3,976	142 (3.6)	4,146	115 (2.8)	16,231	648 (4.0)
Specialist HIV services‡	722	24 (3.3)	434	12 (2.8)	294	12 (4.1)	166	6 (3.6)	1,616	54 (3.3)
Unspecified ward	2,397	61 (2.5)	2,268	59 (2.6)	2,802	45 (1.6)	4,572	266 (5.8)	12,039	431 (3.6)
Total secondary care	**55,606**	**1,093 (2.0)**	**56,182**	**965 (1.7)**	**56,885**	**803 (1.4)**	**58,039**	**942 (1.6)**	**226,712**	**3,760 (1.7)**
Total unknown service types#	**1,468**	**18 (1.2)**	**1,919**	**22 (1.1)**	**2,813**	**38 (1.4)**	**3,582**	**33 (0.9)**	**9,782**	**111 (1.1)**
Total tested	**160,330**	**2,943 (1.8)**	**176,554**	**2,823 (1.6)**	**178,597**	**2,692 (1.5)**	**171,840**	**2,740 (1.6)**	**687,321**	**11,155 (1.6)**

* At the 21 centres for which full data are available 2007-2010. Excludes dried blood spot testing, antenatal testing, reference testing, and testing from hospitals referring all samples. Data are de-duplicated subject to availability of date of birth, soundex and first initial. All data are provisional.

†This refers to all other hospital services not specified here: for example, it may include respiratory medicine, orthopaedics, care of the elderly, dermatology or cardiology departments.

‡ This refers to infectious disease services, hepatology departments and gastroenterology departments.

§ These are hospital services which are currently being investigated to identify specific service type, and may include any of the secondary care services mentioned above.

These services are currently being investigated to identify specific service type, where possible.

2.6.1 Trends in testing in primary services

- Overall, the majority of people testing through primary services were tested through general practice (45.4%), or GUM clinics (35.6%). In addition, 13.9% of individuals were tested through occupational health services (Table 6).
- The overall trend in testing through primary services, increasing between 2007 and 2008, remaining stable into 2009, has been driven by testing within GUM services and general practice. However the decrease seen in 2010 was primarily as a result of a 10% (4,254/43,019) decrease in testing from GUM services, and a 18.5% (3,136/16,932) decrease in testing through occupational health.
- Testing through accident and emergency, prison services and drug dependency services has remained largely stable between 2007 and 2010.
- The proportion of HBsAg positive individuals declined from 1.77% in 2007 to 1.55% in 2008, and increased to 1.56% in 2009 and 1.60% in 2010.
- The greatest number of positive individuals identified from either primary or secondary care services was in general practice. Overall, they accounted for over one third (37.8%) of all HBsAg positive individuals reported between 2007 and 2010, compared to 20.9% from GUM clinics.
- Comparing individuals tested in 2007 with those tested in 2010, a significant trend was only seen among individuals testing through general practice, where the odds of testing positive were 10% lower in 2010 compared to 2007 ($aOR_{ethnicity, gender, age\ group}$ = 0.90; 95% CI 0.82 - 0.98; p=0.003).

2.6.1 Trends in testing in secondary services

- The number of individuals tested by specific secondary services increased between 2007 and 2009, and declined in 2010 (Table 6).
- Two fifths (39.5%) of individuals tested in secondary services between 2007 and 2010 were tested by other known services which did not have a specific focus on infectious diseases or liver services.
- The number of individuals tested in general medical surgical wards, renal units, and specialist HIV services declined between 2007 and 2010,
- The number of individuals tested in specialist liver services declined until 2009, but increased in 2010 back to a similar number reported in 2007.
- The number of individuals tested in obstetrics and gynaecology increased between 2007 and 2010.

- The overall proportion of HBsAg positive individuals tested in secondary services declined from 1.97% in 2007 to 1.41% in 2009, but increased to 1.59% in 2010.
- The greatest number of positive individuals were tested through specialist liver services and other known wards.
- Comparing individuals tested in 2007 with those tested in 2010, a significant trend was only seen among individuals testing through specialist liver services (aOR $_{ethnicity,\ gender,\ age\ group}$ = 0.45; 95% CI 0.29 - 0.55; p<0.001) and general medical/surgical services (aOR $_{ethnicity,\ gender,\ age\ group}$ = 0.46; 95% CI 0.36 - 0.58; p<0.001), where the odds of an individual testing positive in 2010 was approximately half that of in 2007.

2.7 Trends in antenatal screening between 2007 and 2010

- The decline in the number of women undergoing routine antenatal HBsAg screening previously reported [2], has continued into 2010 (Table 7).
- The mean age of women tested varied little between 2007 and 2010.
- Overall, 0.5% of women undergoing antenatal screening tested positive.
- The odds of women screened through antenatal services testing positive were 71% lower compared to non-antenatal women (aOR $_{ethnicity,\ age\ group,\ year\ of\ test}$ = 0.29; 95% CI 0.27- 0.31; p<0.001)
- There were no significant changes in the odds of women undergoing antenatal screening testing positive in 2010 compared with earlier years. Adjusting for age group and/or ethnicity did not increase the significance.
- Overall, 95.7% of HBsAg positive women were tested for HBeAg (1,368/1,430), of whom 14.2% tested positive. Similar proportions of south Asian and non-south Asian origin tested positive for HBeAg

Table 7. Trends in testing for antenatal women, trend centres 2007-2010*

	2007	2008	2009	2010
All antenatal women tested for HBaSg				
Number tested	70,214	67,448	62,360	62,804
Mean age in years	28.95	28.82	28.81	28.82
Number S. Asian (%)	7,135 (10.2)	6,982 (10.4)	6,315 (10.1)	6,362 (10.1)
Mean age S. Asians in years	28.19	28.19	28.38	28.43
HBsAg positive women				
Number positive	373 (0.5)	372 (0.6)	350 (0.6)	335 (0.5)
Mean age in years	28.67	28.40	28.79	28.27
Number S. Asian (%)	53 (14.2)	52 (14.0)	55 (15.7)	36 (10.7)
Mean age S. Asians in years	28.00	28.76	28.73	29.11
HBsAg positive women tested for HBeAg				
Number tested (%)	354 (94.9)	361 (97.0)	336 (96.0)	317 (94.6)
Number S. Asian (%)	52 (98.1)	51 (98.1)	53 (96.4)	32 (88.9)
HBeAg positive women				
Number tested (%)	53 (15.0)	56 (15.5)	41 (12.2)	44 (13.9)
Number S. Asian (%)	9 (17.3)	2 (3.9)	4 (7.5)	3 (9.4)

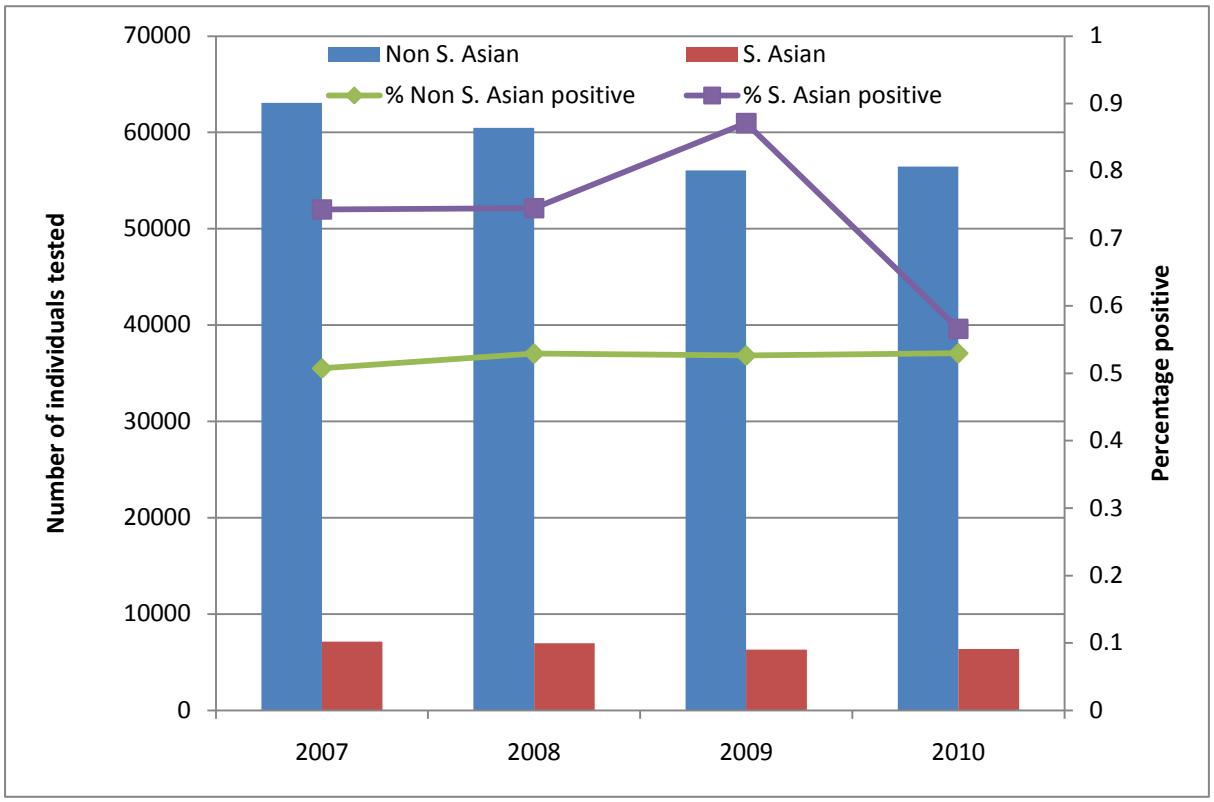
*At the 21 centres for which full data are available 2005-2009. Includes women aged between 10-50 years identified as undergoing antenatal testing from a combination of test request location and/or clinical details.

2.8 Trends in antenatal screening of South Asian women

- Names were available for >99% of women undergoing antenatal testing for HBsAg, of whom 10.2% were identified as being of South Asian origin.
- The mean age of South Asian women tested and testing positive for HBsAg showed little variation over time.
- The number and proportion of South Asian women testing positive for HBsAg declined between 2007 and 2009, and levelled off in 2010
- The odds of an antenatal women of South Asian origin testing positive was 74.8% lower compared to non-antenatal South Asian women (aOR $_{\text{age group, year of test}}$ = 0.26; 95% CI 0.22- 0.30; p<0.001).
- There was no significant difference in the odds of a woman of South Asian origin testing positive in 2010 compared to 2007. Adjusting for age group and/or ethnicity did not increase the significance.
- Overall, 95.9% (188/196) of South Asian women who were HBsAg positive were tested for HBeAg, of whom 9.6% (18/188) tested positive. The large fluctuations in the proportion of HBeAg positive women each year is as a result of the small number of women tested.

- Classifying women into broad ethnic groups, 0.2% of women of white or white British ethnicity tested positive, compared to 4.1%, 3.8% and 0.7% among individuals of other or mixed ethnicity, black or black British, and Asian or Asian British ethnicity, respectively.

Figure 4. Antenatal testing of HBsAg by ethnicity, trend centres 2007 – 2010*



*At the 21 centres for which full data are available 2007-2010. Includes women aged between 10-50 years identified as undergoing antenatal testing from a combination of test request location and/or clinical details.

3.0 Trends in HDV testing between 2007 and 2010

Between 2007 and 2010, excluding antenatal testing, 5,362 HBV infected individuals were tested for HDV, of whom 4.6% (n=249) tested positive (Table 8).

3.1 Demographics

- The number of individuals tested for HDV increased by 82% between 2007 and 2010
- Gender and age were well reported (>99%).
- A higher proportion of men were tested than women, which increased over time, from 53.1% to 61.4%.
- The mean age of individuals being tested remained stable over time, however, the age of those testing positive increased between 2007 and 2009, and reduced slightly in 2010. This fluctuation is most likely a result of the small numbers of individuals testing positive.
- Approximately two thirds of individuals tested, and individuals testing positive were aged between 25-44.
- Among all individuals, there was no significant difference in the age of those testing, and those testing positive. The same was true for individuals of South Asian origin.
- There was no significant difference in the odds of testing positive by sex. Overall, 4.2% (88/2,100) of females and 4.9% (149/3065) of males tested positive.
- In 2010, the odds of an individual testing positive for HDV were 36% lower than in 2007 ($aOR_{\text{age group, gender, ethnicity}}$= 0.64; 95% CI 0.12 - 0.93; p<0.001).

Table 8. Trends in individuals tested, and testing positive for HDV, excluding antenatal testing, 2007-2010*

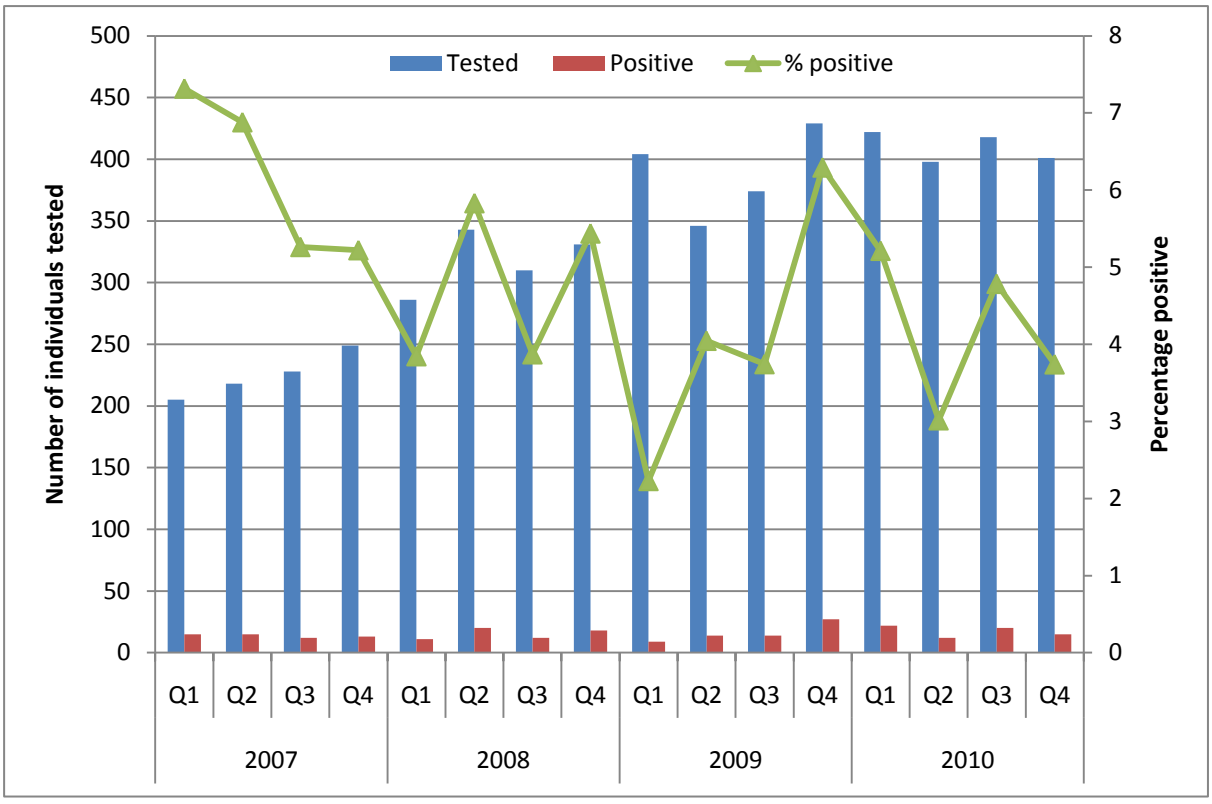
	2007	2008	2009	2010
All Individuals tested				
Number tested	900	1270	1553	1639
mean age in years	37.6	38.4	37.7	37.6
number male (%)	478 (53.1)	716 (56.4)	865 (55.7)	1006 (61.4)
Number S. Asian (%)	142 (15.8)	208 (16.4)	216 (13.9)	226 (13.8)
mean age S. Asian in years	37.8	39.3	35.7	37.0
Positive individuals				
Number positive (%)	55 (6.1)	61 (4.8)	64 (4.1)	69 (4.2)
mean age in years	33.55	36.75	39.22	36.84
number male (%)	33 (60.0)	34 (55.7)	36 (56.3)	46 (66.7)
Number S. Asian (%)	15 (27.3)	12 (19.7)	14 (21.9)	9 (13.0)
mean age S.Asian in years	31.25	36.62	37.86	35.11

* At the 3 centres for which full data are available 2007-2010. Excludes dried blood spot testing, antenatal testing.

3.2 Quarterly trends in testing

- The number of individuals tested for HDV by quarter increased steadily between 2007 and 2009, and levelled off in at approximately 400 tests per quarter during 2010 (Figure 5).
- The number of individuals testing positive for HDV varied by quarter.
- Although the proportion of positive individuals decreased over time, the absolute numbers of positives increased from 55 in 2007 to 69 in 2010.
- Overall, the proportion of individuals testing positive varied considerably by quarter, and although not significant, it has decreased over time as the number of tests have increased. This is likely to be as a result of the small number of tests performed each quarter.

Figure 5. Individuals tested, and percentage positive for HDV by quarter between 2007 and 2010*



* At the 3 centres for which full data are available 2007-2010. Excludes dried blood spot testing.

3.3 Testing by service type

- The majority of individuals testing in primary services were tested through general practice and GUM clinics, representing 67.3% and 23.7%, respectively (Table 9).
- The overall proportion of individuals who tested positive was higher among those testing through secondary services (5.5%) compared to primary services (4.9%), although the difference was not significant.
- The majority of individuals testing in secondary services (58.0%), and testing positive (60.9%), were tested through other known ward types (includes hospital services not specified here such as respiratory, cardiology etc).
- The greatest number of positive individuals identified from either primary or secondary services were tested in general practice. Overall between 2007 and 2010, 36.4% (32/88) of positive individuals tested through general practice.
- Overall, between 2007 and 2010, 244 women were tested for HDV antenatally, of whom 2.9% tested positive.
- The largest number of tests were from hospitals referring all samples, which accounted for 64.9% of all testing performed. Overall, 4.6% of individuals testing through these hospitals, tested positive.
- The highest proportion of positive individuals were of Asian or Asian British origin (Table 10). Compared those of white ethnicity, the odds of individuals of Asian ethnicity testing positive were 53% higher (aOR $_{\text{age group, gender, year tested}}$= 1.53; 95% CI 1.16 - 2.18; p<0.019).

Table 9. Number of individuals tested, and proportion positive by service type between 2007 and 2010*

	Number tested	Number positive	% positive
Primary care			
General practitioner	651	32	4.9
GUM clinic	230	13	5.7
Other known primary services	86	2	2.3
Total primary care	**967**	**47**	**4.9**
Secondary care			
General medical / surgical	81	4	4.9
Other ward type (known service)†	431	25	5.8
Specialist liver services‡	98	6	6.1
Unspecified ward§	42	3	7.1
Other known secondary services	91	3	3.3
Total secondary care	**743**	**41**	**5.5**
Other service types			
Hospitals referring all samples	3,636	160	4.4
Antenatal	244	7	2.9
Unknown service type#	16	1	6.3
Total excluding antenatal	**5,362**	**249**	**4.6**
Total tested	**5,606**	**256**	**4.6**

* At the 21 centres for which full data are available 2007-2010. Excludes dried blood spot testing. Data are de-duplicated subject to availability of date of birth, soundex and first initial. All data are provisional.

†This refers to all other hospital services not specified here: for example, it may include respiratory medicine, orthopaedics, care of the elderly, dermatology or cardiology departments.

‡ This refers to infectious disease services, hepatology departments and gastroenterology departments.

§ These are hospital services which are currently being investigated to identify specific service type, and may include any of the secondary care services mentioned above.

These services are currently being investigated to identify specific service type, where possible.

Table 10. Number of individuals tested, and proportion positive by grouped ethnicity between 2007 and 2010*

	Number tested	Number positive	% positive
Asian or Asian British	883	55	6.2
Black or black British	528	26	4.9
White or white British	2,216	93	4.2
Other and/or Mixed	934	24	4.3
Unknown	801	51	6.4

* At the 3 centres for which full data are available 2007-2010. Excludes dried blood spot testing and antenatal testing.

3.4 Trends in antenatal testing between 2007 and 2010

- Between 2007 and 2010, the number of women undergoing antenatal HDV testing increased from 48 to 84, to include 244 women overall.
- The mean age of women tested varied little between 2007 and 2010 (mean 28.6; range 27.6 - 29.4).
- Overall, 2.9% (n=7) of women undergoing antenatal testing, tested positive.
- Of women tested, 88.5% were non-South Asian and 11.5% South Asian.
- There was no significant difference in the proportion of South Asian women who tested positive (0.3%; 6/216) compared to non-South Asian women (0.4%; 1/28).

4.0 Discussion

This report presents the seventh analysis of hepatitis B testing data from the sentinel surveillance of hepatitis testing study, and the first for hepatitis D. This surveillance scheme contains over nine years of testing and demographic data including an estimated 2,616,600 individuals, 1,891,228 of whom were tested for HBV, drawn from sentinel laboratories in each strategic health authority in England. In this report, four years of testing and demographic data have been included to describe trends in testing.

As discussed in the hepatitis C report from sentinel surveillance, data on country of birth and/or self defined ethnicity are not routinely available. Ethnicity analysis based on an individuals name has therefore, been used as a proxy measure. Although there are limitations in the correlation assigned ethnicity with an individuals risk of acquiring hepatitis this approach gives more detailed information than otherwise available [3].

4.1 Hepatitis B testing

The demographics of individuals tested for HBsAg in 20010 were similar to those reported in 2009 [2]. Marginally more males were tested than females, with the odds of males testing positive two-thirds higher than females. Individuals aged between 15 and 44 years accounted for almost half of those tested and 61% of those testing positive. A relatively small proportion of individuals were identified as being of South Asian origin (13.2%), which is consistent with previous reports[2]. South Asian individuals undergoing testing were almost 6 years younger than non-South Asians and the odds of testing positive was two-thirds higher among south Asians compared with non-South Asians. While there are limitations with the use of NamPehchan to assign ethnicity these data are the most accurate available[3]. The increased likelihood of South Asian individuals testing positive compared to non-South Asians may be due to South Asians of relatively higher risk accessing testing and/or an increase in prevalence of hepatitis B in this group. As reported last year women who underwent routine antenatal screening were less likely to test positive for HBsAg compared to women undergoing first line testing.

Using combined ethnicity data available for the first time this year we have been able to further explore the relationship between ethnic group and patterns of testing. In 2010, excluding those of unknown ethnicity, over half (57.2%) of all individuals undergoing testing in 2010 were of white or white British ethnicity. The proportion positive varied by broad ethnic group, ranging from 8.8% among those of other and/or mixed ethnicity (8.8%) to 0.84% among those of white or white British ethnicity.

Trend data (from 21 centres) showed an increase in the number of individuals undergoing routine testing for HBsAg between 2007 and 2009, and a slight decrease in 2010. As discussed in the previous report, on-going surveillance is essential to monitor future changes in HBsAg.

The proportion of tests accompanied by risk factors and/or reason for testing from the freetext clinical details field, remains low (~1/3). This severely restricts any analysis of risk factors among the groups testing positive. Whilst these data may be available to the clinicians requesting the test, it can also be useful to virologists and epidemiologists examining data on positive individuals and we maintain that these data should be added to the test request form and onto the laboratory system.

As with last year there has been a greater decline in the likelihood of South Asian individuals testing positive than individuals who are not South Asian; this decline in positivity among South Asians corresponds to an increase in testing. The increase in testing in this community is welcome, and may be due to increased awareness among South Asians and/or general practitioners.

General practice has remained as the service through which the greatest numbers of people are tested hepatitis B, and have identified the greatest number of HBsAg positive individuals each year over the past four years. This underscores the importance of general practice in identifying prevalent hepatitis B infections.

The decline in the number of women undergoing routine antenatal screening for HBsAg has continued, and is likely to reflect changes in local screening arrangements. The population of women undergoing antenatal screening were significantly less likely to test positive for HBsAg than women undergoing routine first-line testing (odds ratio 0.29), which is an indication that women being tested for hepatitis B as part of ‘routine front-line’ testing are being targeted for HBsAg testing, possibly due to risk factors. Here we reported that 14.2% of HBsAg positive antenatal women were also HBeAg positive. Infants born to these women are given HBIG in addition to vaccination against hepatitis and followed up during their first year to ascertain whether they have undergone seroconversion to hepatitis B to ensure that every effort is made to reduce the likelihood of transmission to the child[4].

The annual frequency of new diagnoses among individuals tested for HBsAg has continued to decline. This is a positive finding and may result from increased awareness raising and immunisation of key risk groups. Furthermore, infections classified as acute have continued

to decline of the past 4 years, representing approximately one in 9 newly diagnosed HBsAg positive individuals in 2007, and 1 in 14 in 2010.

4.2 Hepatitis D testing

Hepatitis D infection occurs only in the presence of hepatitis B, without which it is unable to replicate or generate infectious particles. Hepatitis D may infect those who are already chronic HBV carriers (super-infection) or co-infect people simultaneously with HBV (co-infection), where it increases the severity of the hepatitis. For those co-infected, it increases the severity of the initial hepatitis, whereas those super infected more often progress to a more aggressive hepatitis, and hepatocellular carcinoma.

Limited data are available for hepatitis D in the UK, mainly because testing is offered by a limited number of centres. Our findings suggested that the number of individuals tested for hepatitis D by quarter has almost doubled since 2007, from approximately 200 in the first quarter of 2007, to more than 400 by the last quarter of 2010. Overall 4.6% of individuals tested were positive. Two-thirds of individuals tested, and of those who tested positive were aged between 24 and 44. This compares to half of all individuals tested (49.3%) being aged between 15-34, and 58.9% of those who tested positive were aged 25-44 among individuals tested for HBsAg. This similarity in the ages of those tested and testing positive held for those of both south Asian and non-south Asian origin, and for all broad ethnic groups. However, individuals of Asian or Asian British ethnicity were significantly more likely to test positive for hepatitis D compared to those of white or white British ethnicity

As with testing for hepatitis B, the majority of individuals tested for hepatitis D were tested through hospitals referring all samples and general practice. However, the overall proportion of those testing positive was higher among those who were tested through secondary services compared to primary services. This may reflect testing for hepatitis D being targeted towards those with more severe disease. Furthermore, testing for hepatitis D among antenatal women who have tested positive for hepatits B is not routine practice.

Acknowledgements

We would like to thank all the GPs and clinicians whose hepatitis B and D test requests have contributed to sentinel surveillance and all the laboratory staff who have undertaken HBV and HDV testing and data entry of tests. We would also like to thank all the information technology and other staff within each of the participating centres for helping the project coordinator to establish the study procedures and extract the data.

We thank Samar-Ahmad Ajmal for managing the data collection and ensuring data quality. We also thank Lisa Brant, Martin Hurrelle and Emily Tweed for their earlier work on sentinel surveillance. Without their efforts this programme would not be as successful as it is today.

Finally, we would like to thank the lead contact in each of the centres for their ongoing support and involvement in the study.

References

1. Brant L, *et al.* Sentinel laboratory surveillance of hepatitis C antibody testing in England: understanding the epidemiology of HCV infection. *Epidemiol Infect* 2007; 135: 417-426.

2. Collins S, Brant L. HEPATITIS B TESTING, 2009 Report: Analysis of 2009 and trend (2005-2009) data. Health Protection Agency, 2010.

3. Brant LJ and Boxall E The problem with using computer programmes to assign ethnicity: Immigration decreases sensitivity. *Public Health.* 2009; 123: 316-320.

4. Sloan D, *et al.* Prevention of perinatal transmission of hepatitis B to babies at high risk: an evaluation. *Vaccine.* 2005; 23: 5500-5508.

5. Cummins C, *et al.* An assessment of the Nam Pehchan computer program for the identification of names of south Asian ethnic origin. *J Public Health Med.* 1999; 21: 401-406.

6. Brant LJ, *et al.* Using automated extraction of hepatitis B tests for surveillance: evidence of decreasing incidence of acute hepatitis B in England. *Epidemioly and Infection (in press)* 2011;

7. Mateos P. A review of name-based ethnicity classification methods and their potential in population studies. Population, Space and Place. 2007; 13: 243-263.

8. Mateos, P. Using People's Names to Classify Ethnicity. ESRC Research Methods Festival; 1-7-2008.

Appendix 1: Methods

Methods of the sentinel surveillance study have been described elsewhere [1]. Details of participating laboratories are given in Appendix 2.

The de-duplication process implemented and reported on in 2009 was updated in 2010 to allow de-duplication across multiple centres. This identified duplicate patient records, using patient soundex, first initial, date of birth and where available NHS number. Patient records were retrospectively checked to identify duplicate records which were excluded from analysis. Duplication checks are now run on a monthly basis. This has led to a slight decrease in the number of patients tested and reported as positive. The removal of duplicate patients has allowed us to produce even more accurate data.

Although the sentinel surveillance began in 2002, participating laboratories joined the program at different dates. The second phase of prospective data collection has been ongoing since September 2004, with some but not all sites provided retrospective data on joining the program. Two sites joined the program since the last report, bring the total to 23 currently active sentinel sites (as of June 2011; see Figure 6 and Appendix 2). Consequently full data between 2002 and 2010 for use in trends analysis was only available for a limited number centres. Therefore, trends in testing are described here since 2007 in order to maximise the number of sentinel centres that were included in the trends analysis. The data presented represents testing from 21 sentinel centres with full data between 2007 and 2010 (of a total 27 which have ever participated).

Since 2010, sentinel laboratories have prospectively provided testing and demographic data for individuals tested for hepatitis D and E in addition to data for hepatitis A, B and C. Retrospective hepatitis D and E data has been integrated into the existing dataset to allow analysis of trends over time. The majority of samples tested for HDV testing were from hospitals that referred all hepatitis D testing to a sentinel laboratory. A limitation of these data was that information about the specific service that initially requested the hepatitis D test was not available. In some cases the requestor location was from a laboratory which only sent reference samples for hepatitis A, B, and/or C testing to a sentinel laboratory. The sentinel laboratories confirmed the HDV tests they performed was a primary diagnostic service. These samples, and hence the individuals tested, have therefore been classified as having undergone first line testing and were classified as belonging to the ‘hospitals referring all samples’ service type.

Work is progressing to integrate HIV and HTLV-1 testing and demographic data alongside hepatitis testing, with most sentinel laboratories providing these data prospectively. Retrospective HIV and HTLV-1 data has also been provided by some sentinel laboratories. Specialist HIV services are therefore included as a distinct category for the first time in this report.

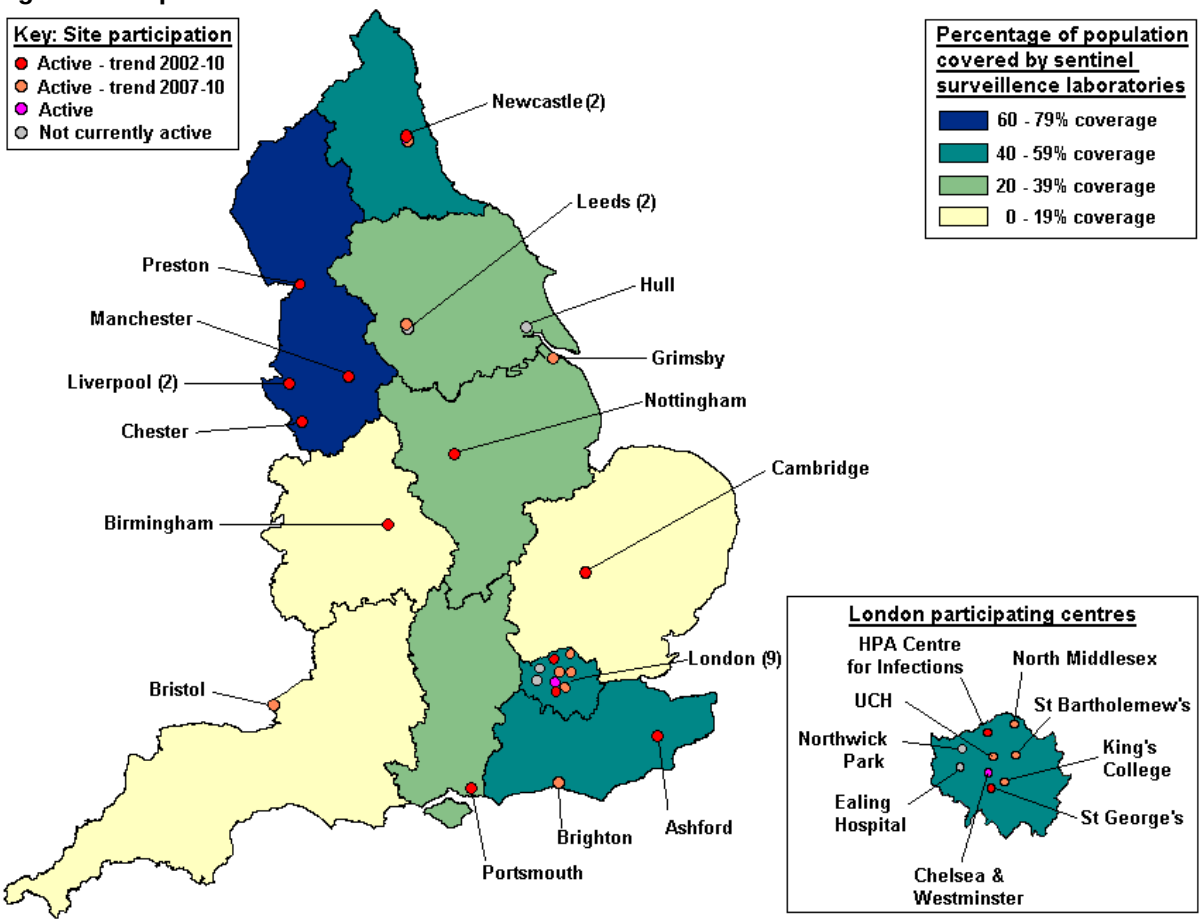
In previous reports ethnicity classification was based on name analysis using Nam Pechan software[5]. In 2010 additional ethnicity analysis was performed using OnoMap [7;8]. These data were hierarchically coded into a summary ethnicity field using i) self-reported ethnicity where available, ii) OnoMap 2001 Census classification, iii) Nam Pechan South Asian name analysis. Due to the small numbers of individuals tested identified as belonging to certain ethnic groups (e.g. mixed White and Black Caribbean) a grouped-ethnicity field was created; where individuals were classified as belonging to one of four broad ethnic groups – “Asian or Asian British”, “Black or Black British”, “mixed or other ethnic groups”, “White or White British”, or as being of an unknown ethnic group. Where this report refers to individuals as having names of South Asian or non-South Asian origin ethnicity has been derived solely from Nam Pechan name analysis. The use of grouped-ethnicity indicates a broad ethnicity classification based on the hierarchical assessment of multiple data sources has been used.

Women undergoing routine antenatal testing were identified using a combination of test location and/or data from the freetext clinical details field. Where a date of birth was available only women aged between 10 and 50 years were included. A review of the small proportion of individuals who were of unknown gender or classified as male indicated that most were male. These individuals were therefore included in the analysis of antenatal women.

The classification of newly diagnosed hepatits B infections has been described elsewhere [6]. Briefly, three laboratories used quantitative anti-HBc IgM tests, and in these centres the consultant virologist defined the IgM levels used locally (and used for the classification) to determine the stage of infection, according to the test in use, manufacturers instructions and local evaluation. Anti-HBc IgM and HBsAg results were reviewed for every sample and classified into nine categories, beginning with quantitative anti-HBc IgM results first as these can more accurately determine stage of infection. For the remaining laboratories that used qualitative IgM, other markers were included where appropriate. For individuals who had more than one sample that was IgM positive, the overall status was classified hierarchically in the following order: confirmed acute, probable acute, possible acute, probable chronic.

The characteristics of individuals tested and testing positive were described in sections 3 and 4. Statistical significance between groups was tested for using chi-squared. Trends in testing for the 21 laboratories for which full data were available between 2007 and 2010 were assessed using univariable and multivariable logistic regression. The largest group in each category were taken as the baseline group in logistic regression, for example, sex baseline group was males, age-group was 25-34 years, ethnicity was non South Asian and region was London. The annual frequency of new diagnoses of HBV was calculated as number of positive individuals identified that year divided by the population of England covered by the sentinel study. This number represents a rough estimate and it should be remembered that each laboratory and region have different approaches as to how people are identified for testing.

Figure 6: Map of sentinel laboratories.



Data were managed in MS Access and ORACLE and analysed in STATA and MS Excel.

Ethical approval was obtained from the Northern & Yorkshire Multi-Centre Research Ethics Committee and the Public Health Laboratory Service (PHLS) ethics committee. The study was funded until 30th September 2009 by the English Department of Health (study ref: GHP/003/002/02, previous ref: AIDB 2/28) and is now funded by the HPA.

Appendix 2: List of participating laboratories and periods of data collection

	Participating sentinel laboratory	HPA Region	Dates for which data are available		Included in analysis		
					2010	Trends*	HDV
1	Ashford laboratory	South East Coast	01/01/2002	31/12/2010	✓	✓	×
2	Birmingham laboratory	West Midlands	01/01/2002	31/12/2010	✓	✓	×
3	Brighton laboratory	South East Coast	16/10/2006	31/12/2010	✓	✓	×
4	Bristol laboratory	South West	01/04/2006	31/12/2010	✓	✓	×
5	Cambridge HPA laboratory	Eastern	01/01/2002	31/12/2010	✓	✓	✓
6	Centre for Infections	London	01/01/2002	31/12/2010	✓	×	✓
7	Chelsea and Westminster Hospital	London	01/01/2008	31/12/2010	✓	×	×
8	Chester HPA laboratory (via Manchester)	North West	01/01/2002	31/12/2010	✓	✓	×
9	Dulwich laboratory	London	01/09/2004	31/12/2010	✓	✓	×
10	Ealing Hospital	London	16/11/2002	15/10/2003	×	×	×
11	Freeman Hospital	North East	02/01/2002	31/12/2010	✓	✓	×
12	Grimsby laboratory	East Midlands	01/04/2002	31/12/2010	✓	✓	×
13	Hull laboratory	Yorkshire and Humberside	01/04/2002	30/11/2007	×	×	×
14	Leeds General Infirmary	Yorkshire and Humberside	01/09/2004	31/12/2010	✓	✓	×
15	Leeds HPA laboratory	Yorkshire and Humberside	01/01/2002	29/07/2005	×	×	×
16	Liverpool HPA laboratory (via Manchester)	North West	01/01/2002	31/12/2010	✓	✓	×
17	Manchester HPA laboratory	North West	01/01/2002	31/12/2010	✓	✓	×
18	Newcastle laboratory	North East	01/01/2002	31/12/2010	✓	✓	×
19	North Middlesex Hospital	London	29/07/2002	31/12/2010	✓	✓	×
20	Northwick Park Hospital	London	Data not yet available		×	×	×
21	Nottingham laboratory	East Midlands	02/09/2002	31/12/2010	✓	✓	×
22	Portsmouth laboratory	South Central	01/01/2002	31/12/2010	✓	✓	×
23	Preston HPA laboratory (via Manchester)	North West	01/01/2002	31/12/2010	✓	✓	×
24	Royal Liverpool Hospital	North West	01/01/2002	31/12/2010	✓	✓	×
25	St Bartholomew's Hospital	London	01/08/2004	31/12/2010	✓	✓	×
26	St Georges Hospital	London	01/01/2002	31/12/2010	✓	✓	×
27	University College Hospital	London	01/09/2004	31/12/2010	✓	✓	✓

*Trend data based on the centres for which complete 2007-2010 data were available

Appendix 3: Sentinel surveillance study participants

Hamid Jalal, Melanie Matthews, Rachael Smith. Addenbrookes Hospital, Cambridge

Chas Ashley, Peter Muir. Bristol Regional HPA Laboratory

(Rolf Meigh. Castle Hill Hospital, Cottingham, Hull)

Mark Atkins, Mark Green, Lesley Mayoh. Chelsea and Westminster Hospital, London

John Croall. Chester Microbiology Laboratory, Countess of Chester Hospital, Chester

Tony Vicca. Diana Princess of Wales Hospital, Grimsby

(Ferial Ahmad, Imad Ibrahim. Ealing Hospital, London)

Julia Locklan, Sheila Waugh, Freeman General Hospital, Newcastle

(Koye Balogun), (Lisa Brant), Sarah Collins, Samar-Ahmad Ajmal, Sam Lattimore, Mary Ramsay. Health Protection Agency, Centre for Infections, London

Samreen Ijaz, Siew Lin Ngui, Richard Tedder. Sexually Transmitted and Blood Borne virus laboratory, Health Protection Agency, Centre for Infections. London.

Manoj Vallapil, (Jeff Taylor), (Clive Taylor). Health Protection Agency, Newcastle laboratory, Newcastle General Hospital, Newcastle

Elizabeth Boxall, Janet Mowbray. Health Protection Agency West Midlands laboratory, Heart of England Foundation Trust, Birmingham

David Lewis, Antony Hale. Leeds Teaching Hospitals NHS Trust, Leeds

Martin Hurrelle. Health Protection Agency, Leeds laboratory, Seacroft Hospital, Leeds

Ralph Henderson, David Johnson, Mark Zuckerman. Kings College Hospital, London

Alan Blackley, Paul Klapper, (Ken Mutton), (Keith Paver), (Andrew Turner). Manchester Medical Microbiology Partnership, Manchester Royal Infirmary, Manchester

Matthew Longbone, Mohammed Osman Hassan Ibrahim, Royal Sussex County Hospital, Brighton

(Shuja Shafi, Dilip Zala. Northwick Park Hospital, London)

Will Irving, Lisa Prichett, (Simon Pugh). Queens Medical Centre, Nottingham

Josephine Silles, (Geoff Benge), (Bharat C Patel). HPA Collaborating centre, North Middlesex University Hospital, London

Louise Hesketh. Microbiology Laboratory, Royal Preston Hospital, Preston. Lynne Ashton, Ian Hart. Royal Liverpool Hospital, Liverpool

Tony Oliver, (Adele Lee), (Ines Ushiro-Lumb), Xose Couto-Parada. Barts and The London NHS Trust, London

Hasan Al-Ghusein, Phil Rice. St George's Hospital, London

Graham Hewitt, Gillian Underhill. St Mary's Hospital, Portsmouth

Mike Kidd, Peter Luton, (Emma Aarons). University College Hospital, London

Mark Baker, James Nash. William Harvey Hospital, Ashford, Kent