Student worksheet 1 answers

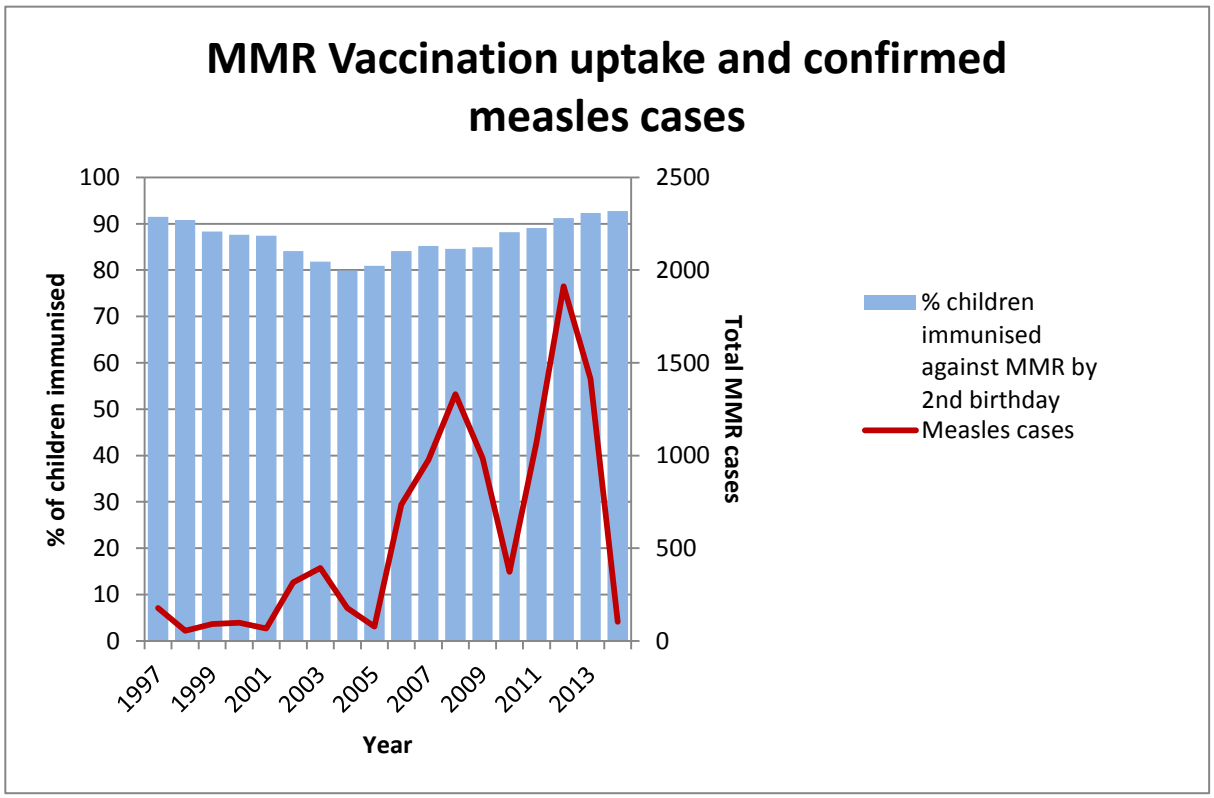
1. The table below provides the percentage of children immunised by their second birthday against measles, mumps and rubella (MMR) between 1996 and 2014 (England only). This data is from the Health & Social Care Information Centre (available from http://www.hscic.gov.uk/catalogue/PUB14949/nhs-immu-stat-eng-2013-14-rep.pdf).

Year of 2nd Birthday	MMR 1st dose (%)
1996-97	91.5
1997-98	90.8
1998-99	88.3
1999-2000	87.6
2000-01	87.4
2001-02	84.1
2002-03	81.8
2003-04	79.9
2004-05	80.9
2005-06	84.1
2006-07	85.2
2007-08	84.6
2008-09	84.9
2009-10	88.2
2010-11	89.1
2011-12	91.2
2012-13	92.3
2013-14	92.7

The table below provides numbers of confirmed cases of measles in England by age, between 1997 and 2013. This data is from Public Health England.

Year	< 1 year	1 – 9 years	10 – 19 years	20 + years	Not known	Total cases
1997	4	101	46	22	4	177
1998	2	26	12	16	0	56
1999	6	35	11	38	2	92
2000	11	52	14	23	0	100
2001	5	26	13	26	0	70
2002	33	171	58	43	3	308
2003	34	264	71	64	5	438
2004	24	108	25	31	3	191
2005	7	47	6	17	0	77
2006	76	389	129	144	2	740
2007	91	558	210	131	0	990
2008	112	649	380	229	0	1370
2009	84	603	331	125	1	1144
2010	33	128	112	107	0	380
2011	57	358	401	271	0	1087
2012	215	743	674	398	0	2030
2013	163	548	769	363	0	1843
2014	17	41	16	47	0	121

2. Using the data provided, plot a single graph showing MMR vaccination uptake and measles cases in England between 1997 and 2014. Plot the MMR vaccination uptake as a bar graph and the number of measles cases overtop as a line graph.



3a. Interpret your graph showing MMR vaccine uptake and measles cases in England. What has happened?

The graph indicates that there was an immediate decline of MMR vaccination rates starting in 1998 when the first paper was published. The rates continued to drop until they reached their lowest point in 2003/04, below 80%. After 2004, the rates steadily increase and in 2014 they are at a historic high of 92.7%.

However, in contrast, the general trend in confirmed measles cases is increasing beginning in 2002.

3b. Why do you think there were changes in the vaccination uptake rates and cases of measles? What influenced the changes?

Media coverage of Andrew Wakefield's flawed studies influenced the public's view of the safety of the MMR jab. As a result, the vaccination rates decreased below the recommended 95% uptake resulting in increase of the pool of susceptible individuals to measles. Parents were unsure about the safety of the vaccine, and this resulted in not vaccinating their children. The rates of measles in England increased, and there were large outbreaks in 2008 and 2012.

4. What is the relationship between these two figures? How do they impact each other?

As the vaccination uptake decreases, measles infections in the population begin to increase. Once the vaccination uptake increases, beginning in 2005, the measles infections in the population is affected.

5. What were the ages of individuals who had measles in 2002? Explain why that may be?

The majority of the measles cases in 2002 were aged 1-9 yrs. These were children that were offered at least one dose of the MMR vaccine (1st dose of MMR should be given age 13 months, 2nd dose between the ages of 3.5 and 5yrs). Because the vaccination uptake had been falling, fewer children had been vaccinated and therefore caught measles when coming into contact with the infection.

6. Divide the measles cases data into three periods: 1997-2002, 2003-2008 and 2009-2014. What trend do you notice in the overall numbers and individual age groups?

period	< 1 year	1 – 9 years	10 – 19 years	20 + years	Not known	Total cases
1997-2002	61	411	154	168	9	803
2003-2008	344	2015	821	616	10	3806
2009-2014	569	2421	2303	1311	1	6605

The number of cases of measles is increasing, between 1997-2002 and 2003-2008 the number of cases more than quadruples. In the following period, the cases double again. While in the first period there were more cases of measles in the very young age group, in the next periods there was an increase across all age groups. As the cohort of young people who were not vaccinated against MMR between 2002 and 2005 start to grow older, they are at risk of being infected with measles, mumps or rubella, and herd immunity cannot have a protective effects. Therefore, when an outbreak occurs, more of the susceptible population can be infected. The greater the pool of susceptible individuals, the larger the outbreaks and the longer the outbreak continues. Unless susceptible individuals are vaccinated the only way they can obtain immunity is through having the infection.

7. What conclusions can you draw from the ages of the confirmed cases of measles?

As the MMR vaccine uptake decreases, there is an increase in the number of children who are susceptible to catching measles. In the first period from 1997-2002, most cases of measles were in the 1-9yrs old. This is because the older age groups have had better vaccine uptake and were therefore protected by the MMR vaccine. However, in the subsequent periods, the age profile of the cases is changing as susceptible individuals (those not vaccinated) grow older.

8. How was herd immunity affected by the media in this example?

Herd immunity indirectly protects individuals in the population who have not had a vaccine. However, rates of vaccine uptake need to be very high (around 95%) for herd immunity to have an effect. Measles is very infectious and spreads easily from person to person. In this example, the MMR vaccine uptake between 2002 and 2005 is only about 80%, so many children in the population are not protected and cannot offer indirect protection to their peers and family.