RAPID RISK ASSESSMENT

A fatal case of diphtheria in Belgium

24 March 2016

Main conclusions and options for response

Universal immunisation with diphtheria toxoid-containing vaccine is the only effective preventive control measure for diphtheria. Vaccination against diphtheria in children, adolescents and adults should follow the national immunisation schedules in the EU/EEA Member States.

The following options should be considered:

- Ensure that clinicians have the knowledge required to promptly recognise and treat diphtheria and have access to testing algorithms and instructions for how to collect and transport samples to the laboratory.
- Laboratories and countries that lack capacity for confirming toxigenic diphtheria infections should make provisions to send samples to the WHO reference laboratory in the United Kingdom.
- Assess the level of access to diphtheria antitoxin (DAT) and, if required, consider transnational options for securing rapid access to it for all patients that have suspected or confirmed diphtheria-toxin-induced disease.
- Advise travellers to diphtheria-endemic countries to check whether they have completed primary vaccination against diphtheria before departure, and to receive a booster dose of diphtheria toxoid if more than 10 years has passed since the last dose.
- Equity of access to immunisation should be promoted and monitored.

Options for reducing the risks associated with limited access to diphtheria antitoxin in the EU

A range of options need to be considered for resolving the acute shortage of DAT. Member States should assess the level of access to DAT in their country and, if required, consider transnational options for securing rapid access to it for all patients that have suspected or confirmed diphtheria-toxin-induced disease. Sharing of information collected through such an assessment would also enable an initial assessment of the current stockpiles within the EU.

Testing of existing stockpiles for potency and quality, through transnational testing arrangements if necessary, would also help in the assessment of the scope and timescale of future procurement of stock.

In the light of such assessments, EU/EEA Member States might wish to consider expressing interest in the European joint procurement of medical countermeasures as a mechanism for procuring an emergency stockpile of DAT.

Erratum, 4 April 2016
Table 1, in the total for 'reporting country' under 'unknown pathogen', '(2 confirmed, 2 possible)' was deleted.

Suggested citation: European Centre for Disease Prevention and Control. A fatal case of diphtheria in Belgium, 24 March 2016. Stockholm: ECDC; 2016.

Options for reducing the risks of non-vaccination against diphtheria

A range of options need to be considered for resolving the issue of non-vaccination against diphtheria in the EU/EEA. These options would also support vaccination against all other vaccine-preventable diseases:

- Develop and roll out training programmes for vaccine providers that will make them better equipped to deal with parents who are hesitant about vaccinating their children.
- Similarly, develop and roll out information programmes for vaccine receivers to better understand why they are offered vaccination.
- Explore mechanisms for improved monitoring of vaccine coverage, such as using electronic immunisation registries that may facilitate the identification of unvaccinated individuals and could offer additional benefits in terms of those who want to keep track of their children's vaccinations.
- Checking immunisation status at every healthcare encounter and at major milestones and vaccinating when necessary.

Source and date of request

ECDC internal decision, 17 March 2016.

Public health issue

Risk related to under-vaccination against diphtheria and shortage of diphtheria antitoxin in the EU, following a fatal case of diphtheria in Belgium in an unvaccinated child.

Consulted experts

Internal experts consulted (in alphabetical order): Denis Coulombier, Ida Czumbel, Tarik Derrough and Lucia Pastore-Celentano.

External experts consulted (in alphabetical order): Natasha Crowcroft (Public Health Ontario, Canada), Wim Flipse (Agency for Care and Health, Flanders, Belgium), Tine Grammens (Scientific Institute of Public Health, Belgium), Denis Pierard (National Reference Centre for *C. diphtheriae*, UZ Brussel, Belgium), Martine Sabbe (Scientific Institute of Public Health, Belgium).

The external experts have submitted declaration of interest statements pertaining to this risk assessment.

Event background information

On 17 March, Belgian authorities reported a case of toxigenic respiratory diphtheria through the Early Warning and Response System (EWRS). The case had been confirmed on 15 March in Antwerp in a 3-year-old unvaccinated child of Chechnyan origin, born in Belgium.

The case had onset of symptoms on 6 March. On 10 March, the child was transferred from a regional hospital to the University Hospital in Antwerp and admitted to a special intensive care unit with severe tonsillitis. Diphtheria was included in the differential diagnosis and a search for DAT was started the same day. Since no DAT was readily available in Belgium, the search was extended but not expedited as the girl's clinical condition improved. At this point, no formal microbiological diagnosis had been made. On 11 March, the girl was transferred to the ward in an isolator. Later on, she developed an AV block and myocarditis. An external pacemaker was used.

On 15 March, the National Reference Centre for diphtheria in Belgium confirmed the case as caused by toxigenic *Corynebacterium diphtheriae*, which was later confirmed by the WHO Global Collaborating Centre for Reference and Research on Diphtheria in the UK. As there is no stockpile of DAT in Belgium, ECDC helped to procure the antitoxin when contacted on 16 March 2016. The National Institute for Public Health and the Environment (RIVM) of the Netherlands supplied the antitoxin the same day. Despite administration of DAT, the child died on 17 March. Upon confirmation of the case, Belgian regional authorities implemented prevention and control measures according to regional regulations [1].

Control measures: The family of the child received prophylactic antibiotic treatment and were swabbed to determine the presence of the bacterium. The medical personnel and caregivers – who could have been exposed to droplets during the admission process in the first hospital – were swabbed and received antibiotics. The doctor at the day-care centre verified the vaccination status of all children in the child's group and another two groups in

adjacent rooms. One child needed a supplementary vaccination. All others were vaccinated in accordance with the vaccination schedule. On 16 March, all parents who had children in the day-care centre received a detailed information letter.

Staff and parents of pupils in the day-care centre attended by the child were informed individually, and supplementary vaccination was provided on an individual basis as appropriate. Only one child needed a supplementary vaccination.

The parents and three siblings of the case tested negative for *C. diphtheriae*. Preliminary results of the screening of the healthcare personnel (N=15) and of the children at the day-care centre (N=26) indicated that they were all negative for diphtheria.

In Flanders, vaccinations against diphtheria are offered at 8, 12 and 16 weeks of age, with booster doses at 15 months, 6 years and 14 years of age. A survey in Flanders in 2012 estimated vaccination coverage for diphtheria at 98.7% for the third dose and 93.0% for the fourth dose [2]. For Belgium, vaccination coverage for diphtheria was estimated at 98.8% for the third dose and 92.7% for the fourth dose of DTP by weighted average of regional vaccination coverage surveys from 2012 to 2015.

Disease background information

Clinical manifestations and treatment

Diphtheria is a transmissible bacterial disease primarily infecting the pharynx, larynx, tonsils and nose. In tropical and subtropical settings the bacteria frequently affect skin or mucous membranes, including conjunctivae and vagina. The causative agents of diphtheria are mainly toxin-producing *C. diphtheriae* transmitted via droplets during close contact. No significant reservoirs for toxigenic *C. diphtheriae* other than humans have been identified. The incubation period for *C. diphtheriae* ranges from two to five days but can be as long as ten days [3]. Other corynebacteria, *C. ulcerans* and very rarely *C. pseudotuberculosis*, may produce diphtheria toxin although the strains appear to belong to distinct species and may have different routes of transmission [4].

Diphtheria has a gradual onset with development of a sore throat, low-grade fever and mild exudative pharyngitis. Mild cases resemble streptococcal pharyngitis. In severe cases, pseudo-membranes start forming after 2 to 3 days. Pseudo-membranes are thick greyish membranes that are firmly attached to the underlying mucosa. The critical pathogenic factor for severe diphtheria is the exotoxin produced by toxigenic *C. diphtheriae* which causes cell destruction. Upon absorption, the toxin has a predilection for the myocardium and the cells of the nervous system.

The overall case–fatality rate for diphtheria is 5 to 10%, with higher death rates of up to 20% among persons younger than 5 and older than 40 years of age. The case–fatality rate for diphtheria has remained stable in the past 50 years [5].

Non-toxin-producing strains may cause mild to moderate pharyngitis but are not associated with formation of a pseudo-membrane. However, the few severe cases that have been reported may have been caused by toxigenic strains that were not detected because of inadequate culture sampling [5].

Infections may occur in highly vaccinated individuals and populations but these are usually asymptomatic or result in a mild clinical course and therefore may remain undiagnosed and underreported. However, severe cases including two deaths have recently been reported in fully vaccinated children in Brazil, where the disease is still endemic [6].

Successful treatment of diphtheria depends on rapid administration of equine diphtheria antitoxin (DAT) in combination with antibiotics. DAT should be administered upon clinical suspicion of diphtheria, whether or not there are systemic toxic symptoms present, as it binds to circulating toxin but does not neutralise toxin that has already bound to, or entered into cells. DAT treatment initiated later than 48 hours after onset of systemic toxic symptoms has limited impact on the clinical outcome although DAT is, when necessary, offered at any stage of the disease [7]. Administration of DAT can cause acute and delayed hypersensitivity reactions. DAT is included in the *World Health Organization Essential Medicines List for Children* [8].

Antibiotic treatment, in addition to the DAT treatment, is necessary to eliminate the bacteria and prevent further spread to other susceptible individuals.

Delays in appropriate treatment with DAT and antibiotics are often the result of delayed clinical suspicion of disease because the treating physician may never have seen a case of diphtheria because it is now so rare.

Countries should follow national guidelines on case management. Most guidelines recommend treatment with benzylpenicillin (penicillin G) or a macrolide (erythromycin, azithromycin or clarithromycin) for a period of 14 days. Individuals who continue to harbour the bacteria after treatment should receive an additional course of oral erythromycin and submit a new sample for culture after completion of the course. Antibiotic resistance seems rare but strains with intermediate susceptibility to penicillin G and erythromycin have been reported [6].

In addition, patients should receive immunisation with diphtheria toxoid upon recovery since natural diphtheria infection does not always confer protective immunity.

Diphtheria (caused by *C. diphtheriae, C. ulcerans* and *C. pseudotuberculosis)* is a notifiable disease in the EU and Member States are expected to report new cases to ECDC as soon as they are diagnosed [9].

Diagnostic tests

Diagnostic tests used to confirm a case include the isolation of *C. diphtheriae* by culture and toxigenicity testing.

There are no commercial tests available for the diagnosis of diphtheria. Laboratory identification and confirmation of diphtheria requires isolation of *C. diphtheriae* by culture from a clinical specimen (nasal swabs, pharyngeal swabs or swabs from pseudo-membrane, wound or skin lesions) and toxigenicity testing. Direct and real-time polymerase chain reaction (PCR) assays can detect the *C. diphtheriae* toxin gene within a few hours, but confirmation of diphtheria toxin expression must be undertaken with the Elek test. Procedures for the collection of specimens are available in the WHO *Manual for laboratory diagnosis of diphtheria* [10]. Potentially positive samples should be sent for confirmation and further biotyping to the WHO Collaborating Centre for diphtheria in the UK (http://apps.who.int/whocc/Detail.aspx?cc_ref=UNK-194&cc_code=unk).

Case detection is strongly influenced by availability of laboratory resources (techniques, methods, reagents and the quality of the reagents) and the technical expertise. A reliable, sensitive and timely diphtheria laboratory service is necessary to diagnose infections and to demonstrate the absence of diphtheria transmission in a population.

The results of the External Quality Assessment exercise carried out in 2013 in EU/EEA Member States indicate challenges in several EU/EEA laboratories in providing quality diagnostic methods for diphtheria as well as challenges in availability of reagents for the tests [11]. Limitations in the capacity to confirm toxigenic infections may delay diagnosis, treatment and public health interventions in some EU Member States. Enhanced surveillance, molecular typing and whole genome sequencing of patient isolates have the potential to improve the understanding and monitoring of transmission patterns of diphtheria.

Outbreak control

The identification and management of close contacts of a single suspected or confirmed case caused by toxigenic *C. diphtheria* is a public health emergency and calls for immediate action. Outbreak management guidelines are usually available at national and regional level in the EU/EEA Member States and they should be consulted and followed in light of a suspected case of diphtheria.

Definition of close contacts and control measures

Close contacts

Any close contact of a suspected or confirmed case of diphtheria caused by toxigenic *C. diphtheriae* should be considered at risk of developing the disease if contact was within seven days before the first symptoms started until 48 hours after the start of antibiotic treatment. Contacts of cases due to non-toxigenic *C. diphtheriae* or *C. ulcerans* (including toxigenic *C. ulcerans*) are not at risk and are not discussed here.

Closeness and duration of contact are important in determining the spread of the disease, and prolonged close contact is usually required for spread. However, transmission can also occur through direct exposure to large particle droplets or secretions. In addition, a close contact identified through contact tracing may have been the source of infection for the index case, and this may require sensitive communication.

Contacts considered at risk are those who have had prolonged close contact with a suspected or confirmed case or with a known carrier in a household-type setting, or those who have had transient close contact if they have been directly exposed to large particle droplets or secretions. The risk is higher for any contact who is unvaccinated or only partially vaccinated.

Those to be considered at greatest risk of contracting the infection, and so classified as close contacts, are:

- parents, siblings and other family members that are living and sleeping in the same household as the index case
- those who have kissed or had intimate contacts with the case
- healthcare workers who have given mouth-to-mouth resuscitation
- school and kindergarten classroom contacts
- care givers (e.g. childminder for many hours each day of children less than 7 years of age, babysitter) who regularly visit the home.

The risk of infection in other contacts (e.g. friends, relations, school contact, school camps and other healthcare staff) will depend on the duration of contact with the case and should be assessed on a case by case basis by the local public health authority team.

Control measures

In general, the options for control measures following the isolation and management of suspected diphtheria consist of:

- identifying close contacts, especially household members and persons that may have been directly exposed to oral secretions of the case
- monitoring the clinical conditions of contact persons
- swabbing (nose and throat swabs) close contacts regardless of immunisation status
- providing antibiotic treatment to close contacts after nasopharyngeal and throat swabs have been collected, regardless of culture result and according to national or regional recommendations.

  Recommended agents for chemoprophylaxis are either erythromycin (seven days) or, if erythromycin cannot be tolerated, an alternative macrolide such as azithromycin or clarithromycin (seven days). These would eradicate *C. diphtheriae* from the nose and throat of carriers in an average of three days. A single intramuscular dose of benzylpenicillin can be given. If there is a positive culture from a close contact of a toxigenic *C. diphtheriae* case, even asymptomatic, the same measures should be implemented as for a case.

- assessing the vaccination status of each contact and administration of supplementary doses when required:
  - All close contacts who have never been vaccinated, or have received fewer than three doses of diphtheria toxoid in the past, or whose immunisation status is unknown, should be given an immediate booster dose of diphtheria-toxoid-containing vaccine, and then complete the full immunisation series according to the nationally recommended schedule.
  - Contacts who have received a primary immunisation series (minimum three doses), but have not had a booster within the last five years, should receive an immediate booster dose.
  - Contacts who have had three doses of vaccine in the past, should receive an immediate booster dose, unless the last dose was given in the previous 12 months.
  - Special attention should be given to close contacts who refuse vaccination, and measures should be assessed individually.

As for all vaccine-preventable diseases, a case of diphtheria arising in an unvaccinated individual (child or adult) or their contacts is an opportunity to review the immunisation system to determine the reasons for the lack of immunisation in that individual or group and inform future strategies to strengthen the system and reduce barriers to immunisation.

Prevention through vaccination

Vaccination against diphtheria is included in all immunisation schedules in the EU/EEA Member States. It is offered as part of primary vaccination during the first year of life and subsequent boosters later during childhood, usually at the age of first school-entry and adolescence [12].

The vaccine effectively protects against the effects of the exotoxin produced by *C. diphtheria* and *C. ulcerans* but vaccinated individuals can still be infected by the bacteria, become asymptomatic carriers of toxin-producing strains and may transmit these to others.

The reported vaccination coverage among children in the EU/EEA is reported to be >95% [13] .

However, some groups of people continue to refrain from vaccination for personal, philosophical or religious reasons. In addition, there are families from under-served population groups, including migrants who may not have been offered vaccination and face barriers to accessing preventive services including immunisation.

Diphtheria vaccines are effective and have essentially eliminated clinical diphtheria from the European region. There are unresolved issues about waning immunity and the need for booster doses. Limited data on population level immunity published in 2000 reported significant proportions of susceptible individuals particularly among adults and the elderly [14].

If adults do not have natural exposure to diphtheria-causing organisms or receive booster doses of diphtheria toxoid, their immunity induced by childhood immunisation wanes and they become susceptible to the disease [15].

Therefore, WHO recommends [16] booster doses with diphtheria toxoid approximately every 10 years throughout life and that tetanus prophylaxis following injuries should be given as a combination of diphtheria and tetanus toxoid (DT or dT).

Diphtheria epidemiology in the EU/EEA

Diphtheria caused by *C. diphtheriae, C. ulcerans* and *C. pseudotuberculosis* is a notifiable disease in the EU and cases are reported to ECDC and follow the EU case definition for communicable diseases [9]. During the period 2009–2014, 140 cases were reported to the ECDC in the EU/EEA, with 79 cases of *C. diphtheriae* (76 confirmed and 3 possible) (Table 1). There has been an increase in the number of *C. diphtheriae* cases reported at EU level since 2011 (Table 1). Latvia is the only EU Member State that reported indigenous transmission.

Table 1: Cases of *C. diphtheriae* and *C. ulcerans* reported in the EU/EEA, by year and country, 2009–2014

Year	2009	2010	2011	2012	2013	2014	Total
All diphtheria cases	10	14	20	27	31	38	140
C. diphtheriae (n)							
Total	5	3	12	16	19	24	79 (76 confirmed, 3 possible)
Reporting country	DE (2), SE (1), UK (2)	DE (1), LV (1), UK (1)	DE (2), FR (3), LV (6), SE (1)	DE (3), FR (2), LV (8), NL (1), SE (2)	LV (14), SE (2), UK (3)	AT (2), DE (3), ES(1), FR (1), LV (12), NL (1), NO (2) SE (2)	AT (2), DE (11), ES (1), FR (6), LV (41), NL (2), SE (8), UK (6)
Age range (yrs)	11–74	20–68	11–69	3–75	5–75	2–76	2–76
C. ulcerans (n)							
Total	3	11	7	11	12	13	57
Reporting country	FR (1), UK (2)	DE (7), FR (2), LV (1), UK (1)	DE (2), FR (2), SE (1), UK (2)	BE (1), DE (6), FI (1), FR (2), UK (1)	BE (1), DE (4), FR (6), UK (1)	DE (6),FR(5), SE (1), UK (1)	BE (2), DE (19), FI (1), FR (13), LV (1), SE (1), UK (7)
Age range (yrs)	30–87	19–89	59–85	10–92	46–85	13–88	10–92
Unknown pathogen (n)							
Reporting country	DE (2)	0	LT (1)	0	0	LV (1)	4
Age range (yrs)	56–62	–	55	–	–	78	55–78

Countries reporting cases: BE–Belgium, DE–Germany, FI–Finland, FR–France, LT–Lithuania, LV–Latvia, NL–Netherlands, NO–Norway, SE–Sweden, UK–United Kingdom.

In a recent European study, 10 European countries each screened between 968 and 8551 throat swabs from patients with upper respiratory tract infections for *C. diphtheriae* during 2007–2008. Six toxigenic strains of *C. diphtheriae* were identified: two from symptomatic patients in Latvia and four from Lithuania (two cases, two carriers). Among the toxigenic isolates, the Saint Petersburg epidemic clone that caused large diphtheria outbreaks in Russia and the Newly Independent States of the former USSR in the 1990s was still in circulation [17]. Carriage rates among household contacts of a laboratory-confirmed case may be as high as 25% [18].

ECDC threat assessment for the EU

The diphtheria case in Belgium does not currently represent a serious cross-border threat to health in the EU but is a matter of concern in light of the limited availability of DAT across the EU/EEA Member States.

Such cases are not unexpected among unvaccinated individuals since exposure to *C. diphtheriae* may occur amongst travellers to, or those with social connections to, endemic countries.

Absence of vaccination against diphtheria

This event is a reminder that in non-endemic countries with high vaccination coverage, people not vaccinated against diphtheria are at risk of developing the clinical form of diphtheria because *C. diphtheriae* may circulate in healthy vaccinated populations. ECDC produced a rapid risk assessment about a non-vaccinated child in Spain in June 2015 [19].

Diphtheria is a life-threatening condition with a high risk of sequelae among survivors, and the only effective protection is vaccination. This applies particularly to migrant groups who in addition to being at increased risk of being unvaccinated may also be at increased risk of exposure through social connections or travel to diphtheria-endemic parts of the world.

Families and individuals who do not vaccinate or are hesitant about vaccinations tend to cluster geographically, creating pockets of unvaccinated communities within otherwise highly vaccinated populations [20,21]. This increases the risk of developing the disease if *C. diphtheriae* is introduced into these communities. In addition, there may be population groups that are under-served and under-vaccinated and they also tend to cluster geographically [22].

Availability of DAT in EU/EEA Member States

Several countries stopped manufacturing DAT following the significant decline in incidence of the disease after the introduction of mass vaccination in Europe [23]. With the support of the Member States, ECDC is working to maintain an inventory on the availability of DAT in EU/EEA countries.

Countries with indigenous cases, such as Latvia, hold a stockpile at national level that enables immediate administration when needed. However, there are several countries, including some that have reported imported cases in the last five years, which do not hold a stock, or hold a stock which is close to expiring or has expired. Some countries have relied on DAT produced in Croatia by the Institute of Immunology, but production has been stopped and vials still available have now largely expired.

Attempts by EU/EEA governments to procure DAT from producers in Russia (www.microgen.ru), India (http://www.indiamart.com/vinsbioproducts) and Brazil (http://www.butantan.gov.br) have encountered difficulties, although occasionally DAT from non-EU suppliers has been imported for emergency use.

ECDC has received information that the Bulgarian company BulBio (http://www.bulbio.com) produces DAT for internal use, although they do not currently have stock to share. The situation is similar in North America, where no supplier exists. In addition, there is a quality assurance issue for non-licensed pharmaceutical products. Some EU/EEA regulatory agencies work closely together by testing and conducting research to analyse DAT concentrations and to assure the quality of the product.

The current lack of DAT is of great concern. DAT is needed in the EU/EEA for immediate use when clinicians suspect a diphtheria case, which is rare, but still occurs every year. The scarcity of DAT stock also emphasises the importance of the maintenance of high vaccine coverage in all countries. There is an urgent need to allow EU Member States to access to DAT in the 48 hours following the initial symptoms in case a diphtheria patient is suspected.

Clinical recognition of diphtheria

Most clinicians in the EU might lack first-hand experience of diphtheria and may not even consider diphtheria in the differential diagnosis of patients unless an outbreak has been declared or it becomes clear that the patient is unvaccinated. Delays in the recognition of symptoms can be compounded by difficulties in accessing diphtheria diagnostics.

Monitoring of immunisation coverage

Good quality immunisation coverage monitoring and feedback supported by a health/public health system that identifies marginalised groups and designs systems to meet their needs will help address equity in immunisation access issues.

Carriage in general EU populations

Carriage of C. *diphtheriae* in unvaccinated and vaccinated healthy individuals is documented and will remain an important determinant of the risk of exposure to diphtheria. Knowledge about trends and distribution of carriage rates is important for the risk assessments but can only be obtained through repeated representative surveys [17].

Surveillance of diphtheria immunity levels

Regular assessment of the prevalence of diphtheria toxin antibody positivity, through surveys on population samples, is of value in assessing responses to vaccination and immunisation schedule effectiveness, in determining the rates of immunity within broad populations of all age groups, as well as exploring the immune status of individuals who may be at risk of infection (i.e. travellers, physicians, laboratory personnel, medical risk groups, elderly people, hard-to-reach populations, etc.) [14,24].

Conclusions and options for response

Universal immunisation with diphtheria-toxoid-containing vaccine is the only effective preventive control measure for diphtheria. Vaccination against diphtheria in children, adolescents and adults should follow the national immunisation schedules in the EU/EEA Member States.

The following options should be considered:

- Ensure that clinicians have the knowledge required to promptly recognise and treat diphtheria and have access to testing algorithms and instructions for how to collect and transport samples to the laboratory.
- Laboratories and countries that lack capacity for confirming toxigenic diphtheria infections should make provisions to send samples to the WHO reference laboratory in the UK.

- Assess the level of access to DAT and, if required, consider transnational options for securing rapid access to it for all patients that have suspected or confirmed diphtheria-toxin-induced disease.
- Advise travellers to diphtheria-endemic countries to check whether they have completed primary vaccination against diphtheria before departure, and to receive a booster dose of diphtheria toxoid if more than 10 years has passed since the last dose.
- Equity of access to immunisation should be promoted and monitored.

Options for reducing the risks associated with limited access to DAT in the EU

A range of options need to be considered for resolving the acute shortage of DAT. Member States should assess the level of access to DAT in their country and, if required, consider transnational options for securing rapid access to it for all patients that have suspected or confirmed diphtheria-toxin-induced disease. Sharing of information collected through such an assessment would also enable an initial assessment of the current stockpiles within the EU.

Testing of existing stockpiles for potency and quality, through transnational testing arrangements if necessary, would also help in the assessment of the scope and timescale of future procurement of stock.

In the light of such assessments, EU/EEA Member States might wish to consider expressing interest in the European joint procurement of medical countermeasure as a mechanism for procuring an emergency stockpile of DAT.

Options for reducing the risks of non-vaccination against diphtheria

A range of options need to be considered for resolving the issue of non-vaccination against diphtheria in the EU/EEA. These options would also support vaccination against all other vaccine-preventable diseases:

- Develop and roll out training programmes for vaccine providers that will make them better equipped to deal with parents who are hesitant about vaccinating their children.
- Similarly, develop and roll out information programmes for vaccine receivers to better understand why they are offered vaccination.
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