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*Mini-review*

# Evolution of the Libyan Expanded Programme of Immunization

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**ABSTRACT**

Vaccines are used to prevent related diseases and complications. Vaccine is considered the most successful and cost-effective medical intervention ever introduced; it is the corner stone of primary health-care services. The Libyan vaccine program is long lasting. It started in the 1960s, and being continuously evaluated with time. Libya was the first country to introduce BCG vaccination on massive scale. Initial vaccine program involved 6 antigens. Currently, the Libyan vaccination programme is immunizing against 17 infectious diseases. However, no routine adult vaccination is implemented in Libya yet.

## Introduction

The development of vaccination as a public health tool is attributed to Edward Jenner and his trials with cowpox in 1796, as smallpox vaccine was the first vaccine to be used widely in human, it was applicable that smallpox was the first human contagious disease to be eradicated by vaccination, a cornerstone achieved in 1979 [1]. Vaccines are used to prevent related diseases and their complications, hepatic cell carcinoma prevented by of hepatitis B vaccine (Hep B), congenital anomalies and intellectual disability like in Rubella vaccine, genital warts and cervical cancer like in human papilloma virus (HPV) vaccine, meningococcal infection and reduce its complication like in conjugated meningococcal vaccine (CMV), Physical disability like in polio vaccine, subacute sclerosing panencephalitis like in measles vaccine, and prevention of antibiotic resistance in case of pneumococcal bacterial infections.

Vaccination is considered the most successful and cost-effective medical intervention ever introduced, it is the corner stone of primary health-care services: particularly in the critical perinatal and early infancy period, as it helped in building up the infrastructure (primary health care, cold chain, vaccination centres, surveillance, documentation, stores), training qualified human resources (nurses, physicians, technicians, etc), and importing effective and quality Vaccines. What is unique regarding the Libyan vaccination programme is being a governmental monopoly (free of charge), available only in public sectors, compulsory by law, equitable for all Libyan and non-Libyan residents (expatriates), sustainable even during harsh times [2].

Libyan vaccine program is long lasting. It started in the 1960s, and being continuously evoluted with time. Libya was the first country to introduce Bacillus Calmette-Guérin (BCG) vaccine on massive scale, Libya in 1971 has passed a legislation that made BCG vaccination compulsory, and since then BCG coverage rate approaching 100%. Initial vaccine program involved 6 antigens (tuberculosis, pertussis, diphtheria, measles, tetanus, and polio). Nowadays, the Libyan vaccination programme is immunizing against 17 infectious diseases (Figure 1). The programme is being upgraded continuously, measles, mumps and rubella (MMR) vaccine was introduced in the early 1990s, and being given at 12 and 18 months. A cross sectional study of Libyan children at school-entry showed protective antibodies against measles, mumps, and rubella in 94%, 80%, 98.5% of these children, respectively [3].

Hepatitis B vaccine was first introduced in 1993 [4], started first for neonates at birth and high-risk groups (If babies were infected, more than 90% of them will be chronic carriers, if an adult was infected, only a 10% will be a chronic carrier), then The National Immunisation Technical Advisory Group (NITAG) of Libya to close the gap went back and immunized, those born in 92 and 91, and went back further and immunized those born in 1990, 1989 and 1988. Therefore, all those who born in Libya for first January 1988 and up-to-date are being immunised against hepatitis B virus. And nowadays, hepatitis B infection is rarely seen in Libya.

Libya was part of Global Polio Eradication Initiative established by World Health Organization (WHO) in 1988,[5] this involved high vaccine coverage, immunaziation days twice a year for children under age of 5, surveillance and survey of all cases of acute flaccid paralysis. Libya was involved in this process and the last case of confirmed paralytic polio in Libya was in September 1991[6], in Almarej district, since then all


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cases of acute flaccid paralysis were investigated by the expert committee for polio eradication in Libya and all proved to be not due to paralytic polio (were mainly due to Guilan-barre syndrome in most cases).

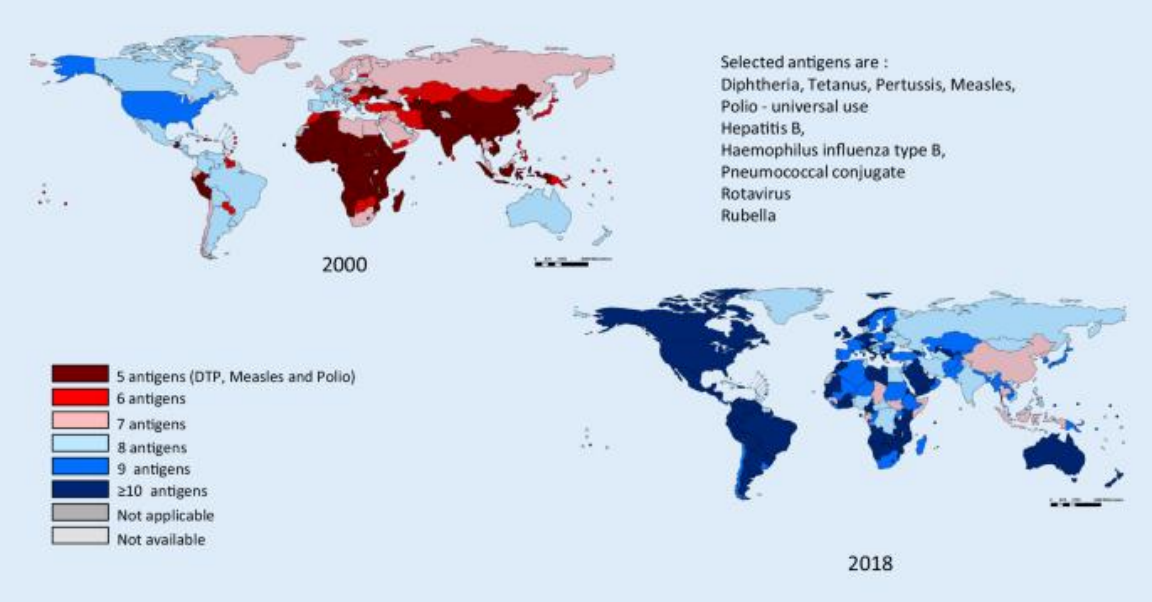


***Figure 1. Number of vaccines antigens introduced in national immunization schedule [2].***

Due to vaccine associated paralytic polio and circulating vaccine derived polioviruses (when vaccine virus becomes wild), Libya has been through the switching process successfully from trivalent (1, 2, 3 virus) to bivalent (1, 3 virus) in April 2016 (The Switch) [7]. Nowadays, immunization against polio includes 2 doses of bivalent oral polio (BOPV) at birth and 9 months, in addition to 5 doses of injectable polio vaccine (IPV) given at 2, 4, 6, 18 months and 6 years. In response to reported cases of paralytic polio from Syria, Nigeria, and Malawi, Libya has conducted several polio vaccinations campaigns against polio.

Sustainment and efficiency of the Libyan Expanded Programme on Immunization (EPI) even at conflicting zones is represented by: maintaining vaccination programme in full, introducing new vaccines, renewal of the cold chain system, and national campaigns with coverage rates > 95% and these campaigns were monitored by UNICEF, WHO and non-governmental organizations.

Haemophilus influenzae type b (Hib) vaccine (introduced in January/2007) given at age of 2, 4, 6 months and booster dose at age of 18 months was added in 2013. This resulted in a remarkable decline in the incidence of Hib meningitis and epiglottitis with no reported cases of Hib diseases for several years.

The national EPI was upgraded in 2013 and included the following: changing from oral polio to IPV, changing from whole cell (Cellular) to acellular pertussis vaccine (aP), addition of a booster dose of Hib vaccine (mentioned above). The upgrade of EPI in 2013 included new vaccine introduction: pneumococcal conjugated vaccine (PCV), conjugated meningococcal vaccine, human papilloma virus vaccine, rotavirus vaccine, and seasonal flu vaccine.

The immunization coverage for the third dose of diphtheria toxoid, tetanus toxoid and pertussis vaccine (DTaP) were high in Libya, maintained above 90% for many years. The current immunization schedule in Libya includes 3-dose of DTaP given at 2, 4, and 6 months of age and a fourth dose at 18 months. A booster dose (Tdap) was introduced at school entry in 2020 after a study showed the absence of detectable antibodies against pertussis in 76.1% of the children at school-entry [8]. Another booster dose (Tdap) is given at 15 years of age.

In 2013, conjugated meningococcal vaccination against A, C, Y, W135 serotypes was started to be given at 9-month, 12-month, 6 year, and 15 years of age. After 6 years, the schedule of CMV adjusted to the following ages: 9-month, 12 month, and 12 years.

In Libya, oncogenic HPV prevalence was 4.5%, and it was present in 60% of women with cervical lesions [9]. Every year 240 women are diagnosed with cervical cancer and 141 die from the disease (estimations for 2020), and cervical cancer ranks as the 3rd most frequent cancer among women and the 3rd leading cause of cancer deaths of female cancer deaths [10]. Nowadays, no availability of a cervical screening program in Libya (this led to delayed presentation and poorer prognosis).

In Libya, HPV vaccination programme Introduced in 2013 to prevent HPV transmission and infection, it was started at age of 15 years then changed to 12 years (the immune response is at its best between 10 and 12


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years of age), HPV vaccine is school based and offered to girls (3 doses).WHO recently launched the strategy 2030 control target to eliminate cervical cancer with the goals of achieving: 90% HPV vaccination coverage, 70% screening coverage, and 90% access to treatment for cervical pre-cancer and cancer [11].
The overall proportion of reported rotavirus gastroenteritis in Libya before introducing rotavirus vaccine ranged between 31.5% and 48% of total diarrheal diseases < age of 5 were due rotavirus infection [12-14]. Accordingly, rotavirus vaccine was introduced 2013 and give at 2, 4, 6 months and advised not to be given after age of 8 months (fear of intussusceptions) [15].
Seasonal influenza vaccine introduced in Libya in 2013, and given annually for high-risk groups including pregnant women, children 6 months to 5 years of age, adult > 65 years old, healthcare workers, patients with chronic medical conditions [(lung, heart, and kidney diseases), metabolic disease, and immune deficient patients], following WHO recommendations [16].
In the Last upgrading of the Libyan EPI in 2023 where varicella vaccine and hepatitis A vaccine (Hep A) were started and given at age of 15 months. Table 1 showed the updated national Libyan immunization schedule.

***Table 1. Current national Libyan immunization schedule***

<table>
<tr><th>Birth</th><th>2 mon</th><th>4 mon</th><th>6 mon</th><th>9 mon</th><th>12 mon</th><th>15 mon</th><th>18 mon</th><th>6 yrs</th><th>12yrs</th><th>15yrs</th></tr>
<tr><td>BCG</td><td>DTaP<br>IPV<br>Hib<br>Hep B</td><td>DTaP<br>IPV<br>Hib<br>Hep B</td><td>DTaP<br>IPV<br>Hib<br>Hep B</td><td>CMV</td><td>MMR<br>CMV</td><td>Varicella<br>Hep A</td><td>DTaP<br>IPV<br>Hib</td><td>Tdap<br>IPV</td><td>HPV (girls) 3 doses<br>CMV</td><td>Tdap</td></tr>
<tr><td>Hep B</td><td colspan="7"></td><td>MMR</td><td colspan="3"></td></tr>
<tr><td>BOPV</td><td colspan="4"></td><td>BOPV</td><td></td><td colspan="4" rowspan="3"></td></tr>
<tr><td></td><td>Rota vaccine</td><td>Rota vaccine</td><td>Rota vaccine</td><td colspan="3"></td></tr>
<tr><td></td><td>PCV 13</td><td>PCV 13</td><td colspan="2"></td><td>PCV 13</td></tr>
<tr><td colspan="11">Seasonal Influenza Vaccine For high-risk group</td></tr>
</table>

*BCG: Bacillus Calmette-Guérin vaccine, Hep B: Hepatitis B vaccine, BOPV: bivalent oral polio vaccine, DTaP: Diphtheria, tetanus, and acellular pertussis vaccine, IPV: Inactivated poliovirus vaccine, Hib: Haemophilus influenzae type b vaccine, PCV: Pneumococcal conjugate vaccine, CMV: Conjugated Meningococcal vaccine, MMR: Measles, mumps, and rubella vaccine. Hep A: Hepatitis A vaccine, Tdap: Tetanus, diphtheria, and pertussis booster, HPV: Human papillomavirus vaccine.*

Travel and pilgrim vaccines (yellow fever, CMV and PCV) are offered to the public who intend to do Hajj and Omrah, and to those who travel to certain countries with high risk of yellow fever and meningitis.
Covid-19 was pandemic in 2020 and vaccines were invented in a short time, and the virus has several mutations, the vaccines imported in Libya are Oxford–AstraZeneca, Pfizer–BioNTech, Sputnik V, Sinopharm, and Sinovac-CoronaVac (COVID-19) vaccine according to the advice of The High Consultatory Scientific Committee Against Corona.
Currently, no routine adult vaccination implemented in Libya. In a recent large study showed that most Libyan pregnant women (98.5%) at the time of delivery were seronegative for pertussis antibodies [17]. Therefore, introducing pertussis vaccine during pregnancy would reduce the burden of neonatal and younger infants' pertussis infections in Libya. There is a need for introducing adult vaccination and boosters against many diseases such as tetanus, pneumococcal infection, pertussis, meningococcal infection, etc.
Challenges that encountered the Libyan vaccination programme over the years: securing funds, lack of awareness, misinformation and misconception, and vaccine skeptics and anti-vaccine groups.

## Conclusion

Vaccination is considered the most successful and cost-effective medical intervention ever introduced, and it is the best health investment in preventive medicine. The Libyan vaccination is dynamic, and being evaluated continuously, free of charge for all including expatriates, therefore equity achieved. In Libya, vaccination is enforced by law (kept as government monopoly).

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***Conflict of interest.*** Nil

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**المستخلص**

تُستخدم اللقاحات للوقاية من الأمراض والمضاعفات المرتبطة بها. ويُعتبر اللقاح التدخل الطبي الأكثر نجاحًا وفعالية من حيث التكلفة على الإطلاق؛ وهو حجر الزاوية لخدمات الرعاية الصحية الأولية. وبرنامج التطعيم الليبي طويل الأمد. فقد بدأ في ستينيات القرن الماضي، ويخضع للتقييم المستمر مع مرور الوقت. وكانت ليبيا أول دولة تقدم لقاح BCG على نطاق واسع. وشمل برنامج التطعيم الأولي 6 مستضدات. وحاليًا، يوفر برنامج التطعيم الليبي التحصين ضد 17 مرضًا معديًا. ومع ذلك، لم يتم تنفيذ أي تطعيم روتيني للبالغين في ليبيا حتى الآن.


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