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Research Article

COST MINIMIZATION ANALYSIS OF THE AVAILABILITY OF VACCINES IN INDIAN MARKET AND PEDIATRIC HOSPITALS IN GUNTUR, ANDHRA PRADESH

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A B S T R A C T

Aim & Objectives: The aim of the study was to know the availability of vaccines in the Indian market within the age group of 0 – 12 years of age (pediatric population).The cost minimization analysis (The minimum, maximum and % variation) of all the vaccines that are available in Guntur, Andhra Pradesh, India were analyzed and thereby we can reduce the health care costs.

Methodology: It is a pure prospective observational study carried in Guntur during the period of May to October 2016. We followed CMA and CBA to evaluate the cost minimization and cost benefits of all the vaccines mentioned below.

Results and Discussion: All the above-mentioned vaccines are available in Guntur, Andhra Pradesh, India are analyzed in the terms of their minimum cost with efficacy and % of variation with the minimum and maximum cost per each vaccine available in the Guntur market for the individual pediatric population. The health care cost of vaccination schedule for individual pediatrics in private sector was given in the above table and it is found that minimum cost is Rs.27, 690, maximum cost is Rs.32,860 and the % variation was 76.37 %.

Conclusion: We finally conclude that usage of vaccination schedule of pediatric population is preferable to take at government health care sectors rather than visiting private health care sector and thereby we can reduce the economical burden for the common people.

INTRODUCTION

Cost-Minimization Analysis Definition: Cost-minimization analysis is a method of calculating drug costs to project the least costly drug or therapeutic modality. Cost minimization also reflects the cost of preparing and administering a dose. This method of cost evaluation is the one used most often in evaluating the cost of a specific drug. Cost minimization can only be used to compare two products that have been shown to be equivalent to dose and therapeutic effect. Therefore, this method is most useful for comparing generic and therapeutic equivalents or «me too» drugs. In many cases, there is no reliable equivalence between two products and if therapeutic equivalence cannot be demonstrated, then cost-minimization analysis is inappropriate.[23]

Cost-Benefit Analysis Definition: Cost-benefit analysis (CBA) offers a method of economic evaluation that values all benefits against all costs. The resulting cost-benefit ratio gives an indication of whether or not the benefits outweigh the costs of an intervention and hence provides a decision-making tool with a broad societal perspective.[24]

Minimum Price **Definition:** futures contract which sets out a minimum price upon delivery of the underlying commodity. The price is defined in order to reduce the risk of fluctuations in the commodity's price.[25]

Maximum Price Definition: The highest possible cost of a good or service that is permissible. Although an unregulated market rarely has a maximum price, other than what consumer are willing to pay perhaps, a market operating under some form of official price control may have such a constant that a business will need to take into account in its planning process.[25]

Types of Vaccines

Immunization Schedule that is recommended for Persons Age group 0 to 18 years

Vaccination at birth means as early as possible within 24 to 72 hours after birth as or at least not later than one week after birth

When multiple vaccinations are to be given, they should be given within 24 hours if the administration is not feasible due to some reasons.

The recommended age in weeks /months/years, any dose that is not administered at the recommended ages should be administered at the visit.

The use of combination vaccine generally is preferred over separate injections of its equivalent component vaccines.

When two or more parenteral/intranasal vaccines are present they should not be administered on the same day, there should be time interval at least 28 days (4 weeks). Whereas this rule does not apply to live oral vaccines.

Any interval can be kept between life and inactivated vaccines. If they are given 5 days before the period it is counted as an invalid dose. Whereas a number of antigens can be given on the same day.

Changing of the needles between drawing vaccine into the syringe is not needed.

Once the cap of a single –dose vial has been opened, the vaccine should be discarded at the end of the immunization because it is difficult to know whether the rubber cap is punctured are not.

Whereas 2 different vaccines most not be mixed in the same syringe.

After the vaccination patient must be absorbed for 15 to 20 mins for any reactions.

when 2 simultaneous IM injections are to be given an anterolateral region of the thigh is selected because of its greater muscle mass.

When 2 injections are given there must be at least 1-inch gap between them to overcome possible reactions.

Whereas while injecting the IM route aspiration is done after injecting the syringe if blood appears it is inappropriate to place.

If previous immunization schedule with a dose that has less than the standard dose or one administered by a non-standard route should be counted, and the person should be reimmunized as appropriate to age.[1, 2, and 3]

Specific instructions

BCG Vaccine

Routine vaccination: should be given at birth or at first contact and catch up vaccination may be given up to 5 years

Poliovirus vaccines

Routine vaccination**:** a Birth dose of OPV usually does not lead to VAPP.OPV in place of IPV, if unfeasible, minimum 3 doses whereas an additional dose of OPV on small SIAs.

IPV: Minimum age-6weeks.

IPV: instead of 3 doses can be also used if primarily series started at 8 weeks and the interval between the doses is kept 8 weeks.

No child should leave the facility without polio immunization (IPV or OPV) if indicated by the schedule.
Intradermal vaccination: ACVIP does not approve the use of Intradermal fractional dose IPV (ID-f IPV) for office practice. However, considering the extreme shortage of IPV and the urgent need of providing immunity against type 2 poliovirus, the committee has now provisionally accepted the immune protection accorded by two ID-f IPV doses given at 6 and 14 weeks as moderately effective against type 2 polioviruses. However, another full dose of IM-IPV should be offered at least at 8 weeks interval of the second dose of ID-f IPV

- If a child has received one dose ID-f IPV at 6 weeks, 2 more full doses of IM-IPV should be offered at least 8 weeks after the first dose
- •The minimum interval between the second and third dose should be at least 8 weeks

Catch-up vaccination

- IPV catch-up schedule: 2 doses at 2 months apart followed by a booster after 6 months of the previous dose.

Hepatitis B (HepB) vaccine

Routine vaccination

- Minimum age: birth
- Administer monovalent HepB vaccine to all newborns within 48 hours of birth
- Monovalent HepB vaccine should be used for doses administered before age 6 weeks
- Administration of a total of 4 doses of HepB vaccine is permissible when a combination vaccine containing HepB is administered after the birth dose
- Infants who did not receive a birth dose should receive 3 doses of a HepB vaccine starting as soon as feasible
- The ideal minimum interval between dose 1 and dose 2 is 4 weeks, and between dose 2 and 3 is 8 weeks. Ideally, the final (3^{rd} or 4^{th}) dose in the HepB vaccine series should be administered no earlier than age 24 weeks and at least 16 weeks after the first dose, whichever is later
- The herb vaccine may also be given in any of the following schedules: Birth, 1, & 6 months, birth, 6 & 14 weeks; 6, 10 & 14 weeks; birth, 6, 10& 14 weeks, etc. All schedules are protective.

Catch-up vaccination

- Administer the 3-dose series to those not previously vaccinated
- In catch-up vaccination use 0,1,and 6 months schedule

Diphtheria and tetanus toxoids and pertussis (DTP) vaccine

Routine vaccination

- Minimum age: 6 weeks
- The first booster (4^{th} dose) may be administered as early as age 12 months, provided at least 6 months elapsed since the 3^{rd} does
- DTaP vaccine/ combinations should preferably be avoided for the primary series.
- DTaP may be preferred to DTwP in children with history of severe adverse effects after the previous dose(s) of DTwP or children with neurologic disorders
- First and second boosters may also be of DTwP. However, considering a higher reactogenicity, DTaP can be considered for the boosters.
- ACVIP does not approve the use of Tdap as a 2^{nd} booster of DTP schedule!

- If any 'acellular pertussis' containing vaccine is used, it must at least have 3 or more components in the product
- No need of repeating/giving additional doses of whole-cell pertussis(WP) vaccine to a child who has earlier completed their primary schedule with acellular pertussis(aP) vaccine containing products

Catch-up vaccination

- Catch-up schedule: The 2nd childhood booster is not required if the last dose has been given beyond the age of 4 years
- Catch-up below 7 years: DTwP/DTaP at 0,1 and 6 months
- Catch-up above 7 years: Tdap, Td, and Td at 0, 1 and 6 months.

Inactivated polio vaccine (IPV)

- The polio virus in IPV as been inactivated (killed). The inactivated polio vaccine (IPV) is also called the Salk vaccine after the late American physician-virologist Jonas Salk.
- Persons allergic to eggs or the drugs neomycin or streptomycin should receive OPV, not the injectable IPV. Conversely, IPV should be given if the vaccine recipient is on long-term steroid (cortisone) therapy, has cancer, or is on chemotherapy or if a household member has AIDS or there is an unimmunized adult in the house.

Rotavirus (RV) vaccines

Routine vaccination

- Minimum age: 6 weeks for all available brands (RV-1[Rotarix], RV-5[RotaTeq] and RV-116E [Rotavac])
- Only two doses of RV-1are recommended.
- RV-1 should preferably be employed in 10 and 14-week schedule, instead of 6 and 10 weeks; the former schedule is found to be far more immunogenic than the later
- If any dose in series was RV-5 or RV-116E or vaccine product is unknown for any dose in the series, a total of three doses of RV vaccine should be administered

Catch-up vaccination

- The maximum age for the first dose in the series is 14 weeks, 6days
- Vaccination should not be initiated for infants aged 15 weeks, 0 days or older
- The maximum age for the final dose in the series is 8months, 0 days

Measles, mumps, and rubella (MMR) vaccine

Routine vaccination

- Minimum age: 9 months or 270 completed days
- Administer the first dose of MMR vaccine at age 9 through 12 months, the second dose at age 15 through 18 months and the final (3rd) dose at age 4 through 6 years.
- The second dose must follow in the second year of life. However, it can be given at any time 4-8weeks after the first dose.
- •No need to give stand-alone measles vaccine

Catch-up vaccination

- Ensure that all school-aged children and adolescents have had at least two doses of MMR vaccine (three doses if the 1st dose is received before 12 months)
- The minimum interval between the two doses is 4 weeks
- One dose if previously vaccinated with one dose (two doses if the first st dose is received before *Twelve* months)
- "Stand alone" the measles/any measles-containing vaccine or MMR can be administered to infants aged of 6months through 8 months during outbreaks. However, this dose should not be counted.[8,21]

Typhoid vaccines

Routine vaccination

- Both Vi-PS conjugate and (polysaccharide) vaccines are available Minimum ages groups: Vi-PS conjugate (Typbar-TCV): 6 months
  Vi-PS conjugated (Peaty): six months
  Vi-PS vaccines: two years (polysaccharide)

Vaccination schedule:

Typhoid conjugate vaccines (Vi-PS)
Typbar-TCV: one dose at 9-12 months through 23 months followed by a booster at two years of age groups.
Paratype: one dose at 9-12 months through 23 months followed by a booster at two years of age
Vi-PS vaccines (polysaccharide): one dose at the two years, revaccination every three years.

- Newly, 2 typhoid conjugated vaccines are, Typbar-Peaty and TCV are Indian markets are available.
- An interval of at least four weeks of the MMR vaccine should be maintained while administering Typbar-TCV and Peaty vaccines were administered.
- The Typhoid revaccination every three years ones, if Vi-PS vaccine is used
- No evidence of hypo-responsiveness upon repeated vaccination of the Vi-PS vaccine so far. However, typhoid conjugate vaccine should be preferred and also over un-conjugated Vi-PS vaccine was used.

Catch-up vaccination

The Recommended also the adolescent period, i.e, up to 18 years of age groups.

Hepatitis A (HepA) vaccines

Routine vaccination

- Minimum age groups: *Twelve* months
- Inactivated HepA vaccine: start to the two-dose HepA vaccine series for children aged *twelve* through twenty-three months; separate the two doses by 6months -18 months have used the vaccine.
- The Live attenuated H2 strain HEPA A vaccine: single dose starting at *Twelve* months and through twenty-three months of the age groups.

Catch-up vaccination

- Ensure that all persons are aged to seven years through 18 years without evidence of immunity has two doses of the live vaccine.

- For children aged 12 months through 12 years the recommended minimum interval between doses in 3months. However, if the second dose was administered at least 4 weeks after the first doses, it will be accepted as a valid vaccine.
- The persons aged 13years and older, the minimum intervals are between doses is weeks.
- For persons without evidence of immunity, administer 2 doses if not previously vaccinated or the second dose if the only 1dose has been administered.
- The evidence of the immunity' to varicella includes any of the followings the vaccines:
- The documentation of the age –appropriate vaccination with a varicella vaccine are used.
- Laboratory values evidence of immunity or laboratory test confirmation of disease.
- Diagnosis or verification of a history of varicella disease by a health care provider are improved QOL.
- The diagnosis tests performed to or verification of a history of herpes zoster by a health –care providers also.[16]

Varicella vaccine

Routine vaccination

- Minimum age: Twelve months age groups.
- The vaccine is administered the first dose at age 15months through 18 months and the second dose at least age 4years through 6 years.
- The minimum second dose may be administered before the age 4 years, provided at least three months have elapsed since the 1st does. If the 2nd dose was administered at least 4 weeks after the first dose, it can be accepted as valid the vaccination program.
- The risk of the breakthrough the Varicella vaccine is lower if given 15 months onwards.

Catch-up vaccination

- It will be Ensure that all persons aged 7years through 18 years without 'evidence of immunity' have 2nd doses of the vaccine.
- All the children aged 12 months through 12 years; the recommended minimum interval between doses is 3 months. However, if the second dose was administered at least 4 weeks after the 1st dose, it can be accepted as valid vaccine schedule.
- All the persons aged 13 years and older, the minimum interval between doses is 4 weeks.
- All they are persons without evidence of immunity, administer 2 doses if not previously vaccinated or the 2nd dose if only 1 dose has been administered, are recommended.
- The 'Evidence of the immunity' to varicella includes any of the following vaccination programs
- The documentation of age groups -appropriate vaccination with a varicella vaccine.
- The laboratory finding evidence of immunity or laboratory confirmation tests of disease
- The diagnosis tests performed or verification of a history of varicella disease by health-care providers.
- The diagnosis or verification of the history of herpes zoster by health-care providers.[16]

Human Papillomavirus (HPV) vaccines
Routine vaccination

- Minimum age: Nine years age groups.
- The HPV2 (Cervarix) and HPV4 (Gardasil) are licensed and available in a market.
- Only the 2 doses of either of the 2 HPV vaccines (HPV4& HPV2) for adolescent /preadolescent girls aged 9years -14 years of age groups;
- For girls 15 years and older 'and immunocompromised individuals, 3doses are recommended.
- For two-dose schedule, the minimum interval between doses should be 6 months.
- Either HPV4 (0, 1, 6 months) is recommended vaccine in a three-dose series for female age groups are 15 years and orders.
- The mainly HPV4 can also be given in a 3 dose series for male aged 11years or 12 years, but not yet licensed for use in male in India market.
- The vaccine is series can be started beginning at the age 9 years age groups.
- all the three –dose schedule, administer the 2nd dose 1 to 2 months after the 1st dose and the 3rd dose 6 months after the 1st dose (at least 2 weeks after the 1st dose).

Catch-up vaccination

- Administer the vaccine series to female (either HPV2 or HPV4) at age 13 through 45 years if not previously vaccinated.
- Use recommended routine dosing interval (see above) for vaccine series catch –up.[1, 21]

IAP recommended vaccines for high-risk children (vaccines under special circumstances)

These vaccines are used to depend upon the switch vacation used.

- Influenza vaccine
- Meningococcal vaccine
- Japanese encephalitis vaccine
- Cholera vaccine
- Rabies vaccine
- Yellow fever vaccine
- Pneumococcal polysaccharide vaccine(PPSV23)

***Aim And Objectives*:** The aim of the study was to know the availability of vaccines in the Indian market within the age group of 0 – 12 years of age(pediatric population).

The cost-minimization analyses (The minimum, maximum and % variation) of all the vaccines that are available in Guntur, Andhra Pradesh, India were analyzed and thereby we can reduce the health care costs.

METHODOLOGY

Study design: It is a pure prospective observational study carried in Guntur during the period of May to October 2016
Selection criteria:

- Study design should be complete economic evaluation, classified in one of the formal health-economic categories of cost-minimization analysis (CMA), cost-effectiveness analysis (CEA), cost-utility analysis (CUA) or cost-benefit analysis

(CBA), being done in one of the MICs based on the country classification data from the World Bank **(5).**

- We followed CMA and CBA to evaluate the cost minimization and cost benefits of all the vaccines mentioned below

BCG,OPV,HepatitisB, DPT-1,IPV-1,HIB-1,Hepatitis B,Rotavirus-1, OPV-1.Hepatitis-B, OPV-2,MMR-1,THYHOID-1,Hepatitis-A,MMR-2,varicella-1,PCV booster, DTWP/DTAP booster,Hib booster,IPV booster, Hepatitis A-2, Typhoid booster, DTwp/DTaP,IPV,varicella,Typhoid Booster, Tdap/Td,Hpv

By applying this we can evaluate the minimum, maximum and % variation of all the vaccines for individual pediatric population.[23]

RESULTS AND DISCUSSION

S.NO		VACCINE	MINIMUM COST	MAXIMUM COST	PERCENTAGE%VARIATION
1	At birth	BCG,OPV,HepatitisB	182	389	113.7
2	6,10,14 weeks	DPT-1,IPV-1,HIB-1,Hepatitis B,Rotavirus-1	8,436	8,436	-
3	6 months	OPV-1.Hepatitis-B	172	364	111.6
4	9 months	OPV-2,MMR-1	142	614	332.3
5	9-12 months	THYHOID-1	290	290	-
6	12 months	Hepatitis-A	915	1650	80.32
7	15 months	MMR-2,varicella-1,Pcv booster	5,215	5,644	8.2
8	16-18 months	DTWP/DTAP booster,Hib booster,Ipv booster	2,643	2,643	-
9	18 months	Hepatitis A-2	915	1650	80.32
10	2 years	Typhoid booster	290	290	-
11	4-6 years	DTwp/Dtap,opv,varicella,Thphoid Booster	1721	1721	-
12	10-12 years	Tdap/Td,Hpv	6,769	9,169	35.45
	Total cost of vaccines		27,690	32,860	76.37

All the above-mentioned vaccines are available in Guntur, Andhra Pradesh, India is analyzed in the terms of their minimum cost with efficacy and % of variation with the minimum and maximum cost per each vaccine available in the Guntur market for the individual pediatric population. The health care cost of vaccination schedule for individual pediatrics in private sector was given in the above table and it is found that minimum cost is Rs.27,690, maximum cost is Rs.32,860 and the % variation was 76.37 %.[6]

CONCLUSION

BCG, OPV, HepatitisB, DPT 1, IPV 1,HIB 1, Hepatitis B, Rotavirus 1, OPV 1.Hepatitis B, OPV 2,MMR 1, THYROID 1, Hepatitis A, MMR 2, varicella1, PCV booster, DTWP/DTAP booster, Hib booster, IPV booster, Hepatitis A 2, Typhoid booster DTwp/DTaP,IPV,varicella,Typhoid Booster, Tdap/Td, Hpv are the vaccines available for the pediatrics as an vaccination schedule from the age of birth to 12 years age-old. In our study, we found that there is a vast difference of each and every vaccine in terms of units (cost), and the variation of all these vaccines was found to be 76.37 % in the private sector. It is totally more than 50 % of variation was found in the private market. Though all these vaccination schedules were also available in all the government health care sector with zero cost. We finally conclude that usage of vaccination schedule of pediatric population is preferable to take at government health care sectors rather than visiting private health care sector and thereby we can reduce the economical burden for the common people.[5]

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