WEEKLY EPIDEMIOLOGICAL REPORT

A publication of the Epidemiology Unit
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WEER SRI LANKA 2023

Vol. 50 No. 36 02nd– 08th Sep 2023

Assessment of Vaccine Herd Protection Part I

This is the first article of a series of two articles on 'Assessment of Vaccine Herd Protection'

Vaccine Herd Protection is the population level protection in a vaccinated population, that exceeds the effect expected, on the basis of the vaccine's known protective efficacy within individuals and the level of vaccine coverage. Herd protection has been suggested for a diverse array of vaccines used in public health practice.

Herd protective effects of vaccines can result from:

- Transmission of a live vaccine from vaccinee to neighboring non-vaccinee (e.g. OPV);
- Passive transfer of vaccine-induced immunity from one person to another (e.g. maternal immunization with TT, influenza, acellular pertussis vaccines)
- Reduction of transmission of the target pathogen in a population in which a proportion has become immune due to vaccination (occurs either with live or inactivated vaccines & applies only to pathogens transmitted from person to person).

Transmissibility of pathogens from person to person:

Transmissibility of an infectious agent can be quantified by **"basic reproduction number (R_0)"** which denotes the average number of secondary infections produced by a typical case of an infection in a fully susceptible population. Higher the R_0, greater the intensity of transmission. As an example, if the R_0 for measles in a population is 15, then we expect each new case of measles to produce 15 new secondary cases (assuming that everyone around the case was susceptible). This excludes the new cases produced by the secondary cases.

The basic reproduction number is affected by several factors:

- Rate of contacts in the host population
- Probability of infection being transmitted during contact
- Duration of infectiousness

*For an epidemic to occur, the R_0 must be >1, so that case number is increasing.

However, in the real world, the population will rarely be totally susceptible to a given infection. Some individuals can be immune either due to prior infection which has conferred immunity or as a result of previous immunization. Thus, not all contacts of a diseased individual will become infected and the average number of secondary cases per infectious case will be lower than the R_0. This is referred to as the **"effective reproduction number (R_n)"** which is the average number of secondary cases per infectious case in a population made up of both susceptible and non-susceptible hosts.

$R_n > 1$	:Number of cases will increase
$R_n = 1$	:Disease is endemic
$R_n < 1$	:Decline in number of cases

The effective reproduction number (R_n) can be estimated by product of the basic reproduction number and the fraction of the host population that is susceptible (S);

$R_n = R_0 * S$

For example, if R_0 for influenza is 12 in a population where half of the population is

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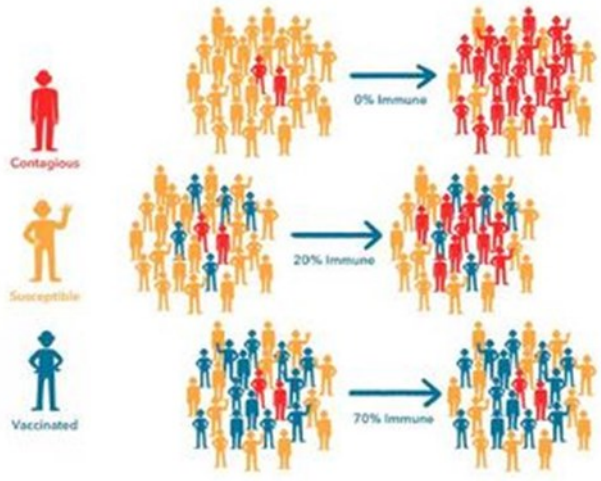
immune, the R_n for influenza will be 12 * 0.5 = 6. Therefore, under these circumstances, a single case of influenza would produce an average of 6 new secondary cases.
*To successfully eliminate a disease from a population, R_n needs to be < 1.

For recently developed and licensed vaccines such as those against rotavirus, pneumococcus and human papillomavirus, the effects of herd protection are seriously considered, as these vaccines are substantially more expensive than the traditional childhood vaccines. In some cases, the cost effectiveness profile of such vaccines becomes favorable only if herd protective effects are considered. Additionally, some new generation vaccines such as the orally administered cholera vaccine confers moderate degree of protective efficacy within individuals and demonstration of herd protection might establish whether using such type of vaccines are sufficient for disease control. The herd protective effects of vaccines could also potentially change the epidemiology and ecology of microbial pathogens, sometimes with deleterious consequences such as shifting the average age of infection by a pathogen or helping to set the stage for replacement of the targeted pathogen by a related pathogen. Evidence about a vaccine's herd protective effects generated by clinical studies of a vaccine, would benefit policy decisions about the deployment of a vaccine.[1]

Vaccine herd protection

Vaccine-induced herd effects include the terms **'vaccine herd immunity'** and **'vaccine herd protection'** **which are often used interchangeably**. **Vaccine herd immunity** describes the protection of non-vaccinated people exposed to live vaccine organisms transmitted by shedding of these organisms by vaccinees, leading to a protective immune response (e.g. live oral polio vaccine). Thus, herd immunity in this regard, refers to only live vaccines and does not depend on whether the target



infection is transmitted from person to person, or by some other route[1].

Sources:

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 to be continued ...

Table 1: Selected notifiable diseases reported by Medical Officers of Health 26th– 01st Sep 2023 (35th Week)

RDHS	Dengue Fever		Dysentery		Encephalit		Enteric Fever		Food Poi-		Leptospirosis		Typhus		Viral		Human		Chickenpox		Meningitis		Leishmania-		WRCD	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	T*	C**
Colombo	127	11346	0	12	0	11	0	2	1	11	4	243	0	0	0	5	0	0	9	231	0	33	0	6	**38**	**100**
Gampaha	107	11476	0	17	0	14	0	7	0	5	7	421	0	8	1	14	0	0	6	208	5	81	2	35	**6**	**100**
Kalutara	72	3930	2	20	0	2	1	1	0	6	9	623	0	2	0	7	0	1	12	379	0	73	0	1	**0.5**	**2**
Kandy	167	5666	0	29	0	1	0	10	0	15	4	219	0	45	0	3	1	2	14	198	0	20	0	25	**88**	**100**
Matale	36	1276	0	2	0	3	0	1	0	13	0	122	0	13	0	5	0	0	2	50	0	4	7	237	**28**	**100**
NuwaraEliya	3	218	5	126	0	4	0	3	0	44	5	115	2	57	0	5	0	0	8	126	0	19	0	2	**62**	**100**
Galle	48	2170	0	37	0	13	0	5	3	24	18	720	3	56	0	1	0	1	8	251	0	21	0	3	**38**	**100**
Hambantota	12	1222	0	8	0	3	0	1	0	9	2	239	2	62	0	9	0	0	1	114	0	16	9	465	**30**	**100**
Matara	26	1531	0	20	0	8	0	1	0	17	7	427	0	29	0	5	0	2	13	232	0	16	4	139	**58**	**100**
Jaffna	19	1918	0	79	0	2	0	12	0	28	0	11	2	497	1	5	0	2	2	149	0	14	0	2	**66**	**93**
Kilinochchi	0	86	0	8	0	0	0	1	0	16	0	8	0	7	0	0	0	0	1	15	0	2	0	0	**30**	**100**
Mannar	0	78	0	6	0	0	0	1	0	0	0	32	0	5	0	0	0	0	0	2	0	8	0	0	**49**	**100**
Vavuniya	11	145	3	9	0	1	0	0	2	6	1	30	0	8	0	1	0	0	1	21	0	12	0	10	**16**	**100**
Mullaitivu	3	115	1	13	0	1	1	4	0	12	1	34	1	6	0	1	0	0	0	12	0	2	0	7	**23**	**100**
Batticaloa	14	2121	4	161	0	7	0	5	0	18	2	75	0	1	0	5	0	1	4	77	2	28	0	1	**64**	**100**
Ampara	1	209	1	6	0	1	0	1	0	52	0	112	0	2	0	1	0	0	0	62	1	41	0	6	**10**	**100**
Trincomalee	2	1984	0	19	0	1	0	1	0	65	0	61	0	15	0	3	0	0	3	55	0	25	0	2	**29**	**100**
Kurunegala	30	2515	2	38	1	10	0	1	0	6	16	315	1	15	0	9	0	2	10	403	2	152	18	404	**28**	**100**
Puttalam	23	2850	3	27	0	3	0	1	0	2	4	60	0	8	0	1	0	0	2	88	2	52	1	19	**27**	**99**
Anuradhapur	2	652	1	11	0	1	0	1	0	7	4	236	0	30	0	3	0	2	1	191	0	43	5	436	**28**	**100**
Polonnaruwa	4	514	0	13	0	5	0	1	0	11	1	144	0	5	0	12	0	0	2	68	0	16	2	323	**36**	**100**
Badulla	20	912	2	30	0	5	0	0	1	44	7	274	0	47	0	74	0	0	4	131	0	37	0	32	**66**	**100**
Monaragala	28	570	0	21	0	6	0	0	0	4	5	443	0	33	1	22	0	1	2	60	6	63	6	143	**29**	**100**
Ratnapura	42	1823	2	36	1	15	0	2	0	16	16	932	0	26	0	16	0	2	4	162	3	121	0	140	**36**	**100**
Kegalle	55	2536	1	20	0	2	0	2	0	14	4	533	0	35	0	5	0	0	13	334	0	62	2	34	**32**	**100**
Kalmune	7	1664	0	65	0	10	0	0	0	0	0	46	0	1	0	0	0	0	7	85	2	31	0	0	**48**	**100**
SRILANKA	859	59527	**27**	**833**	**2**	**129**	**2**	**64**	**7**	**445**	**117**	**6475**	**11**	**1013**	**3**	**212**	**1**	**16**	**129**	**3704**	**23**	**992**	**56**	**2472**	**41**	**99**

Source: Weekly Returns of Communicable Diseases (esurvillance.epid.gov.lk). **T=**Timeliness refers to returns received on or before 01st Sep, 2023 Total number of reporting units 358 Number of reporting units data provided for the current week: 356 **C****-Completeness

A = Cases reported during the current week. B = Cumulative cases for the year.

Table 2: Vaccine-Preventable Diseases & AFP

26th– 01st Sep 2023 (35th Week)

Disease	No. of Cases by Province									Number of cases during current week in 2023	Number of cases during same week in 2022	Total number of cases to date in 2023	Total number of cases to date in 2022	Difference between the number of cases to date in 2023 & 2022
	W	C	S	N	E	NW	NC	U	Sab					
AFP*	00	00	00	00	00	00	01	00	00	01	00	65	53	22.6 %
Diphtheria	00	00	00	00	00	00	00	00	00	00	00	00	00	0 %
Mumps	00	01	00	05	00	00	00	00	00	06	00	161	58	177.5 %
Measles	10	02	08	05	00	02	00	01	02	30	00	340	16	2025 %
Rubella	00	00	00	00	00	00	00	00	00	00	00	03	00	0 %
CRS**	00	00	00	00	00	00	00	00	00	00	00	00	00	0 %
Tetanus	00	00	00	00	00	00	00	00	00	00	00	06	05	20 %
Neonatal Tetanus	00	00	00	00	00	00	00	00	00	00	00	00	00	0 %
Japanese Encephalitis	00	00	00	00	00	00	00	00	00	00	00	02	07	- 71.4 %
Whooping Cough	00	00	00	00	00	00	00	00	00	00	00	06	01	500 %
Tuberculosis	59	07	10	00	15	06	17	04	03	121	627	6161	4737	30.0 %

Key to Table 1 & 2

Provinces: **W**: Western, **C**: Central, **S**: Southern, **N**: North, **E**: East, **NC**: North Central, **NW**: North Western, **U**: Uva, **Sab**: Sabaragamuwa.

RDHS Divisions: **CB**: Colombo, **GM**: Gampaha, **KL**: Kalutara, **KD**: Kandy, **ML**: Matale, **NE**: Nuwara Eliya, **GL**: Galle, **HB**: Hambantota, **MT**: Matara, **JF**: Jaffna, **KN**: Killinochchi, **MN**: Mannar, **VA**: Vavuniya, **MU**: Mullaitivu, **BT**: Batticaloa, **AM**: Ampara, **TR**: Trincomalee, **KM**: Kalmunai, **KR**: Kurunegala, **PU**: Puttalam, **AP**: Anuradhapura, **PO**: Polonnaruwa, **BD**: Badulla, **MO**: Moneragala, **RP**: Ratnapura, **KG**: Kegalle.

Data Sources:

Weekly Return of Communicable Diseases: Diphtheria, Measles, Tetanus, Neonatal Tetanus, Whooping Cough, Chickenpox, Meningitis, Mumps., Rubella, CRS,

Special Surveillance: AFP* (Acute Flaccid Paralysis), Japanese Encephalitis

CRS =**Congenital Rubella Syndrome

NA = Not Available

Take prophylaxis medications for leptospirosis during the paddy cultivation and harvesting seasons.

It is provided free by the MOH office / Public Health Inspectors.

Comments and contributions for publication in the WER Sri Lanka are welcome. However, the editor reserves the right to accept or reject items for publication. All correspondence should be mailed to The Editor, WER Sri Lanka, Epidemiological Unit, P.O. Box 1567, Colombo or sent by E-mail to **chepid@sltnet.lk. Prior approval should be obtained from the Epidemiology Unit before publishing data in this publication**

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