WEEKLY EPIDEMIOLOGICAL REPORT

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Ministry of Health

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The immune system (Part I)

This is the first in a series of two articles on the immune system

Introduction

Our environment contains a great variety of infectious microbes – viruses, bacteria, fungi, protozoa and multi cellular parasites which can cause disease and if they multiply unchecked, eventually kill their host. But most infections in normal individuals are short-lived, leaving little damage. This is due to the immune system, which combats infectious agents.

The immune system is a complex system of interacting cells, primary purpose of which is to identify foreign ("non-self") substances referred to as antigens by recognizing molecular shapes which are only a few amino acids in length. The immune system provides protection from infectious disease by identifying most of these microbes as foreign. Immunity is generally very specific to a single organism or group of closely related organisms. Because microorganisms come in many different forms, a wide variety of immune responses are required to deal with each type of infection.

Antigen

An antigen is a substance that stimulates an immune response, especially the production of antibodies. Antigens are usually proteins or polysaccharides (long chains of sugar molecules that make up the cell wall of certain bacteria), but can be any type of molecule, including small molecules (haptens) coupled to a protein (carrier).

Antigens induce immunity. The immune system develops a defence against foreign antigens. This defence is known as the immune response and usually involves the production of protein molecules, called antibodies (immunoglobulin or Ig), and of specific cells (also known as cell-mediated immunity) whose purpose is to facilitate the elimination of foreign substances. The most effective immune responses are generally produced in response to a live organism. However, an antigen does not necessarily have to be a live natural infection with a virus or bacteria to produce an excellent immune response. Some proteins, such as hepatitis B surface antigen, are easily recognised by the immune system. Polysaccharides, on the other hand, are less effective antigens and the immune response may not provide a good protection.

The part of the antigen that antibody binds to is called the antigenic determinant, antigenic site or epitope. A given organism contains many different antigens. Viruses can contain as few as three (polyoma virus) to more than 100 (herpes and pox), whereas protozoa, fungi and bacteria contain hundreds to thousands.

Non specific defences

In the first instance the exterior defences of the body present an effective barrier to most organisms and very few infectious agents can penetrate the intact skin. There are also a variety of biochemical and physical barriers. Some of them are the skin, mucus, cilia, lysosyme, and commensal bacteria etc.

Specific immunity

Active and passive immunity

There are two basic mechanisms for acquiring immunity - active and passive.

Active immunity is protection that is produced by the person's own immune system. This type of immunity is usually permanent.

Passive immunity is protection by products produced by an animal or human, and transferred to another human, usually by injection. Passive immunity often provides effective protection, but this protection wanes (disappears) with time, usually a few weeks or months.

Passive immunity is the transfer of antibody produced by one human or other animal to another. Passive immunity provides protection against some infections, but this protection is

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temporary. The antibodies will degrade during a period of weeks to months and the recipient will no longer be protected. The most common form of passive immunity is that which an infant receives from its mother. Antibodies are transported across the placenta during the last 1-2 months of pregnancy. These antibodies will protect the infant from certain diseases for up to a year. Protection is better against some diseases (e.g. measles, rubella, tetanus) than others.e.g. polio, pertussis). Active immunity is stimulation of the immune system to produce antigen-specific humoral (antibody) and cellular immunity. Unlike passive immunity, which is temporary, active immunity usually lasts many years, often for a lifetime. One way to acquire active immunity is to have the natural disease. In general, once persons recover from an infectious disease, they will be immune to those diseases for the rest of their lives. Pertussis is an exception.

The persistence of protection for many years after the infection is known as immunologic memory. Following exposure of the immune system to an antigen, certain cells (memory B-cells) continue to circulate in the blood (and also reside in the bone marrow) for many years. Upon re-exposure to the antigen, these memory cells begin to replicate and produce antibody very rapidly to re-establish protection.

Another way to produce active immunity is by vaccination. Vaccines interact with the immune system and often produce an immune response similar to that produced by the natural infection, but do not subject the recipient to the disease and its potential complications. Vaccines produce immunologic memory similar to that acquired by having the natural disease.

Many factors may influence the immune response to vaccination. These include the presence of maternal antibody, nature and dose of antigen, route of administration and the presence of adjuvants (e.g. aluminum-containing materials added to improve the immunogenicity of the vaccine). Host factors such as age, nutritional factors, genetics, prolonged psychological stress and coexisting disease may also affect the response.

Specific (adaptive) immunity

Any immune response involves, firstly, recognition of the pathogen or other foreign material, and secondly, a reaction to eliminate it. Broadly, the different types of immune response fall into two categories; innate (non adaptive) and adaptive immune responses. The important difference between these is that the adaptive immune response is highly specific for a particular pathogen. Moreover, although innate response does not alter on repeated exposure to a given infectious agent, the adaptive response improves with each successive encounter. In effect the adaptive immune system 'remembers' the infectious agent and can prevent it from causing disease later. For example, diseases such as measles and diphtheria induce adaptive immunity which generates lifelong immunity following infection. Two key features of the adaptive immune response are thus specificity and memory.

The lymphatic system

The thymus and bone marrow are the primary lymphatic organs. Lymphocytes are produced by stem cells in the bone marrow and then migrate to either the thymus or bone marrow where they mature. T-lymphocytes undergo maturation in the thymus (hence their name), and B-lymphocytes undergo maturation in the bone marrow. After maturation, both B- and T-lymphocytes circulate in the lymph and accumulate in secondary lymphoid organs, where they await recognition of antigens.

The spleen, lymph nodes and accessory lymphoid tissue (including the tonsils and appendix) are the secondary lymphoid organs. These organs contain scaffolding that support circulating B and T-lymphocytes and other immune cells like macrophages and dendritic cells. When microorganisms invade the body or the body encounters other antigens (such as pollen), the antigens are transported from the tissue to the lymph. The lymph is carried in the lymph vessels to regional lymph nodes. In the lymph nodes, the macrophages and dendritic cells which have phagocytosed (engulfed) the antigens, process them and present the antigens to lymphocytes, which can then start producing antibodies or serve as memory cells to recognize the antigens again in the future.

The spleen contains lymphocytes that filter the blood stream. Accessory lymphoid tissues act as barriers along points of entry for infections, such as the lung, the reproductive system, and the gut.

Cells and molecules of the immune system

Immune responses are mediated by a variety of cells and by soluble molecules they secrete. Although the leucocytes are central to all immune responses, other cells also participate, by signalling to the lymphocytes and responding to the cytokines (chemical messengers) released by T lymphocytes and macrophages. Functions of some selected cells are discussed below

Leukocytes (White Blood Cells)

B-cells-Lymphocytes normally involved in the production of antibodies. They are precursors to plasma cells. During infections, individual B-cell clones multiply and are transformed into plasma cells, which produce large amounts of antibodies against a particular antigen on a foreign microbe. This transformation occurs through interaction with the appropriate CD4 T-helper cells.

T-cells-T-cells are a subset of lymphocytes that play a large role in the immune response. The abbreviation "T" stands for thymus, the organ in which their final stage of development occurs.

- Cytotoxic T-cells (CD8+) destroy infected cells. These cells function as "killer" or cytotoxic cells because they are able to destroy target T-cells which express specific antigens that they recognize. These cells are important in fighting viral infections and tumours.
- Helper T-cells (CD4+) are "middlemen" in the immune response. When they get activated, they proliferate and secrete cytokines that regulate or "help" effector lymphocyte function. They are known as one of the targets of HIV infection, and the decrease of CD4+ T-cells results in AIDS. Some helper T-cells secrete cytokines that turn off the immune response once an antigen has been eliminated from the body.

Regulatory T-cells (also known as suppressor T-cells) suppress activation of the immune system and maintain immune system homeostasis. Failure of regulatory T-cells to function properly may result in autoimmune diseases in which the immunocytes attack healthy cells in the body.

Every effective immune response involves T-cell activation; however, T-cells are especially important in cell-mediated immunity, which is the defense against tumor cells and pathogenic organisms inside body cells. They are also involved in rejection reactions.

Source-The immune system and vaccination-available form *http://www.immune.org.nz/immune-system-and-vaccination*

Compiled by Dr. Madhava Gunasekera of the Epidemiology Unit

Table 4: Selected notifiable diseases reported by Medical Officers of Health 20th – 26th July 2013 (30th Week)

RDHS	Dengue Fever		Dysentery		Encephaliti		E Fever		F Poisoning		Leptospiros		T Fever		V Hepatitis		H Rabies		Chickenpox		Meningitis		Leishmaniasis		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	293	5691	1	120	0	13	2	86	0	35	4	141	0	5	2	52	0	0	4	267	0	31	0	0	**92**	**8**
Gampaha	97	2248	6	108	0	11	1	28	0	23	6	227	0	11	6	131	0	0	6	111	1	63	0	5	**100**	**0**
Kalutara	38	1074	2	96	1	16	0	49	0	13	5	255	0	2	1	14	0	0	5	182	3	49	0	0	**85**	**15**
Kandy	43	1151	2	92	0	6	0	15	0	7	1	51	0	80	1	61	0	0	1	89	1	9	0	2	**78**	**22**
Matale	7	282	4	59	0	3	0	16	0	1	2	46	0	2	0	31	0	0	0	33	0	22	0	5	**69**	**31**
NuwaraEliya	5	157	9	108	0	2	0	6	0	3	1	21	4	52	1	17	0	0	2	63	2	9	0	0	**92**	**8**
Galle	30	556	6	66	0	12	0	3	3	77	6	142	2	28	1	8	0	1	12	205	2	37	0	0	**95**	**5**
Hambantota	7	208	2	34	0	3	0	10	9	20	2	147	2	47	1	71	0	0	4	74	0	23	0	200	**92**	**8**
Matara	26	337	4	56	0	9	0	19	0	27	3	114	4	45	0	122	0	2	3	183	4	49	1	57	**100**	**0**
Jaffna	7	500	5	143	0	5	1	272	0	82	0	6	2	324	0	14	1	1	1	119	1	42	0	0	**83**	**17**
Kilinochchi	0	34	0	14	0	0	0	9	0	5	0	9	0	16	0	0	0	0	0	2	0	7	0	6	**50**	**50**
Mannar	0	57	2	34	0	1	0	54	0	14	0	11	0	17	0	2	0	0	0	11	0	4	0	1	**80**	**20**
Vavuniya	2	53	0	30	0	11	0	7	2	13	0	47	0	2	0	1	0	2	0	19	0	24	0	7	**50**	**50**
Mullaitivu	4	91	2	9	1	1	0	6	0	34	0	31	0	6	0	0	0	2	0	7	0	3	0	9	**40**	**60**
Batticaloa	6	440	6	195	0	4	1	3	0	14	0	28	0	2	0	9	1	2	0	26	0	6	0	0	**79**	**21**
Ampara	2	102	1	72	0	0	0	4	0	6	0	24	0	1	0	2	0	0	0	55	0	10	0	1	**57**	**43**
Trincomalee	5	163	0	46	0	3	0	4	0	1	1	55	0	7	0	3	0	1	1	32	0	4	0	26	**83**	**17**
Kurunegala	24	2151	0	115	0	26	2	29	0	15	0	199	2	23	1	37	0	1	6	246	2	84	0	34	**85**	**15**
Puttalam	6	652	2	47	0	4	1	15	0	35	1	23	1	12	0	4	0	0	0	59	1	19	0	7	**69**	**31**
Anuradhapura	8	377	4	61	0	13	0	3	1	15	1	283	0	17	0	15	0	1	2	117	3	78	3	250	**79**	**21**
Polonnaruwa	9	252	0	48	0	1	0	12	0	53	2	141	0	3	1	23	0	1	0	104	0	16	1	92	**100**	**0**
Badulla	13	334	7	120	0	3	1	12	1	8	4	35	4	56	0	35	0	0	1	87	3	49	0	4	**76**	**24**
Monaragala	4	165	3	78	0	3	1	14	0	19	1	182	0	31	4	60	0	1	0	39	0	15	0	8	**100**	**0**
Ratnapura	33	1294	8	256	0	80	0	34	0	16	8	242	1	33	4	195	0	1	3	107	1	54	0	8	**83**	**17**
Kegalle	17	731	3	84	0	11	3	15	0	8	2	132	2	59	0	156	0	0	1	204	3	80	0	0	**73**	**27**
Kalmune	4	479	2	106	0	1	0	3	0	73	0	5	0	2	0	4	0	0	1	59	1	8	0	1	**77**	**23**
SRI LANKA	**690**	**19579**	**81**	**2197**	**02**	**242**	**13**	**728**	**16**	**617**	**50**	**2597**	**24**	**883**	**23**	**1067**	**02**	**16**	**53**	**2500**	**28**	**795**	**05**	**723**	**83**	**17**

Source: Weekly Returns of Communicable Diseases (WRCD).

***T=**Timeliness refers to returns received on or before 26th July , 2013 Total number of reporting units 339. Number of reporting units data provided for the current week:279 C** Completeness

A = Cases reported during the current week. **B** = Cumulative cases for the year.**H Rabies***= Human Rabies, **E Fever***=Enteric Fever, **F Poison*** =Food Poisoning, **T Fever***=Typhus Fever, **V Hepatitis***=Viral Hepatitis

Table 1: Vaccine-Preventable Diseases & AFP

20th – 26th July 2013 (30th Week)

Disease	No. of Cases by Province									Number of cases during current week in 2013	Number of cases during same week in 2012	Total number of cases to date in 2013	Total number of cases to date in 2012	Difference between the number of cases to date in 2013 & 2012
	W	C	S	N	E	NW	NC	U	Sab					
AFP*	00	00	00	00	00	00	01	00	01	02	01	49	47	04.3 %
Diphtheria	00	00	00	00	00	00	00	00	00	-	-	-	-	-
Mumps	06	12	04	01	00	01	02	01	01	29	21	947	2448	- 61.3 %
Measles	82	07	43	00	02	03	04	00	33	174	02	1615	28	+ 5667.8 %
Rubella	01	00	00	00	00	00	00	00	00	00	-	20	-	-
CRS**	00	00	00	00	00	00	00	00	00	00	-	00	-	-
Tetanus	00	00	00	00	00	00	01	00	00	01	00	12	07	+ 71.40 %
Neonatal Tetanus	00	00	00	00	00	00	00	00	00	00	-	00	-	-
Japanese Encephalitis	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Whooping Cough	00	00	00	00	00	00	00	00	00	00	00	55	41	+ 34.1 %
Tuberculosis	193	06	19	10	21	08	00	23	17	297	243	5035	5298	+ 04.9 %

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

AFP and all clinically confirmed Vaccine Preventable Diseases except Tuberculosis and Mumps should be investigated by the MOH

Dengue Prevention and Control Health Messages

To prevent dengue, remove mosquito breeding places in and around your home, workplace or school once a week.

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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**

ON STATE SERVICE

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