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厚生科学研究費補助金研究報告書

「我が国における麻疹対策プログラムの作成に関する研究」

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厚生科学研究費補助金（新興・再興感染症研究事業）

総括研究報告書

我が国における麻疹対策プログラムの作成に関する研究

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研究要旨

麻疹は天然痘、ポリオに続く第３の根絶対象疾病と考えられており、ポリオの世界根絶事業の達成が近づきつつある今、世界各地で麻疹制圧、さらには根絶へむけた準備が積極的に進められている。日本の麻疹対策はこのような世界麻疹対策と分離して独自に考えることは好ましくなく、世界麻疹対策の一環として考えるべきである。この研究では以上のような原点から、日本の麻疹対策の現況、そしてその改善策、更に日本がどのように麻疹根絶の世界戦略に貢献できるのかについて、具体的な提案を行った。先ず、日本の麻疹対策への計画としては、2 年間程度、日本国内の麻疹対策の強化、特にサーベイランスの強化を行い、併せて実験室段階での開発（ワクチン改良等）を行うことにより、日本における麻疹対策と根絶の global feasibility との関係について検討することを提案する。南北アメリカにおいては 1991 年のポリオ根絶成功を期に麻疹根絶活動を始めた。また、それ以外の多くの国または地域においても麻疹制圧事業が計画され実施されつつある。麻疹根絶対策は膨大な投資を必要とする。失敗すればマラリア根絶失敗と同様、大きな資源のロスとなる。日本の今後の成果を参考として、注意深い戦略研究が必要であろう。

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A. 研究目的

ポリオの世界根絶事業の達成が近づきつつある現在、次の根絶事業として麻疹が挙げられ、世界各地で麻疹制圧、さらには根絶へ向けた準備が積極的に進められている。国際社会の一部は、日本にも麻疹根絶の開始を望んでいる。日本の麻疹計画は、世界の麻疹根絶計画の一環としての準備行動であるという考えから考慮することが望ましい。しかし、根絶事業は、研究、テクノロジーという技術的要素のもと、リーダーシップ、費用効果、

投資促進といったマネージメント、及び、世界的な協力体制が必要である。この意味から、日本は国内及び国際的な麻疹対策がどうあるべきかについて明瞭な戦略を持つことが必要であり、その具体的な提案を行った。

B. 研究方法

日本における麻疹対策の現状を分析する。また、行われている世界各地の麻疹対策事業の状況を把握する。その結果を、天然痘根絶成功及びポリオ根絶の経験と照らし合わせて、麻疹のグローバルな根絶の成功の生物学的及び社会的条件を検討する。

以上の作業の結果として、現在、日本の麻疹対策でいかにあるべきかを提案する。

C. 研究結果

1) グローバル視点

世界ポリオ根絶計画の次には麻疹根絶を挙げられているが、そのポリオ対策プログラムの終わりが見え始めた。しかし、WHO のいう Target Year 2000 には終わらないであろう。倍増する援助投資により、2002 年頃には全世界ゼロとなるかもしれない。麻疹対策は、制圧（発生を例えば 90%減らす）と根絶（ウイルス伝播をゼロとして対策を止める）の二つに分けられるが、現在、この両方が各大陸また複数の個々の国々で行われている。その状況は以下の通りである。

南北アメリカ：1991 年のポリオ最後の患者発生を期にし、2000 年までの西半球大陸の麻疹根絶プログラムを始め、U.S.では 1999 年 100 名以下、ブラジル・アルゼンチンの再流行を除いて、プログラムは効果をあげつつある。しかし、その長期的効果については、麻疹の高度な伝播力（90%）を考慮すると、更に観察が必要である。

西太平洋：カンボジアにおけるポリオ患者の最後の発生を期として、U.S.の援助によるサーベイランスのパイロットプロジェクトが中国山東省などで始まり、ラオス、カンボジア、ヴェトナム、モンゴル等では Catch up（1 - 15 才）麻疹予防接種が行われつつある。

西太平洋地域では、ポリオ根絶後のプログラムとして麻疹制圧事業が適切だと考えられているが、本研究班は次のように考える。

フィリピンでは 1998 年に麻疹発生を 10 年間で 0 にすることを目標としたフィリピン麻疹制圧計画（ Philippines Measles Elimination Campaign: PMEC）を開始したが、地域的麻疹制圧に関する WHO 決議を地域戦略のない中で開始された麻疹制圧計画の前途は平坦ではないと思われる。WHO 西太平洋地域ではすでにモンゴル、太平洋島嶼国、オーストラリア、ニュージーランド、ベトナム、マレーシアがそれぞれ麻疹ワクチンの全国一斉投与を計画している。早急に短期性、広域性、同期生、徹底性に配慮した地域レベルでの麻疹制圧計画の策定が不可欠である。

地中海沿岸、東南アジア：ポリオ流行国と非流行国に分け、非流行国では麻疹対策強化

アフリカ：南アフリカ諸国で Catch up 計画

欧州：イギリス等で Catch up 計画

2) 日本の状況

定点サーベイランスを基本とする発生モニターでは、過去 10 年間、患者数は減少した。しかし、U.S.やイギリスのように制圧されたとは言い難い。恐らく年間 10 万人程度の発生であろう。また年間 10 例程度の死亡報告がある。年間麻疹対策費は約 80 億円（U.S.では 165 億円）と推定される。

以前のような麻疹の大きな流行は起こらなくな

っているために、ワクチン非接種者は麻疹に罹患する機会が減少し、免疫を持たないまま成人となる可能性が増加している。また、ワクチン接種により附与される免疫レベルは麻疹罹患後の免疫よりも低いが、麻疹流行がある程度抑制されているので、ワクチン接種後における野生株ウイルスの再感染・再暴露の機会が減っている。そのために有効な免疫レベルを維持するのに必要な免疫ブースターがかからず、加齢と共に免疫レベルが更に低下して、いわゆる secondary vaccine failure (SVF) となる可能性が高まっている。このような状況が続くと、近い将来には重篤な成人麻疹、妊婦麻疹、更には新生児麻疹の増加が危惧される。これに対処するためには、ワクチン接種率を高めて麻疹の流行そのものを根絶する努力を進めると共に、適当な年齢層に対して免疫ブースターを目的としたワクチンの追加接種が必要であろう。

更に、近年麻疹ウイルスの遺伝子変異に基づく抗原性・性状の変化が明らかになってきたので、45 年前の流行株に基づく現行の麻疹ワクチンの有効性についても再検討が必要であろう。

D. 考察

近い将来、U.S.の発案で WHA にてポリオ根絶後の麻疹根絶について論議され、世界はグローバル根絶に向けて本格的に開始する可能性が高い。ただし、現在のポリオ根絶の難航ぶり（2000 年現在、いまだ 30 の流行国を抱えている）から、あと 2-3 年は準備試行期間となるだろう。

麻疹流行の日本国民への Burden は少数ながら死亡、1 週間の発熱、発疹、衰弱等の症状や、麻疹発生家族の労働力ロス、母親、医療関係者の 10 万人という計数をかけた苦労、80 億円という予防接種費用であろう。また、日本が米国から麻疹輸出国として批判されており、これらのことを考慮に入れると、日本が近い将来、根絶に参加する意思決定を迫られるのは時間の問題であろう。

このような背景のもと、この研究班は、日本は何をやるべきか、下記の提言を行った。

1. 麻疹根絶の可能性についての検討

1.1 天然痘根絶は成功したが、かつて黄熱、マラリア根絶対策の失敗、そして進行中のポリオ根絶の困難性を視野に入れて、麻疹根絶の可能性について再検討の必要がある。麻疹の高い感染率 90%に対し、天然痘の感染率は意外に低く 40%である。従って、麻疹根絶は各国、各大陸の共同計画の発足なしには輸入例による再流行の繰り返しになる（ブラジル・アルゼンチン　資料２参照）。

1.2 以上から麻疹の伝播中止には極めて高い予防接種率が要求される（95%）。これは人口密度の高いスラムやインド亜大陸においては極めて困難である。サーベイランスによる患者発見、封じ込め接種が代案として浮上するが、これには天然痘、ポリオ以上のダイナミックなフィールドの対策が必要となる。途上国でこの対策が実行可能だろうか（資料 3)。

1.3 人口密度が高く、国際的交流が盛んな先進工業国において麻疹発生がゼロになった国はない。U.S.は 1978 年に根絶計画を開始、いま成功しかかっている。世界天然痘及びポリオ根絶計画が開始した際、既に全ての先進国で常在流行がなかった。このように麻疹は対策抵抗性が強い（資料 1、2)。

1.4 以上のことから、ポリオ根絶に要する全国際協力費用を 2500 - 3000 億ドルと WHO は推定しているが、麻疹根絶はその倍、5000 - 6000 億ドル以上の先進国の投資が必要かもしれない。現在の南北アメリカの麻疹根絶対策の分析、及び、以上の条件を Variable とした数学

モデルによる検討等を早急に行う。

1.5 以上、グローバル麻疹根絶の発足は、発足前の慎重な戦略の検討と法定が必要である。現在、南北アメリカポリオは既に開始したので後戻りはできないが、他の大陸規模の対策開始は共同作戦の考えなしには簡単に始めてはならない。

2 日本の麻疹対策の改善

2.1 サーベイランスの急速な改善が必要である。定点観測と同時に医療機関、一般人の届け出の促進が必要であろう。報告の迅速化と診断確定など解決すべき問題がある。患者の年齢、重症度、感染経路など疫学調査を行う。

2.2 現在の平均75%の定期予防接種率を90%程度にまで引き上げる。これには根気強い母親への説得、メディアの協力等が必要であろう。

2.3 サーベイランスの改善により、集団発生の発見が容易になるので、この封じ込め接種を徹底的に行う。

2.4 WHO では定期接種の他に Catch up（1 - 15 才全年齢 1 回接種）及び Follow-up（数年間隔で 3、4、5 才位までの接種漏れ子どもの接種）を麻疹制圧の良い方法としている。米国は 2 回接種方式を採用しているが、要は 2.1、2.2、そして 2.3 ができるかどうかにかかっている。ここ 2 年程度、これをやってみて、その結果で考える。

2.5 ワクチンの 4 種の使用株（AIK-C、Schwayrz FF8、CAM-70、TD97）の問題点を整理し、その改善策を考える。また MMR、MR の混合ワクチンの再使用について研究する。ワクチンの耐熱性の問題をゼラチンで解決することは止める。

3 その他の研究

3.1 麻疹の迅速診断法の開発は日本のみならずグローバルな貢献となるだろう。

3.2 途上国においては、Disposable syringe の頻回使用によって肝炎などの感染流行が起こり、WHO は Self destructive syringe にあと 2 年間で全途上国が切り替えると言っている。現状では、日本も ODA 予算で U.S.の製品を買って、途上国に送ることになりかねない。日本でこれを製造できないか。天然痘は二叉針、ポリオは経口によるワクチン接種だったが、麻疹根絶は初めての注射器を使用するプログラムである。経口又は経鼻の麻疹ワクチンの開発促進ができるか。世界的な貢献となろう。ブラジル、インドネシアなどの共同研究があればなお良い。

E. 結論

ポリオ根絶の動向から考慮して、日本が慌てて麻疹根絶に参加する必要はないだろう。あと 2 年間は、日本国内の麻疹対策の強化、特にサーベイランスの強化を行ってはどうだろうか。併せて、麻疹根絶の Global feasibility について熟考することを提案する。

F. 研究発表

なし

G. 知的所有権の取得状況

なし

添付資料：

資料１：　1998 年麻疹発生数とワクチン接種率

発生数、接種率とも極めて不規則である。サーベイランス発達の度合、保健対策、実施機関の能力の度合など、根絶対策を行う前に大きな改善作業があることが分る。天然痘根絶またポリオ根絶もグローバルプログラムが始まった時は、工業先進国の状況は殆どの国で発生ゼロ、ワクチン接種 90%以上であった。

資料２：　各 WHO 地域における上位麻疹発生国及び下位発生国

南北アメリカ諸国を除いて、麻疹発生数の低い国は対策を行った国と対策を行っていないが報告をしていない国とが混在している。

資料３：　国内総生産の高い国及び低い国における麻疹発生数（1998 年）

資料４：　Does Polio eradication succeed meeting the target year of 2000?

ポリオ根絶の成功について、その困難性を天然痘根絶の経験より分析。2000 年現在のポリオ流行国が 22 ヶ国の伝播遮断は 3 年かかるであろう。しかも、更に援助投資が必要と警告を発し、この状況を考える折、我が国における麻疹対策プログラムの作成に関する研究根絶は軽はずみに開始してはいけないと結論している。

1998 年麻疹発生数とワクチン接種率

資料 1

AFRO

County	No. of reported cases	Pop.	MCV Coverage (%)
Nigeria	143098	108.9	26
Uganda	42528	21.1	30
Mozambique	15693	19.3	87
Madagascar	15510	15.5	65
Dem. Republic of the Congo	15271	2.9	20
Chad	12371	7.5	30
Cote d'Ivoire	12289	14.5	66
Niger	11404	10.4	85
Cameroon	10731	14.7	47
Mali	10240	11	58
United Republic of Tanzania	10023	32.8	72
Kenya	9262	29.5	61
Guinea	9170	7.4	58
Senegal	6594	9.2	65
* Malawi	3591	10.6	90
Algeria	3301	30.8	75
Angola	2576	12.5	65
Zimbabwe	2049	11.5	65
Ethiopia	1603	61.1	45
Burundi	1449	6.6	44
Liberia	1436	2.9	31
* Mauritania	1303	2.6	
South Africa	977	39.9	
Togo	801	4.5	33
Botswana	700	1.6	80
Benin	678	5.9	82
Namibia	495	1.7	63
Eritrea	316	3.7	52
Congo	174	50.3	
Central African Republic	146	3.6	39

* measles elimination plan

AMRO*

County	No. of reported cases	Pop.	MCV Coverage (%)
Argentina	9469	36.6	99
Brazil	2135	168	96
Bolivia	1004	8.1	80
Colombia	104	41.6	75
United States of America	89	276.2	
Paraguay	70	5.4	78
Costa Rica	20	3.9	86
Canada	12	30.9	96
Dominican Republic	10	8.4	95
Peru	10	25.2	93
Chile	4	15	93
Haiti	4	8.1	22
Venezuela	4	23.7	94
Uruguay	2	3.3	86
Guatemala	1	11.1	81
Jamaica	1	2.6	85
Cuba	0	11.2	99
Ecuador	0	12.4	88
El Salvador	0	6.2	98
Honduras	0	6.3	97
Mexico	0	97.4	96
Nicaragua	0	4.9	99
Panama	0	2.8	95
Puerto Rica	0	3.8	
Trinidad and Tobago	0	1.3	90

* all states: measles elimination plan

EMRO

Country	No. of reported cases	Pop.	MCV Coverage (%)
Afghanistan	2205	21.9	36
Egypt	4868	67.2	98
Iran	2731	66.8	100
Iraq	7814	22.5	
Jordan	428	6.5	86
Kuwait	90	1.9	100
Lebanon	966	3.2	91
Libyan Arab Jamahiriya	50	5.5	
Morocco	7208	27.9	91
* Oman	5	2.5	98
Pakistan	2333	152.3	76
Saudi Arabia	5519	20.9	93
Somalia	3075	9.7	47
Sudan	550	28.9	63
* Syrian Arab Republic	5400	15.7	97
* Tunisia	123	9.5	94
United Arab Republic	296	2.4	95
UNRWA	59		98
West Bank and Gaza Strip	40	2.56	94
Yemen	8785	17.5	66

* measles elimination plan

EURO

Country	No. of reported cases	Pop.	MCV Coverage (%)
* Romania	9547	22.4	97
Russian Federation	6918	147.2	98
Ukraine	4989	50.7	96
Italy	3152	57.3	55
Tajikistan	3069	6.1	95
Azerbaijan	2906	7.7	
Bosnia & Herzegovina	2711	3.8	84
Kyrgyzstan	2397	4.7	98
Kazakhstan	1935	16.3	98
Turkmenistan	1035	4.4	99
Uzbekistan	1004	23.9	96
Republic of Moldova	673	4.31	99
Croatia	648	4.5	91
Slovakia	530	5.4	99
Belarus	517	10.3	98
Georgia	218	5	90
Portugal	96	9.9	96
Bulgaria	81	8.3	95
* United Kingdom	74	58.7	91
Armenia	52	3.5	94
Hungary	23	10	100
Czech Republic	19	10.3	95
Lithuania	18	3.7	96
Estonia	17	1.4	89
Slovenia	13	2	93
Israel	10	6.1	94
Netherlands	9	15.7	96
Latvia	3	2.4	97
Finland	1	5.2	
Belgium	0	10.2	

* measles elimination plan

SEARO

Country	No. of reported cases	Pop.	MCV Coverage (%)
India	33990	998.1	66
* Thailand	13697	60.9	
Bangladesh	6522	126.9	72
Nepal	5771	23.4	73
* Myanmar	1465	45.1	85
* Indonesia	1034	209.3	76
* Sri Lanka	177	18.6	91
* Bhutan	66	2.1	71
Dem. People's Rep. Of Korea	0	23.7	34

* measles elimination plan

WPRO

Coutnry	No. of reported cases	Pop.	MCV Coverage (%)
China	53030	1266.8	97
* Viet Nam	11690	78.7	96
* Lao People's Dem. Republic	4613	5.3	71
* Cambodia	1993	10.9	63
* Philippines	1984	74.5	87
Papua New Guinea	1148	4.7	59
Japan	899	126.5	
* Malaysia	483	21.8	86
* Australia	327	18.7	86
* New Zealand	164	3.8	81
Singapore	114	3.5	96
* Mongolia	8	2.6	93
Republic of Korea	0	46.5	85

* measles elimination plan

Measles Reported Cases and Countries

資料 2

＊ 人口100万人以下の国を省く

AFRO

1998年：麻疹発生報告の高い国		1998年：麻疹発生報告の低い国	
Nigeria	143098 cases	Central African Republic	146 cases
Uganda	42528	Congo	174
Mozambique	15693	Eritrea	316
Madagascar	15510	Namibia	495
Dem. Republic of the Congo	15271	Benin	678

AMRO

1998年：麻疹発生報告の高い国		1998年：麻疹発生報告の低い国		1998年：麻疹発生0報告の国
Argentina	9469 cases	Jamaica	1 case	Mexico
Brazil	2135	Guatemala	1	Ecuador
Bolivia	1004	Uruguay	2	Cuba
Colombia	104	Haiti	4	Honduras
USA	89	Chile	4	El Salvador
				Nicaragua
				Puerto Rica
				Panama
				Trinidad and Tobago

Footnote:

	1991	1994	1997
Brazil	30000	35	50000
Argentina	17806	59	

（再流行例として挙げた）

EMRO

1998年：麻疹発生報告の高い国		1998年：麻疹発生報告の低い国	
Yemen	8785 cases	Oman	5 cases
Iraq	7814	West Bank & Gaza Stripe	40
Morocco	7208	Libyan Arab Jamahiriya	50
Saudi Arabia	5519	UNRWA	59
Syria	5400	Kuwait	90

EURO

1998年：麻疹発生報告の高い国		1998年：麻疹発生報告の低い国		1998年：麻疹発生0報告の国
Romania	9547 cases	Finland	1 case	Belgium
Russia	6918	Latvia	3	
Ukraine	4989	Netherlands	9	
Italy	3152	Israel	10	
Tajikistan	3069	Slovenia	13	

SEARO

1998年：麻疹発生報告の高い国		1998年：麻疹発生報告の低い国		1998年：麻疹発生0報告の国
India	33990 cases	Bhutan	66 cases	North Korea
Thailand	13697	Sri Lanka	177	
Bangladesh	6522	Indonesia	1034	
Nepal	5771			
Myanmar	1465			

WPRO

1998年：麻疹発生報告の高い国		1998年：麻疹発生報告の低い国		1998年：麻疹発生0報告の国
China	53030 cases	Mongolia	8 cases	South Korea
Viet Nam	11690	Singapore	114	
Laos	4613	New Zealand	164	
Cambodia	1993	Australia	327	
Philippines	1984	Malaysia	483	

国内総生産(GDP)の高い国及び低い国における麻疹発生数(1998 年)

資料 3

Highest GDP per head

Country	measles cases
Luxembourg	
Switzerland	
Japan	899
Norway	
Bermuda	
Denmark	
Germany	
Austria	
United States	89
Singapore	114
Iceland	
Belgium	0
France	
Netherlands	9
Sweden	

Lowest GDP per head

Country	measles cases
Mozambique	15693
Ethiopia	1603
Congo	174
Chad	12371
Bhutan	66
Tanzania	72
Burundi	
Malawi	3591
Niger	11404
Sierra Leone	
Nepal	5771
Mali	10240
Madagascar	15510
Burkina Faso	
Nigeria	143098

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Does Polio eradication succeed meeting the target year of 2000?

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Does Polio eradication succeed meeting the target year of 2000?

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Abstract

The global polio eradication programme is under way with target year of 2000. We reviewed the programme progress, in perspective, from the experience of the global smallpox eradication, which is at present a sole disease ever eradicated by orchestrated global efforts. We concluded that despite substantial efforts being made by WHO and member states with the current progress, it would require additional some three years, namely 2002. This would safe-guard the success. As of January 2000, there are still at least 22 endemic states in Indian Subcontinent and Africa, South of Sahara. Experiences in smallpox eradication, although the disease is different, indicated that to stop transmission in such a large number of endemic states took more than three years, assuming that further support would come toward the final goal. This report was presented as special lecture during the 24th Kyusyu Regional Congress of Japanese Tropical Diseases on 22 January 2000 at University of Occupational and Environmental Health, Japan.

Introduction

The development of medical technology has been remarkable during the last millenium, especially in the last 400 years. The circulation of the blood discovered by William Harvey in 17th century, opened the way to scientific management of curative medicine in developed region and smallpox eradication declared by WHO in 1980, opened the way to definitive and real equity for distribution of benefit from medical science to all the humanity, namely both in developed and under-developed regions (1).

This means, the technology development in curative medicine has been enjoyed chiefly by Western civilization and its followers including Japan, not by other civilizations such as African, Chinese, Hinduism, Islamic and Latin. Perhaps, smallpox eradication is the first human attempt in the sense that all the civilizations worked together regardless of their culture and religions, by mobilizing all the resources available in their own domains.

Polio eradication follows smallpox eradication aiming at the achievement of zero world incidence by 2000. It will certainly occur in foreseeable future, the end is beginning, but how far the end? In this note, its progress, problems and future was analyzed and forecast based on the experience gained from smallpox eradication, so that the beginning of the end should be assured.

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Success of Smallpox Eradication

Smallpox eradication, even though its remarkable success, proceeded with difficulty. The first attempt (1958 – 1966) failed owing to the fact that industrialized states, namely western civilization did not understand and meet with the need of developing world of the other civilizations.

The second, namely The Intensified Programme, was successful (1967 – 1980). WHO co-ordination effectively motivated all the civilizations, making the resources available globally. Many national heads of major smallpox endemic states placed the high priority on the programmes. The strategies were innovative, including effective vaccine quality control and vaccine production promotion in selected states, surveillance and containment measures and establishment of international diagnostic laboratories.

The salient picture of progress of smallpox eradication is specifically described below (table 1):

The programme started with U.S. bilateral assistance in 19 states of West and Central Africa in 1967. It successfully stopped the transmission with the last case in Nigeria in 1970. Massive investment of international personnel (average yearly 54 US personnel) as well as necessary transport (more than 100) assured the success.

In entire Asian continent, Indian subcontinent was major reservoir of smallpox. The commencement of the programme was delayed, but, in September 1973, late Indira Gandhi, then prime minister, India, instructed all the health centres staffs took one week every month only for search for smallpox, being followed by containment vaccinations. After implementation of this "Autumn Campaign", India recorded the last case in May 1995. Estimated investments included assignment of average 27 international and 31 national epidemiologists. Similar programme took place in Bangladesh which recorded the Asian continent's last case in October 1995, with average 27 international and later date 28 national epidemiologists in 1974 and 1975.

Having secured the Asian subcontinent to be in odor, the WHO's global programme was able to concentrate on the last battle taking place in the Horn of Africa. In fact in 1976, most of international personnel engaged in Asian Subcontinent Autumn Campaign joined national and international programme personnel in Ethiopia and Somalia, the two last reservoirs states of smallpox. Ethiopia recorded last case in August 1976 and Somalia in October 1977. The case detected in Somalia is, in fact, the end point of natural smallpox transmission over the last 6000 years. Since October 1977, continuing surveillance in the Horn of Africa and elsewhere in the world has not discovered smallpox until to-date. Exception was the laboratory associated smallpox cases in Barmingham, U.K. in 1978. This was quickly contained, but gave a lesson that laboratory stocks of smallpox virus did

pose real risk of reintroduction of smallpox. WHO recommended, therefore, to destroy the variola virus stocks in all research laboratories, having proposed several times the dates of destruction.

As of to-date, this important post eradication action, regrettably, has not yet been implemented; U.S. and Russia have been against this policy. They fear the probable presence of smallpox bioweapon and maintain the virus stocks with dubious understanding that their retention of the virus stocks would prevent the use of such weapon.

Commencement of Polio Eradication

With recognition of this unprecedented achievement of smallpox eradication, WHO and international community thought of the next step, and agreed to strengthen immunization programmes of vaccine preventable diseases. Thus, Expanded Programme of Immunization (EPI) commenced early 1980.

In the course of time, Pan American Health Organization (PAHO) recognized the immunization programmes in a few states effectively stopping the indigenous transmission of wild polio. In 1985, PAHO decided to launch Regional polio eradication in North and South Americas. Notably, PAHO traditionally was interested in disease eradication as seen in their failed efforts for yellow fever as well as malaria eradication. This time, encouraged by success of smallpox eradication they, including ex-smallpox eradication staffs initiated this new venture. Being impressed by PAHO's successful execution, in 1988 WHO resolved to commence the global eradication of polio by the year of 2000.

Progress of Polio Eradication as Compared with That of Smallpox Eradication

In both diseases, there is no animal reservoir, no long term virus shedding, effective vaccines with affordable price, and lastly, world community is concerned about the disease burden, which resulted or will result in greater possibility of global resource mobilization.

The strategy for polio eradication is similar to smallpox eradication. The main strategies consist of National Immunization Days (NIDs) and acute flaccid paralysis (AFP) surveillance. Surveillance containment measures also being aggressively undertaken in the risk areas. PAHO recorded the last endemic case of polio in 1991, WHO Western Pacific Region (WPRO) in 1997 and European Region (EURO) in 1998. Technical advantage of polio eradication over smallpox eradication is that polio vaccine virus can be naturally transmitted to the contacts, thus assuring wider vaccination coverage, and that fecal-oral route of polio infection may be less frequent than respiratory route of smallpox infection. Presence of subclinical infection in polio does not appear hampering the operation, as proved by successful surveillance in PAHO and WPRO.

As of January 2000, there are all together 22 endemic states reporting polio wild virus and 8 states where the virus transmission is strongly suspected due to lack of adequate surveillance and its proximity to endemic states. They are in Africa, Middle East and South East Asia (Map 1). The situation is compared with that of smallpox eradication. In smallpox eradication programme in 1970, 7 years before the last case, there were 17 states where smallpox virus transmission was continuing (Table 1). In other words, the current situation of polio eradication, the number of endemic or suspected polio states is larger than that of smallpox eradication in the year of 1970. If the target year of 2000 were to be met, these a total of 30 states should finish the transmission from now until December 2000 (Map 1), namely, from now on, only 12 months.

Further, if we make the observation one year before the last case in smallpox eradication, the number of states reporting the virus was only two Kenya and Somalia. Kenya had only importation; Somalia had an extensive outbreaks newly developed being imported from Ethiopia. The extent of resources investment was compared in both situations. In smallpox eradication, in about 40 million population areas, 45 WHO personnel were assigned for the special containment campaign in addition to the nationwide mobilization of national staff (Table 2). In polio eradication, there appears to be about 200 international staff worldwide, roughly for 1500 million population in 30 states in Africa and Asian subcontinent.

In the last stage of smallpox eradication, notably the number of laboratories was strictly limited to efficient and reliable ones, CDC Atlanta and Research Institute of Viral Preparation, Moscow, both were WHO International Collaboration Center for diagnosis of smallpox. The measures were particularly critical since there was no room to make mistake in that very last stage of the global programme. This was in a sense an extreme action, but there was the understanding that in the emergency situation, WHO could not afford to let limited number of programme staff work for improvement of laboratory capability at that time. In polio eradication, there are at present 148 polio laboratories being engaged in surveillance activities (Table 3). Of these, 110 laboratories were accredited by WHO. Such global efforts are commendable, but polio programme may wish to limit the number when the end becoming near.

Discussion

First of all, why we are specifically interested in the length of an eradication programme.

As discussed in the Eradication Conference, held in Berlin in 1997, the cost-benefit of eradication programme depends upon its length of eradication programme, namely "the longer the global programme, the greater the expenditure and the lesser the benefit"(2). For example, North and South America became free of polio in 1991 and Western Pacific in 1997. Though this is commendable achievement, they must continue surveillance as

well as immunization programme as long as polio remains endemic in Indian Subcontinent and African continent.

I would note, there is a striking similarity between smallpox eradication and polio eradication programme in terms of the endemic states making "fast" progress and those making "slow" progress. As mentioned previously, smallpox eradication was first launched in 1958. All the 59 states of smallpox endemic were recommended to conduct vaccination programmes. In about 12 year time, states in Latin America as well as in Western Pacific became endemic smallpox free. Thus, the Intensified Programme dealt with the 31 endemic countries of Africa South of Sahara, Indian Subcontinent and Indonesia (Chart 1).

In polio eradication, it started in 1985 South and North Americas, and globally in 1988. Similarly in about 12 year time, "fast" states in Latin America as well as Western Pacific became endemic free. And since 1995, the global programme was dealing with endemic states, so to speak "slow" states, in South of Sahara, African Continent and with those in Indian Subcontinent. Parenthetically, Egypt and Iraq made fast progress in smallpox eradication, but only slow progress in polio eradication, reason for which may need some studies.

Now the question is "Can polio eradication programme stop polio transmission in 2000?", or how near the end?

Since 1998, substantial efforts have been made to strengthen the national programmes in South of Sahara, Africa as well as Indian Subcontinent. Here, we should review the situation in Smallpox eradication as previously mentioned. There were (1) the U.S. bilateral CDC programme with HQ in Lagos, Nigeria in 19 states of West and Central Africa (1967 – 1970) with last case in Nigeria this areas in 1970, (2) Autumn Campaign (1973 – 1975) in Indian Subcontinent with last case in Bangladesh in 1975, and (3) Horn of Africa Campaign (termed "Crocodile" in Ethiopia) with the world last endemic case in 1977. The number of personnel international as well as national were certainly far greater than those for current polio eradication (when the number of personnel international as well as nationals are available, it would be desirable to make correct comparison).

As of January 2000, polio eradication is positioned where? It would not be certainly the position comparable to the smallpox eradication's1976 – one year before the world last case.

Those "slow" states in polio eradication have some advantage over some endemic states during smallpox eradication, first, they have had experience in EPI programmes during last 15 years. Secondly, they should have a confidence they can do, if they want, having achieved the great success in smallpox eradication in the past. Further vaccination

apparently is relatively effective to stop transmission in low densely populated areas like Africa South of Sahara (3). How much these things could accelerate the progress meeting 2000 year target? In smallpox eradication, massive investment of international and national personnel in "slow" states was cause of success as described before. It should be noted that although the diseases are different, managerial aspect of eradication global should be the same.

Parenthetically, in smallpox eradication, the last epidemic in the Horn of Africa was, in fact, "set-back". We were complacent on incomplete surveillance capability in these areas. In polio eradication, political instability appears to be worse than that 20 years ago. Epidemics in Angola was a good lesson. Therefore, strengthening surveillance capability would be also top priority in catching up. I am not saying, the horn of Africa would be the last polio endemic area. It could be any states where surveillance is poor and resulting containment is ineffective.

These reviews may lead to concern that the target 2000 (Dec 2000) may not be reached. As mentioned before, technically both programmes should be feasible but different modus operandi makes one wonder how the polio programme meet the target. It should be noted that even such greater investment the smallpox programme had enormous difficulties such as war, shortage of funding and extremely difficult geographical terran which required helicopters. In all aspects, it would be sensible to give additional three years as to meet the target, based on the experience that the above mentioned special eradication campaigns could eliminate the foci roughly in three year time. I should stress that if the current programme met the target in 2002 (three year from now), it would be still the second greatest achievement by WHO and by member states following smallpox eradication. It would be fair and sensible for polio programme to indicate new target year of 2002, at time of World Health Assembly (WHA) 2000 or of October 2000 when WPRO declare the freedom of polio in part of Asian continent. In this occasion, it is of vital importance to request additional resources to finish the job up.

This revision of target date needs courage. Though, nothing wrong, and politically solid. Once WHO said "Health for all by 2000". Without special notion, the phrase disappeared. We should assure public that once we say, it will be so. Also, pressing too much endemic states toward zero incidence may lead to false surveillance results as happened in Iran and Somalia during the last stage of smallpox eradication programme.

What is the plans, then? The last acceleration period requires to conduct (1) cautious and dispassionate analysis of programmes in individual polio endemic states and (2) estimate of requirements for additional resources to be made available in terms of personnel as well as contingency funds for field and laboratory work. Whether or not the magnitude of investment done by smallpox eradication campaigns should be applied would be critical decision, but it is absolutely certain that substantial increase in international and national

personnel will be needed to meet a new target year. As done in smallpox eradication, special information officer already recruited would be important to deal with the world major presses. When the incidence goes down to some level, reward announcement also can be of help. This would prevent suppression of case reports. Provision of transport may need special attention. As done by U.S. bilateral in West Africa in 1967-70, JICA, Japan provided 257 vehicles to polio eradication in China in 1990's. Any query by international community should be responded promptly. Perhaps, priority will also have to be re-examined and determined with clear understanding that the operational programme to "stop endemic transmission" should come first. Smallpox Programme staffs sometimes broke the WHO rule. This may be a lesson Polio Programme should "not" take.

Lastly, we should add, in this discussion, we did not use the number of reported cases. Instead, we used the number of endemic states. Because the varied surveillance capability often leads to the confusing assessment of actual status of disease transmission. Also, certification programme was not mentioned, of which virtual purpose is for all WHO member states to rest assumed that they can safely disestablish the polio immunization, and this was not objective of this report.

Measles Programme

Discussion on measles eradication programme has started. However, unless polio eradication is over, measles programme should be of a low priority. It is noted that in WPRO, former Regional Director advised not to talk on measles elimination before achieving zero polio in the Region. In fact, this was a wisdom for the success. Sometime in future, there will be a global measles eradication programme, lessons from smallpox eradication as well as this on-going polio eradication will be useful.

Conclusion

Polio eradication is now in progress to interrupt the wild polio transmission globally. It aims to be by December 2000, namely only one year left for the completion of the programme, when this report is being prepared.

Experience in special eradication campaigns conducted by the past smallpox eradication was used to assess and safe-guard the current progress of the global eradication. Such assessment led to cautious thinking that additional three years would be required to reach the global interruption of transmission.

Considerable efforts so far made by WHO as well as member states are commendable. The momentum, if intensified by additional mobilization of world resources, would make the global programme reach the end in 2002. For global resource mobilization, it would

be rational strategy, namely Japan together with other partners focus on Asian subcontinent and U.S. and E.U. on Africa.

Although the delay thus occurred, if succeeded, it would be a tremendous success by humanity after smallpox eradication, in the history of preventive medicine. All the people under different civilizations will be benefited.

Acknowledgement

Although the report is to some extent a departure from present WHO policy, we are thankful to Dr. Bjorn Melgaard and his staff members who have kindly provided valuable information on current situation of global polio eradication. We also thank Dr. Takezumi Yoshimura, Regional President, Kyusyu Region, Japan Tropical Medicine Congress and Dr. Tamotsu Kanazawa, President of Congress, for encouraging us to prepare this report. The report was presented during the regional congress, which was held on 22 January 2000 at University of Occupational and Environmental Health, Japan.

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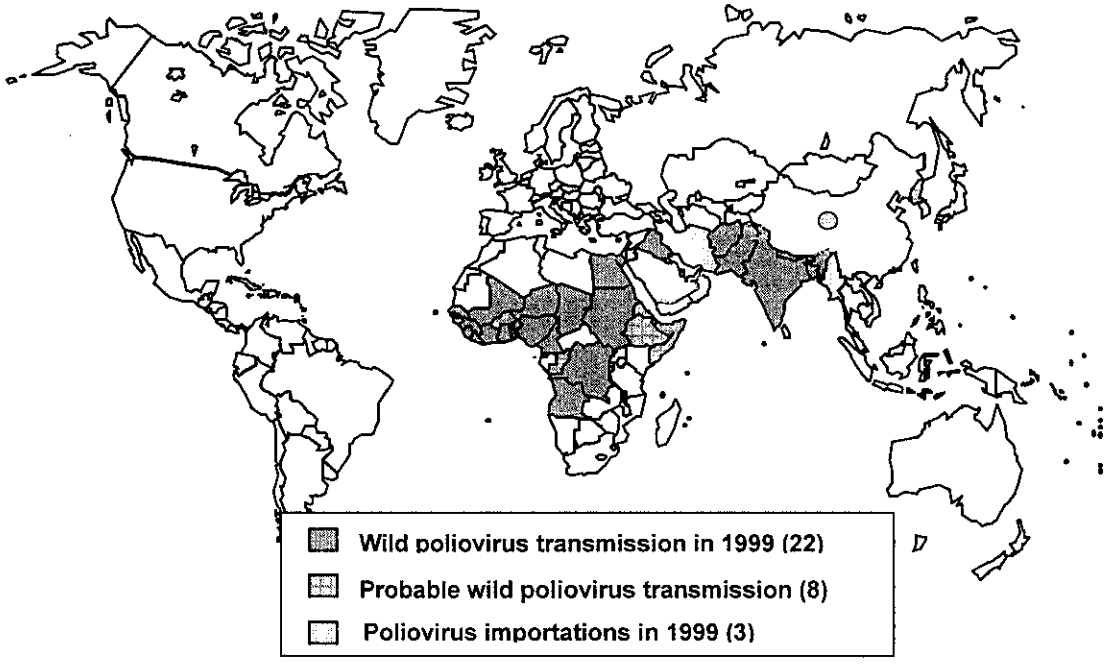
Table 1 Smallpox Eradication
Disease in the number of endemic states

Block Area	Year of Last Cases (State)	No. of Endemic States Worldwide
South America, Africa and Asia	1967	31
Africa West	1970 (Nigeria)	17
Africa Central	1971 (Zaire)	13
America South	1971 (Brazil)	13
Africa East	1972 (Uganda)	10
Africa South	1973 (Botswana)	6
Asia South East	1974 (Pakistan)	5
Asia South East	1975 (India, Bangladesh)	4
Horn of Africa	1976 (Ethiopia)	2
Horn of Africa	1977 (Somalia)	1

Foot Note: In polio eradication, as of January 2000, there are 30 polio endemic states (including suspected 8 states)

Map 1 Status of Polio Eradication



Source: Polio Eradication: WHO
Jan. 2000