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B/Hong Kong/72
B/Singapore/222/79

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The incidence of influenza A and B at Lowry AFB from 1977 to 1981 is reviewed. The incidence of H1N1 influenza, when no vaccine was available, the H1N1 virus caused low incidence smouldering outbreaks in vaccinated personnel in 1979 and 1981. A small outbreak of influenza B occurred in 1978-79, affecting mainly permanent party. A few cases of H3N2 influenza occurred in 1977-78 and 1980-81. It appeared that vaccine was providing good levels of protection to military personnel in the face of large scale outbreaks (continued)

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Summary - Continued

in the surrounding civilian community.

2. During the last 3 years, rates of febrile U.R.I. in students have at no time exceeded 8.8/1000/week.

3. The "protective" H.I. antibody level for H1N1 was above 64 when tested with A/Brazil/78 and was 16 when tested with A/Denver/81, a strain isolated at Lowry in 1981.

4. Serum pairs for 200 recruits who received vaccine containing 14 µg each of A/Bangkok, A/Brazil and B/Singapore were tested to determine the adequacy of response. The response was satisfactory and indicated that only a single rather than a double immunization schedule was necessary.

5. Comparison of methods for recovery of virus from throat washings were reviewed. For H1N1 strains, R.M.K. provided a 72 recovery rate and canine kidney only 36%. Isolation was difficult in chick embryo. Influenza B strains also were most readily isolated in R.M.K.

6. No single serologic test was able to pick up all cases and it appears necessary to continue to use C.F. and H.I. tests, the latter including new strains and ether-split antigens.

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AD_____

PREVENTION OF INFLUENZA AND OTHER RESPIRATORY DISEASES (U)

ANNUAL PROGRESS REPORT

BY

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October 1981
(For the period 1 February 1980 to 30 June 1981)

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1. Introduction

The primary goal of the studies conducted at Lowry AFB over the past 30 years has been to prevent illness caused by respiratory viruses. Adenovirus diseases, formerly the most common illness in the student (recruit) population have virtually disappeared since effective vaccine has been given to recruits at the time when they arrive at Lackland AFB. Influenza has been a major cause of illness only when there has been antigenic shift and suitable vaccine has not been available. Thus, in 1957, 1968 and 1977, when H2N2, H3N2 and H1N1 viruses, respectively, appeared, major epidemics occurred. Antigenic drift had a lesser impact except in 1972 when the A/England strains of H3N2 became prevalent. In most other years, even though either influenza A or B viruses were present in the community and on the base, illness rates from influenza have been low in vaccinated personnel. Controlled trials of vaccine effectiveness, which in earlier years provided much of the solid data of vaccine effectiveness, have not been possible since 1972, but the inference is clear that the low incidence is related to vaccination.

This report recounts observations made during the period from 1977-81 on incidence of influenza, vaccine response in relation to antigenic composition and potency and on the problems encountered with virus isolation and serologic procedures.

2. Incidence of influenza 1977-81

The H1N1 (Russian) epidemic of influenza in 1977-78 provided a vivid reminder of what influenza can do in an unvaccinated military population (Table 1). Based on estimates of excess clinic visits for febrile U.R.I., approximately one-half of the student population had influenza within a one-month period. A large number of cases occurred in the permanent party as well. In this, as in subsequent years, H1N1 cases were confined to persons born after 1957. The clinical disease was relatively mild and the number of persons hospitalized at Fitzsimons Army Hospital was negligible. Nevertheless, the epidemic resulted in a major disruption of programs.

In 1978-79, H1N1 returned to Lowry AFB and there was a sizeable outbreak in young persons in the surrounding civilian community. The number of cases was small in students, reflecting the fact that over one-half were immune as a result of prior infection and that all had received a double vaccination. The number of cases in permanent party, which received a single dose of vaccine, was somewhat larger. The outbreak obviously was blunted and the virus, though present on the base over a 9-week period (Table 2), either failed to spread, as it had during the previous year, or failed to find susceptible individuals.

In 1979-80, influenza A was not detected, but influenza B cases occurred over a 9-week period. There was no epidemic peak and the number of cases was very small (30). Of these, only 5 occurred in students; the remaining 25 cases occurred in permanent parts, most in persons over 30 years of age.

In 1980-81, H1N1 influenza reappeared. Despite the fact that the majority of persons by this time had naturally acquired immunity and that a triple immunization schedule was used, the number of cases in students was larger than in 1978-79 (55). Forty-one cases were detected in the permanent party. The cases were distributed over a nine-week period, without an explosive peak.

H3N2 influenza cases occurred in two years, 1977-78 (A/Texas) and 1980-81 (A/Bangkok). The number of cases in students was extremely small, 4 in 1977-78 and 3 in 1980-81, and was low in the permanent party as well. This was consistent with the fact that most persons have experienced H3N2 infections since H3N2 viruses appeared in 1968 and that response to the H3N2 component of the vaccine has been uniformly good. Parenthetically, it has been of interest to note that members of 2 influenza families were circulating at the same time in two of these years (1977-78 and 1980-81).

3. Febrile U.R.I. rates in students 1977-81

In Table 2, the number of cases of febrile U.R.I./week/1000 in the student population is shown for these four years, along with asterisks which indicate the weeks when influenza A or B cases were confirmed. It is noteworthy that only in 1977-78 did rates exceed 8.8/1000/week. The highest rate, 119.0, occurred at the peak of the H1N1 epidemic in 1977-78. This rate is based on daytime clinic visits and excludes the many nighttime and weekend visits which occurred during the epidemic. In the other three years, influenza A or B produced only a barely perceptive bulge in rates. The rates are very low in relation to those observed in the past. The elimination of adenovirus diseases is in large measure responsible for this change.

4. H.I. antibody response to vaccination 1977-1980

Vaccination regimens have been in a state of flux since H1N1 influenza first reappeared in 1977. The amount of antigen (in µg hemagglutinin), numbers of injections and strain composition have been different each year. The effect of these changes is shown in Tables 3 to 8, which compare pre- and post-vaccination titers against 2 H1N1 strains (A/Brazil/78 and A/Denver/81), 2 H3N2 strains (A/Texas/77 and A/Bangkok/79) and 2 influenza B strains (B/Hong Kong/72 and B/Singapore/79).

Relevant comments accompany each table. Noteworthy is the fact that in tests with A/Brazil the response to the 1980 regimen of 3 injections of 7 µg each was less satisfactory than observed in the earlier year with a double schedule of 20 µg followed by 7 µg (Table 3). The A/Brazil vaccine produced a reasonably good response to A/Denver/81, which was isolated from the 1981 epidemic at Lowry (Table 4).

The responses to the H3N2 components, A/Texas in 1979 (Table 5) and A/Bangkok in 1980 (Table 6), were satisfactory. The A/Bangkok response in recipients of the A/Texas vaccine was less than the homologous A/Texas response, but most persons had titers at levels shown to be "protective". The A/Bangkok vaccine produced an even better response to the earlier A/Texas strain.

With the influenza B component, which was B/Hong Kong in 1979 and B/Singapore in 1980, the response to both strains was reasonably good regardless of the strain composition (Tables 7 and 8). In 1979, the 20 µg vaccine raised the percentage of persons with titers of ≥16 from 20% to 91%. The second injection of 7 µg vaccine produced only a slight further increase. This vaccine raised B/Singapore levels of ≥16 from 12% to 70% after the first injection and to 84% after the second injection. These results must take into account the fact that B/Singapore is probably a less avid strain.

The B/Singapore vaccine used in 1980, even at a dose of 7 µg given twice produced a better B/Hong Kong response than the 1979 vaccine. The third injection of vaccine added almost nothing. The first 2 injections of 7 µg vaccine in 1980 produced a B/Singapore response comparable to that obtained with the 20 µg B/Hong Kong vaccine used in the previous year. The third injection of 7 µg vaccine did raise the percentage of persons with titers of ≥16 from 70% to 85%.

5. Relationship between H.I. antibody level and clinical illness

A relationship between H.I. antibody level and the likelihood of acquiring clinical influenza was first observed in 1943 by the California (Eaton and Meiklejohn) and Michigan (Francis and Salk) components of the A.F.E.B. multicenter military vaccine evaluation during an HON1 epidemic. It was noted at that time that the antibody level linked to protection was higher in vaccinated persons than in those with naturally acquired antibody. This suggested that factors other than serum H.I. antibody alone were involved in resistance to illness.

During the intervening years, the relationship has been confirmed by a number of workers in both epidemic and volunteer studies. It is clear that highest illness rates occur in persons with titers of <8 and that as titers rise the attack rates diminish. Above a certain point, clinical illness virtually ceases to occur. In our laboratory this level has, in general, been 16. Civilian workers have generally accepted a titer of 40 as "protection" (comparable to our figure of 32).

The data on which these interpretations are based were derived during outbreaks caused by HON1, H2N2, and H3N2 epidemics. In the H1N1 epidemics of the 1947-57 period, it appeared that the relationship was less definite. More cases than expected occurred in persons with high post-vaccination titer. A similar situation existed during the influenza B epidemic of 1922-23. With influenza B, and to large extent with some H1N1 influenza A strains, sera inhibition have been a continuing problem.

It is of interest, therefore, to note our experience during the 1981 H1N1 outbreak. Table 9 presents the distribution of acute phase antibody titers of 65 students and 41 permanent party in which the diagnosis of influenza was confirmed by virus isolation and/or a 4-fold or greater increase in antibody titer in either CF or H.I. test. The bulk of cases are concentrated at the lower titer levels, but there is a scattering of persons with high antibody titers.

Table 10 relates the titers of students which are presented in Table 9 to the estimate number of persons with titer at each level. The permanent party are not included because of their variable and multiple vaccination background. The "protective level" when measured with A/Brazil is higher. Thus persons with H.I. titers in the 32-64 range had an attack rate only one half that observed in persons with titers of <8 to 16. At a titer of 128, the attack rate (0.2) fell to one twentieth that observed in persons with titers of <8 to 16.

When the sera were tested with A/Denver/81, an epidemic strain, titers were somewhat lower due either to slight strain variation or to lower avidity. The likelihood of becoming ill with influenza for persons with titers of 32-64 was only one-seventh that of persons with titers of <8 to 16. A few persons (4), however, with titers of ≥128 did acquire influenza.

This relationship between H.I. titer and susceptibility is somewhat imprecise but nevertheless useful. It must be recognized that many factors are at play - strain variation, avidity, inhibitors and probably others. There may be better correlates in the future. At this time it seems desirable to search for a vaccine response which will bring at least 80% of vaccinees to a titer level of 32 or more and that, if higher levels can be achieved without excessive cost or reactions, so much the better.

6. Re-evaluation of vaccine potency in the Spring of 1981

The data presented above on the antibody response to the 1980-81 vaccine, together with the fact that the protection observed during that winter season was less than optimal, led to a re-evaluation of the decision to reduce vaccine potency to 7 µg of each antigen. It seemed desirable to increase potency to at least 15 µg potency, but no data were available on what response would be obtained at this level. For this reason, our laboratory was requested to test sera from recruits at Lackland AFB who received 1.00 ml of the current vaccine, presumably containing 14 µg of each antigen. This recommendation was made by a special committee appointed by the A.F.E.B. consisting of Dr. A.Benenson (Gorgas), W. Jordon (NIAID), E. Kilbourne (Mt. Sinai School of Medicine), T. Woodward (U. of Maryland School of Medicine) and G. Meiklejohn (U. of Colorado School of Medicine).

Because interest centered mainly on H1N1 response and information was lacking on what proportion of recruits had already had H1N1 influenza (and were probably immune or "primed" for vaccination), it was recommended that 200 sera pairs be obtained as soon as possible. This was accomplished under the direction of Lt. Col. David Gremillion of Lackland AFB and the sera were received in excellent condition with a minimum of delay.

In addition to testing responses to the 3 strains contained in the vaccine, a second strain of each component was included in the tests. The following antigens were used in the designated egg passage:

H3N2	A/Bangkok/1/79	E-15
	A/Texas/1/77	E-16
H1N1	A/Brazil/11/78	E-9
	A/Denver/1/81	E-8
B	B/Singapore/222/79	E-25
	B/Hong Kong/5/72	E-17

The results with each strain are presented in tables with two sections, (a) and (b). The first section (a) shows not only the overall distribution of pre- and post-vaccination titers, but also breaks them down into groups of seronegative and seropositive persons. The second section (b) clarifies further who responded to vaccine by showing the proportion of responders broken down by pre-vaccination titer.

Results with H3N2 component (Tables 11 and 12)

Titers were lower in pre-vaccination sera to A/Bangkok than to A/Texas. Antibody response to both strains was excellent. Titers of ≥16 were found for A/Bangkok in 95% and for A/Texas in 96%. Assuming little or no antigenic drift one would anticipate a high degree of protection.

Results with H1N1 (Tables 13 and 14)

Pre-vaccination titers of <8 were found in 55% of persons in tests with A/Brazil and in 58% in tests with A/Denver. However, a large proportion of these persons showed a very marked antibody response (e.g., <8 to 1024), suggesting that they had been infected previously, between 1977 and 1981, when we tested 20 µg vaccine in seronegative persons none developed a titer of ≥256. In the present study, more than half of the "seronegatives" had post-vaccination titers of ≥256. It would appear, therefore, that at least one-half of the "seronegatives" had been previously infected and that the actual percentage of persons who had not been infected by H1N1 strains was less than 25%, rather than the observed 50%. If one half or more of these true seronegatives respond well, the number of susceptibles should be reduced to only 10% or less.

The antibody response was surprisingly good for both strains, with A/Brazil titers being a shade higher. We noted in the tables sent out earlier that the "protective level" was higher with A/Brazil than with A/Denver. It is impossible to state whether this reflects strain difference or avidity. In 1981 illness rates dropped to negligible levels in persons with A/Denver titers of ≥16. Ninety-one percent of the vaccinees in this study had titers of ≥16 and 57% had titers of ≥32.

Comparing this response to that observed in the three previous years, post-vaccination titers for A/Brazil are slightly higher than in 1979 following a single dose of 20 µg vaccine and definitely higher than in 1980 following 2 injections of 7 µg vaccine. Titers are quite comparable to those observed after 3 injections of 7 µg vaccine in 1980.

Results with influenza B (Tables 15 and 16)

Titers in pre-vaccination sera were <8 for B/Hong Kong in 58% persons and for B/Singapore in 79%. Response following vaccination was disappointing for B/Singapore, as they were a year ago. In previous years influenza B antibody response had generally been more satisfactory. B/Hong Kong titers were considerably higher than B/Singapore titers.

These data must be interpreted with caution because data relating antibody level to protection against influenza B illness are relatively scanty. However, in 1979-80, when the student population was almost completely free of influenza in the face of a community-wide outbreak, antibody levels were somewhat higher in the sample tested at that time.

Interpretation of results

A second injection of vaccine would add virtually nothing to protection against A/Bangkok. It might add slightly to protection against A/Brazil and B/Singapore. However, it is doubtful that the gain would be worth the additional cost and effort.

Assuming that significant antigenic drift is not detected before the fall of 1981, a second injection of vaccine is not warranted. It is my understanding that sufficient vaccine for a second injection has been ordered. If antigenic drift occurs it may be advisable to introduce a double immunization schedule at that time.

7 Criteria for the diagnosis of influenza

When influenza occurs in epidemic form, as in 1977-78 during the H1N1 outbreak, clinical diagnosis can be used to estimate attack rates. Because influenza accounts for up to 90% of all febrile U.R.I. during such a period, clinical diagnosis will be very accurate. However, when influenza smoulders for long periods, as it has in subsequent years, laboratory diagnosis is essential if one is to obtain an accurate picture of incidence.

A. Virus isolation

In the past we have had high recovery rates of H3N2 strains in either R.M.K. or chick embryo. We have had little success with the latter with H1N1 or B strains. The data in Tables 17 and 18 show the results of isolation attempts with H1N1 in 1980-81 and with influenza B in 1979-80.

Because of the cost of R.M.K. we ran all throat washings from students in dog kidney tissue culture in parallel. Strains were recovered from 72% of the specimens in R.M.K. and from only 36% in dog kidney. Perhaps with greater experience the yield would be better. For the present, the results are disappointing. Because of our low recovery rate in 1977-78 in chick embryo we tested only a small number of specimens and recovered only a single strain.

The often low and unpredictable recovery rates, as new virus strains appear, emphasize the need for other diagnostic procedures if a complete picture of influenza incidence is to be obtained.

B. Serologic tests

We have run all sera pairs in C.F. and H.I. tests. The latter have been bedeviled in recent years by the low avidity of newly isolated H1N1 and B viruses. We have therefore sometimes used split as well as whole virus and have used late (>15) as well as early egg passage. We have found early tissue culture fluid satisfactory for H.I. tests with influenza B, but similar effort with H1N1 have been disappointing.

Results of tests with sera for patients with H3N2, H1N1 and B/Singapore are shown in Tables 19, 20 and 18. It is clear that no single test is infallible. In general, it appears that if one relied on any single test,up to 20% of cases might be missed. It should be noted that virtually all of these persons had been vaccinated, and this may account for some failures to obtain a rise in C.F. titer. In unvaccinated persons in the past, the percent of persons with C.F. antibody rises has been higher.

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Lt. Col. David Gremillion, USAF MC, Chief, Infectious Diseases Service, Wilford Hall USAF Medical Center, Lackland AFB

Josephine I and Patricia S. Graves, University of Colorado School of Medicine

Table 1.

Type		Number of Cases of Influenza 1977-78	1978-79	1979-80	1980-81
H_1N_1	Students	1,700*	31	0	55
	Permanent Party	350*	59	0	41
H_3N_2	Students	4	0	0	3
	Permanent Party	21	0	0	14
B (HK-Sing)	Students	0	0	5	0
	Permanent Party	0	0	25	0

*Estimates based on excess clinic visits during epidemic period.

Number of laboratory confirmed cases of H_1N_1 and H_3N_2 influenza A and influenza B during 4 seasons from 1977-78 to 1980-81. Specimens were obtained from 75-80% of personnel reporting to Dispensary with febrile U.R.I. Student population numbered approximately 3,500 during time period; permanent party about 5,000.

Comments:

1. H_1N_1. The 1977-78 epidemic demonstrates again how influenza behaves in young unvaccinated personnel. The outbreaks in 1978-79 and 1980-81 were minor, due in part to naturally acquired immunity and in part to vaccination. Despite the double and triple immunization schedule using 7 µg vaccine in 1980-81, more cases occurred in students in 1980-81 than in 1978-79. Almost all cases in the permanent party were in persons 22-27 years old.

2. H_3N_2. Community outbreaks occurred in 1978-79 and in 1980-81. Students were almost completely spared.

3. Influenza B. A community outbreak occurred in 1979-80. Protection of students again was almost complete. Of the 25 cases in the permanent party, one-half were in persons over 30 years old.

Table 2.

NUMBER OF CASES OF FEBRILE U.R.I./1000/WEEK

Week	1977-78	1978-79	1979-80	1980-81
1	4.9	3.2*	1.1	-
2	4.9	7.2*	2.9**	5.4*
3	5.9	6.2*	3.9**	8.6*
4	43.3*	7.2*	5.3**	8.8*
5	119.0*	3.5	3.9**	2.9*
6	24.3*	2.9*	3.2	3.7*
7	7.2*	3.5*	2.9**	1.4*
8	8.1*	4.2	3.7**	2.3*
9	6.5*	1.9*	2.2	2.1*
10	5.3*	2.9	2.3**	2.1
11	6.8	3.5	1.1	
12		1.6	1.9	

*H_1N_1 virus present. **Influenza B present.

Number of dispensary visits for febrile U.R.I. during first 12 weeks of years from 1978-81. In 1981 a small number of cases of H_3N_2 influenza occurred during the last month of 1980.

Table 3.

Year	Serum Specimen	Amount Antigen	Percent with A/Brazil/78 H.I. titer of								
			<8	>8	>16	>32	>64	>128	>256	>512	>1024
1978	Pre-	-	100	-	-	-	-	-	-	-	-
(31)	Post-1	20*	45	55	39	29	23	10	-	-	-
1979	Pre-**	-	76	24	14	6	2	-	-	-	-
	Post-1	20	17	83	78	73	66	61	47	34	25
(75)	Post-2	7	0	100	100	99	87	80	63	39	32
1980	Pre-**	-	44	56	28	8	4	4	4	-	2
	Post-1	7	Sera not available								
(38)	Post-2	7	16	84	80	72	61	56	35	19	11
	Post-3	7	0	100	85	77	66	53	27	16	8

*USSR/92 Vaccine

**Sera from 50 recruits newly arrived at Lackland AFB.

Comparison of H.I. antibody titers for A/Brazil/78 following different vaccination regimens in 1978, 1979 and 1980

Comments:

1. For seronegative persons single injection of 20 mg appeared to be inadequate.
2. Two-dose regimen in 1979 was better than the 3-dose regimen in 1980.
3. Probably it is advantageous with a 2-dose regimen to provide an initial dose larger than the 7 µg amount used in 1980.

Table 4.

Serum Specimen	Amount Antigen	Percent with A/Denver/1970/81 H.I. titer of <8	8	16	32	64	128	256	512	1024
Pre**		58	42	10	6	4	4	2	?	0
Post-1	7*									
(35) Post-2	7	16	84	79	66	45	29	8	5	0
Post-3	7	-	100	92	68	50	32	11	6	3

*A/Brazil/78

**Sera from 50 recruits newly arrived at Lackland AFB in fall of 1980.

Comparison of H.I. antibody titers for A/Denver/1970/81 before and after 2nd and 3rd injection of vaccines containing 7 ug of A/Brazil/78.

Comments:

1. Titers obtained with this strain, isolated from a Lowry AFB patient, were consistely 2-fold lower, than in tests with A/Brazil/78. Early egg passages were clearly of low avidity. The egg passage used in these tests gave considerably higher antibody titers and the differences observed may represent slight antigenic drift away from A/Brazil/78.

2. With 2 injections of vaccine only 66% of persons had titers of ≥ 32. With this strain a titer of 32 appeared to be the "protective" level in contrast to A/Brazil/78. With the latter comparable "protection" was observed only at a titer of 128 (see other table).

Table 5.

Year	Serum Specimen	Amount Antigen	Percent with A/Texas/77 H.I. titer of <8	>8	>16	>32	>64	>128	>256	>512	>1024
1979	Pre-#	-	40	60	56	30	22	12	12	6	2
(75)	Post-1	20*	1	99	94	93	88	76	56	40	27
(75)	Post-2	7*	1	99	96	95	88	76	66	44	28
1980	Pre-	-	22	78	56	26	14	6	2	-	-
	Post-1	7**	Sera unavailable								
(38)	Post-2	7**	-	-	-	100	97	80	42	29	8
(38)	Post-3	7**	-	-	-	-	100	87	50	26	8

*A/Texas/77 Vaccine. **A/Bangkok/79 Vaccine
#Based on sample of 50 newly arrived recuits at Lackland AFB

Distribution of H.I. titers for A/Texas/77 among students vaccinated in 1979 and 1980. Titers are very high and the response, even to the 7 µg dose is what would be expected in a population which has been primed by one or more H_3N_2 previous infections.

Comment: As noted in the "Bangkok Table", when cases of H_3N_2 influenza appeared in 1980-81, only three cases were detected among approximately 3500 students.

Table 6.

Year	Serum Specimen	Amount Antigen	Percent with A/Bangkok/79 H.I. titer of <8	>8	>16	>32	>64	>128	>256	>512	>1024
1979	Pre-#	-	88	12	2	2	-	-	-	-	-
(75)	Post-1	20*	12	88	80	64	52	36	20	14	8
(75)	Post-2	7*	8	92	88	78	56	42	24	16	10
1980	Pre-#	-	44	56	24	8	2	2	-	-	-
	Post-1	7									
(38)	Post-2	7	-	100	87	48	22	14	3	-	-
(38)	Post-3	7	-	-	100	61	29	13	5	-	-

Comparison of antibody titers for A/Bangkok/79 among students vaccinated in 1979 and 1980. A/Texas/77 was used in 1979 and response following a single 20 µg dose was reasonably good.

Comment: In 1980 seventeen cases of H_3N_2 influenza occurred, spread from early November to mid-February. Only 3 cases were detected among approximately 3500 students; the remaining 16 were in permanent party personnel.

Table 7.

Year	Serum Specimen	Amount Antigen	Percent with B/HongKong/72 H.I. titer of								
			<8	>8	>16	>32	>64	>128	>256	>512	>1024
1979	Pre-	-	76	24	20	14	2	2	-	-	-
	Post-1	20*	4	96	91	75	40	25	16	7	4
	Post-2	9*	2	98	95	83	59	29	17	8	3
1980	Pre-	-	44	56	24	8	4	2	2	-	-
	Post-1	7*	Sera not available								
	Post-2	7*	0	100	100	94	67	48	20	5	-
	Post-3	7**	0	100	100	94	76	37	21	5	-

*B/HongKong/72 Vaccine

**B/Singapore/79 Vaccine.

Distribution of H.I. antibody titers for B/HongKong/72 among students vaccinated in 1979 and 1980. B/Singapore/79 vaccine was substituted for B/HongKong/72 vaccine in the fall of 1980.

Comment: Despite apparently low prevaccination titers response was excellent, indicating that persons had been well primed by previous influenza B infection.

Table 8.

Year	Serum Specimen	Amount Antigen	Percent with B/Singapore/79 H.I. titer of								
			<8	>8	>16	>32	>64	>128	>256	>512	>1024
1979	Pre-#	-	86	14	12	4	2	2	-	-	-
(38)	Post-1	20*	20	80	70	50	32	22	6	4	-
	Post-2	7*	14	86	84	64	42	28	12	4	-
1980	Pre-#	-	84	16	2	2	-	-	-	-	-
	Post-1	7*	Sera unavailable								
(38)	Post-2	7*	5	94	73	55	26	10	5	-	-
	Post-3	7**	0	100	85	61	27	16	5	-	-

*B/HongKong/72 Vaccine **B/Singapore/79 Vaccine
#Based on sample of 50 newly arrived recruits at Lackland AFB

Distribution of H.I. antibody titer for B/Singapore/79 among studies vaccinated in 1979 and 1980. B/HongKong/72 vaccine was used until the fall of 1980. Tests were done with egg passages 16-18, which were considerably more avid than earlier passages.

Comment: Proportion of persons with titer ≥32 similar in both years.

Table 9.

Strain	H.I. Titer	Students		Permanent Party		Total	
		No.	%	No.	%	No.	%
A/Brazil/78	< 8	11	20	13	32	24	25
	8	13	24	4	10	17	18
	16	16	29	9	22	25	26
	32	5	9	13	32	18	19
	64	6	11	0	0	6	6
	128	0	0	1	2	1	1
	256	2	4	1	2	3	3
	512	1	2	0	0	1	1
	1024	1	2	0	0	1	1
A/Denver/81	< 8	18	33	19	45	37	39
	8	17	31	9	21	26	27
	16	9	16	7	19	16	17
	32	6	11	4	9	10	10
	64	1	2	1	2	2	2
	128	3	5	1	2	4	4
	256	0	0	0	0	0	0
	512	1	2	0	0	1	2
	1024	0	0	0	0	0	0
Total		55		41		96	

Distribution of acute phase H.I. antibody titers of 55 students and 41 permanent party influenza patients with A/Brazil/78 and A/Denver/81

Table 10

Test Strain	No.with Post-Vaccination Titer of	Estimated No.of Persons	No.of Confirmed Influenza Cases	Attack Rate
A/Brazil/78	<8-16	980	40	4.1
	32-64	560	11	2.0
	128-1024	1964	4	0.2
A/Denver/81	<8-16	1190	44	3.7
	32-64	1295	7	0.5
	128-1024	1015	4	0.4
	Total	3500	55	1.6

Estimated attack rate in student population in persons with different acute phase H.I. antibody titers in tests with (1) A/Brazil/78 and (2) A/Denver/81

Comments:

1. Titers are somewhat higher with A/Brazil/78 antigen; generally two-fold. The attack rate in persons with titers 32-64 is only half that of persons with titers <8-16. Only at titers of ≥128 is a very low attack rate observed.

2. With A/Denver/81 there is a sharp cut-off at a titer of 32.

Table 11-a

Distribution of Pre- and Post Vaccination H.I. Antibodies for A/Texas/1/77 of 200 Air Force Recruits Who Received 14 µg Vaccine in May, 1981

Category	Serum Specimen	Percent with H.I. titer of: <8	≥8	≥16	≥32	≥64	≥128	≥256	≥512	≥1024	% with ≥4X rise
All Persons (200)	Pre-	20	80	59	34	12	4	2	1	1	
	Post-	1	99	97	90	81	72	52	35	20	84
Persons with titer <8 (40)	Pre-	100	-	-	-	-	-	-	-	-	
	Post-	3	97	92	79	60	52	42	30	15	95
Persons with titer ≥8 (160)	Pre-	-	100	73	42	16	6	3	1	1	
	Post-	-	100	97	93	86	76	55	36	22	80

Table 11-b

Percent of Persons with Different Pre-Vaccination H.I. T[iter] Who Had ≥4X Rise After Vaccination

Pre-vaccination H.I. titer	No. of Persons	No. with ≥4X rise	% with ≥4X rise
<8	42	40	95
8	42	39	92
16	50	41	82
32	42	35	83
64	16	9	56
128	4	2	50
256	2	1	50
512	-	-	-
1024	-	-	-
Total	200	167	84

Table 12-a.

Distribution of Pre- Post-Vaccination H.I. Antibodies for A/Bangkok/1/79 of 200 Air Force Recruits Who Received 14 µg Vaccine in May, 1981

Category	Serum Specimen	Percent with H.I. titer of								% with ≥4X rise
		<8	≥8	≥16	≥32	≥64	≥128	≥256	≥512	≥1074	
All Persons (200)	Pre-	53	48	24	10	3	1	1	--	--	
	Post-	2	98	95	85	69	47		19	12	85
Persons with titer <8 (105)	Pre-	100	--	--	--	--	--	--	--	--	
	Post-	4	96	91	77	56	36	24	14	9	92
Persons with titer ≥8 (95)	Pre-	--	100	47	18	4	1	1	--	--	
	Post-	--	99	95	91	82	57	43	24	15	76

Table 12-b.

Percent of Persons with Different Pre-Vaccination H.I. Titers Who Had ≥4X Rise After Vaccination

Pre-vaccination H.I. titer	No. of Persons	No. with ≥4X rise	% with ≥4X rise
<8	105	97	92
8	51	43	84
16	28	25	99
32	13	6	46
64	3	1	(33)
128	-	-	-
256	1	0	0
512	-	-	-
1024	-	-	-
Total	200	169	85

Table 13-a.

Distribution of Pre- and Post-Vaccination H.I. Antibodies for A/Brazil/11/78 of 200 Air Force Recruits Who Received 14 µg Vaccine in May, 1981

Category	Serum Specimen	Percent with H.I. titer of								% with ≥4X rise
		<8	≥8	≥16	≥32	≥64	≥128	≥256	≥512	≥1024	
All Persons (200)	Pre-	6	54	26	14	8	4	2	1	1	82
	Post-	6	94	91	87	80	72	58	47	35	
Persons with titer <8 (105)	Pre-	100	--	--	--	--	--	--	--	--	78
	Post-	10	90	83	75	66	61	49	42	29	
Persons with titer ≥8 (95)	Pre-	--	100	47	25	14	8	4	2	2	85
	Post-		99	98	97	91	82	65	50	39	

Table 13-b.

Percent of Persons with Different Pre-Vaccination H.I. Titers Who Had ≥4X Rise After Vaccination

Pre-vaccination H.I. titer	No. of Persons	No. with ≥4X rise	% with ≥4X rise
<8	92	72	78
8	60	58	97
16	13	13	100
32	11	4	36
64	7	4	(57)
128	3	0	0
256	2	1	(50)
512	-	-	-
1024	-	-	-
Total	200	164	82

Table 14-a.

Distribution of Pre- and Post-Vaccination H.I. Antibodies for A/Denver/81 of 200 Air Force Recruits Who Received 14 µg Vaccine in May, 1981

Category	Serum Specimen	Percent with H.I. titer of <8	>8	>16	>32	>64	>128	>256	>512	>1074	% with ≥4X rise
All Persons (200)	Pre-	51	49	17	10	6	3	1	--	--	
	Post-	5	95	92	87	72	55	43	32	23	81
Persons with titer <8 (101)	Pre-	100	--	--	--	--	--	--	--	--	
	Post-	7	93	86	78	64	54	43	33	25	86
Persons with titer ≥8 (99)	Pre-	--	99	34	20	12	6	2	0	0	
	Post-	1	98	98	96	77	57	43	30	21	74

Table 14-b.

Percent of Persons With Different Pre-Vaccination H.I. Titers Who Had ≥4X Rise After Vaccination

Pre-vaccination H.I. titer	No. of Persons	No. with ≥4X rise	% with ≥4X rise
<8	103	89	86
8	64	62	97
16	14	6	43
32	7	4	57
64	6	0	0
128	4	0	0
256	2	0	0
512	-	-	-
1024	-	-	-
Total	200	161	81

Table 15-a.

Distribution of Pre- and Post-Vaccination H.I. Antibodies for B/Hongkong/72 of 200 Air Force Recruits Who Received 14 µg Vaccine in May, 1981

Category	Serum Specimen	Percent with H.I. titer of								% with ≥4X rise
		<8	>8	>16	>32	>64	>128	>256	>512	>1024	
All Persons (200)	Pre-	51	49	25	8	4	2	1	-	-	
	Post-	7	93	83	68	40	20	10	3	1	62
Persons with titer <8 (102)	Pre-	100	-	-	-	-	-	-	-	-	
	Post-	14	87	72	54	31	17	10	3	0	69
Persons with titer ≥8 (98)	Pre-	-	100	51	16	9	4	2	0	0	
	Post-	-	101	97	85	50	22	8	1	1	54

Table 15-b.

Percent of Persons with Different Pre-Vaccination H.I. Titers Who Had ≥4X Rise After Vaccination

Pre-vaccination H.I. titer	No. of Persons	No. with ≥4X rise	% with ≥4X rise
<8	102	70	69
8	48	37	77
16	34	15	44
32	7	1	14
64	5	0	0
128	2	0	0
256	2	0	0
512	-	-	-
1024	-	-	-
Total	200	123	62

Table 16-a.

Distribution of Pre- and Post-Vaccination H.I. Antibodies for B/Singapore/222/79 of 200 Air Force Recruits Who Received 14 µg Vaccine in May, 1981

Category	Serum Specimen	Percent with H.I. titer of								% with ≥4X rise
		<8	≥8	≥16	≥32	≥64	≥128	≥256	≥512	≥1024	
All Persons (200)	Pre-	75	25	6	2	1	-	-	-	-	
	Post-	12	88	74	52	32	15	5	3	1	64
Persons with titer <8 (149)	Pre-	100	-	-	-	-	-	-	-	-	
	Post-	16	83	68	49	31	16	6	3	1	68
Persons with titer ≥8 (51)	Pre-	-	101	36	8	4	-	-	-	-	
	Post-	-	99	91	60	35	10	2	2	-	53

Table 16-b.

Percent of Persons with Different Pre-Vaccination H.I. Titers Who Had ≥4X Rise After Vaccination

Pre-vaccination H.I. titer	No. of Persons	No. with ≥4X rise	% with ≥4X rise
<8	149	101	68
8	38	21	55
16	9	3	33
32	2	1	(50)
64	2	2	(100)
128	-	-	-
256	-	-	-
512	-	-	-
1024	-	-	-
Total	200	128	64

Table 17.

Results of Different Procedures
for the Isolation of H_1N_1 Influenza Virus
(1980-1981)

Population Group	Tested in	Number Tested	Number Positive	Percent Positive
Student	R.M.K.	57	41	72
	Dog Kidney	36	13	36
	Chick Embryo	4	1	(25)
Permanent Party	R.M.K.	42	29	69
	Dog Kidney	0	0	0
	Chick Embryo	3	0	0
Total	R.M.K.	99	70	71
	Dog Kidney	36	13	36
	Chick Embryo	7	1	(14)

Table 18.

Results of Tests for
gnosis of Influenza B (1979-80)

Procedure	Antigen	Number Tested	Number Positive	Percent Positive
Virus Isolation				
R.M.K.	--	25	12	48
C.E.	--	5	0	0
C.F.	B/HK	25	22	88
H.I.	B/HK - Virus	25	13	52
	B/HK - Split	25	21	84
	B/Singapore	25	18	72

Table 19.

Results of Tests for
Diagnosis of H_3N_2 Influenza (1981)

Test	Antigen	Number Tested	Number Positive	Percent Positive
C.F.	A/Brazil	16*	15	94
H.I.	A/Texas	16	12	75
	A/Bangkok	16	13	81

*In R.M.K. virus strains were isolated from 4 of these 16 patients. In chick embryo strains were isolated from 2 of 4 throat washings tested.

Table 20.

Results of Different Serologic Tests for Diagnosis of H_1N_1 Influenza (1980-81)

Population Group	Test	Antigen	Number Tested	Number Positive	Percent Positive
Student	C.F.	A/Brazil	57	44	77
	H.I.	A/Brazil	57	45	79
		A/Denver/81	57	44	77
Permanent Party	C.F.	A/Brazil	42	27	64
	H.I.	A/Brazil	42	36	86
		A/Denver/81	42	32	76
Total	C.F.	A/Brazil	99	71	72
	H.I.	A/Brazil	99	81	82
		A/Denver/81	99	76	77