EPI Newsletter

Expanded Program on Immunization in the Americas

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Contraindications to Pertussis Vaccine

The Immunization Practices Advisory Committee (ACIP) reviewed the available data concerning the risks of pertussis disease and pertussis vaccine to infants and children with personal or family histories of convulsions. Based on available evidence, the ACIP does not consider a family history of convulsions to be a contraindication to receipt of pertussis vaccine. However, a personal history of a prior convulsion should be evaluated before initiating or continuing immunization with vaccines containing a pertussis component, i.e. diphtheria and tetanus toxoids with pertussis vaccine (DPT) (Figure 1).

Deferral of DPT for Infants and Children with Personal Histories of Convulsion(s)

Although there are uncertainties in the reported studies, recent data suggest that infants and young children who have previously had convulsions (whether febrile or non-febrile) are more likely to have seizures following pertussis immunization than those without such histories. Available data do not indicate that seizures temporally associated with vaccine administration predispose to permanent brain damage or exacerbate existing conditions. The incidence of pertussis in most areas of the United States of America is presently quite low. Consequently, for infants and young children who have histories of seizures before initiation of DPT immunization or who develop seizures before the 4-dose primary series is completed, initiating or continuing pertussis immunization should be deferred until it can be determined that there is not an evolving neurological disorder present. If such disorders are found, the infants or children should be given diphtheria and tetanus toxoids (DT) instead of DPT. If DT is used, three doses at least 4 weeks apart, followed by a fourth dose 6-12 months later, are recommended for infants. For children 1 year of age or older, two doses of DT at least 4 weeks apart, followed by a third dose 6-12 months later, are recommended.

Unnecessarily restrictive policies on contraindications to pertussis vaccination may lead to an increased number of cases of the disease. The decision to deny or defer DPT immunization should only be made after careful individual assessment of each child's medical history.

Recommendations for Beginning or Continuing DPT after Deferral

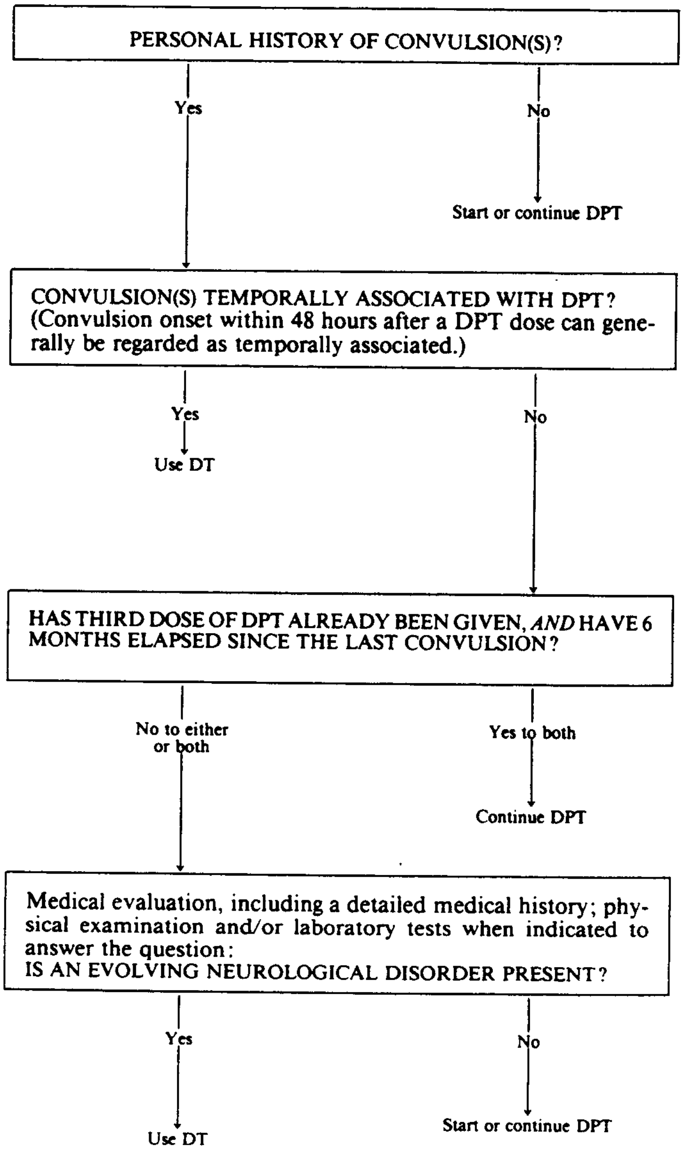
For infants and children whose DPT immunizations are deferred because of histories of convulsion(s), the decision whether to proceed with DPT immunization can usually

Contents

Table 1.

Guidelines for Diphtheria-Pertussis-Tetanus (DPT) Immunization of Infants and Young Children with Histories of Convulsion(s)

The following general guidelines cannot cover every situation. Individualized medical judgment in specific cases may indicate a different course of action.



be made within the next few months. For infants who have received fewer than three doses of DPT, such a decision in most instances should be made no later than at 1 year of age. Following individual assessment, it may be decided to proceed with DPT, because infants and young children with convulsive disorders also appear to be at higher risk of adverse outcomes if they contract pertussis. Further, if unimmunized infants attend day-care centers, special clinics, and residential-care settings where other children may be unimmunized or if they travel to or reside in areas where the disease is endemic, they may be at increased risk of exposure to pertussis.

For infants and children with stable neurological conditions, including well-controlled seizures, the benefits of pertussis immunization outweigh the risks, and such children may be immunized. The occurrence of single seizures (temporally unassociated with DPT) in infants and young children, while necessitating evaluation, need not contraindicate DPT immunization, particularly if the seizures can be satisfactorily explained. An example might be a febrile seizure in the course of exanthem subitum in a 14-month-old child. As with all infants or children with one or more febrile seizures, consideration of continuous anticonvulsant prophylaxis may be warranted.

Parents should be fully informed of the benefits and risks of immunization with DPT. Parents of infants and children with histories of convulsions should particularly be made aware of the slightly increased chance of post-immunization seizures. A minimum of three doses of DPT given at intervals of at least 4 weeks is necessary to provide adequate protection against pertussis. A fourth dose 6-12 months later is also recommended.

Contraindications to Pertussis Vaccine

Hypersensitivity to vaccine components, presence of an evolving neurological disorder, or a history of a severe reaction (usually within 48 hours) following a previous dose, all remain definite contraindications to the receipt of pertussis vaccine. Severe reactions include collapse or shock, persistent screaming episodes, temperature 40.5°C or higher, convulsion(s) with or without accompanying fever, severe alterations of consciousness, generalized and/or local neurological signs, or systemic allergic reactions. Although hemolytic anemia and thrombocytopenic purpura have previously been considered contraindications by the ACIP, the evidence of a causal link between these conditions and pertussis immunization is not sufficient to retain them as contraindications.

Other Immunizations for Infants and Children for whom Pertussis Vaccine is Contraindicated

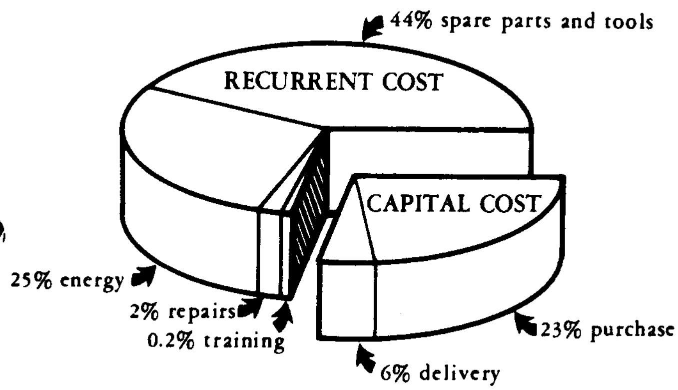
Immunization with DT and/or oral polio vaccine is not known to be associated with an increased risk of convulsions. Therefore, a history of prior convulsions is not a contraindication to receipt of these toxoids and vaccine. In addition, a history of prior convulsion(s) is not a contraindication for measles-mumps-rubella vaccine.

Source: *Weekly Epidemiological Record* **26**:199-201, 1984 (based on *Morbidity and Mortality Weekly Report* **33**(17), 1984, and *The Lancet* 1:98, 1984).

Costing out the Cold Chain

The initial purchase and delivery cost of refrigerators and freezers used in the cold chain represents a small proportion of their total costs over the whole working life of the equipment (Figure 1). In addition to these initial outlays, the cost of the following items must also be taken into consideration: spare parts to keep refrigerators and freezers in working order; training cold chain maintenance personnel and providing them with tools; gas, electricity or kerosene; and labor time for repairs.

FIGURE 1. Breakdown of lifetime costs of cold chain equipment



If breakdowns of cold chain equipment and consequent interruptions in immunization services are to be avoided, program managers must take into account this "lifetime" profile of costs to ensure that sufficient capital and recurrent finance is available for each item of the cold chain.

This becomes particularly crucial when a shortage of funds in the government's recurrent budget, such as travel costs, minor parts and fuel for vehicles, is a chronic constraint on the proper operation of health programs. To assist program managers in anticipating and avoiding these disruptive bottlenecks, it has become conventional to calculate for capital items the annual recurrent cost requirements as a fraction of initial capital.

Full costing of cold chain capital equipment will not of itself guarantee that such problems disappear, but it will allow the program manager to identify the full capital and recurrent cost implications. The distinction between capital and recurrent costs is important in making these cost projections (even though for government accounting purposes all such costs might be classified as recurrent), as is a definition of the expected working life of the equipment in question.

Tables 1 and 2 present profiles of cold chain equipment costs for seven different, commonly used refrigerators and freezers, each assumed to have a 10-year working life. Capital costs are distinguished from recurrent items on the basis of their frequency: a conventional distinction is to regard recurrent costs as those items which have a greater than annual frequency (i.e. payments which have to be made daily, weekly or monthly) and capital items as those payments occurring at yearly or longer intervals. Thus, *capital* costs as presented here include costs of purchase, delivery, spare parts and tools, and of training repair technicians. *Purchase* costs have been drawn from the WHO/UNICEF Product Information System. Delivery costs have been approximated at 30% of purchase price, a proportion based on average costs from a sample of countries.

Spare parts costs have been estimated from predicted failure rates over 10 years—for example, in the case of relay, motor protector and door seal for the 240-liter electric compression refrigerator, each item was assumed to have a working life of three years and, therefore, to need replacement 3.3 times over a 10-year period. More than 70% of the cost of spare parts over 10 years is incurred in the second half of this period.

Tools for repair personnel (approximately US$ 800) are included as a capital item, as is the cost of training for maintenance/repair (US$ 1,250). These capital items may together be seen as the investment costs necessary to establish cold chain equipment in its place of operation.

Recurrent costs comprise energy (electricity, kerosene or gas) and the labor costs of maintenance work. These costs have been calculated for a sample of 18 developing countries and applied to energy consumption rates observed during WHO laboratory tests:

Electricity	US$ 0.052 per Kwh
Kerosene	US$ 0.231 per liter
Gas	US$ 0.379 per Kg

Energy costs were applied to 21 items of equipment commonly used in the cold chain and tested by WHO, using the formula:

$$\frac{\text{Mean energy cost X Consumption per day}}{\text{Net usable volume of refrigerator space}} \text{ X 100 = Cost cooled 100 liters day}$$

It was found that the mean cost per day per 100 liters of cooled space was US$ 0.25. Only five items of equipment fell outside the range of ± 1 standard deviation from the mean.

Only two items of equipment are dramatically more efficient than the mean of the sample: one freezer costing US$ 0.05 per 100 liters of cooled space and one refrigerator costing US$ 0.03 per 100 liters of cooled space.

Energy costs used in the calculation were mostly for urban areas and are probably lower than for rural areas. The results may therefore give an optimistic view of recurrent costs for equipment in the rural areas. Any equipment that can be shown to have a running cost lower than US$ 0.25 per 100 liters of cooled space per day is good value.

The labor costs of maintenance are based on estimates of one major breakdown every three years and an average wage of US$ 6.00 per day, plus an allowance of two-thirds of average wages to cover travel and subsistence costs.

Table 1 shows that recurrent costs range from 20% to 60% of the total capital costs (assuming a 10-year life) over the whole life of cold chain equipment—a sum so substantial as to require special provision in the recurrent budget estimates. Without expenditures being budgeted for, equipment could be expected to be inoperative.

Table 2 shows that spare parts and tools are the biggest single cost item and exceed the initial purchase cost. Minor parts are often regarded as recurrent cost items but, when the total is so important in the lifetime cost profile and repairs are expected so regularly, there is a good managerial, as well as economic, case for treating these items as a capital or investment cost.

TABLE 1. Capital cost, recurrent cost and total cost over a 10-year life of commonly used refrigerators and freezers, in US$, at 1984 values

Type			Capital Costs			Recurrent Costs			Lifetime cost	Annual recurrent cost as a % of capital cost
Refrigerator (R) and/or Freezer (F)	Capacity in liters	Energy source	Purchase	Delivery	Parts/ tools	Training	Fuel	Repairs		
R/F	144	Kerosene	700	210	844	3	842	30	2,629	5
R	240	Electricity	688	206	789	3	228	30	1,944	2
R/F	22	Gas	320	80	985	3	277	30	1,695	2
R/F	22	Kerosene	320	80	844	3	422	30	1,699	4
R/F	22	Electricity	320	80	489	3	266	30	1,188	3
F	220	Electricity	185	56	789	3	436	30	1,499	5
F	142	Gas	760	228	985	3	1,244	30	3,250	6

Purchasing the spare parts at the time of ordering refrigerators entails storage costs but these should be weighed against losses in program performance due to inoperative equipment and idle staff.

It is also clear that energy is the biggest component of recurrent costs. The cost of training is relatively so insignificant that it should always be included in the cost of equipping the cold chain.

TABLE 2. Distribution of total costs over 10-year working life (average of 7 refrigerators and freezers)

Cost item	Average percent	Range	
		Low	High
Purchase	23.2	12.3	35.4
Delivery	6.5	3.7	10.6
Spare parts Tools	43.5	30.3	58.1
Training	0.2	0.1	0.25
Energy	24.9	11.7	38.3
Repairs	1.7	1.0	2.5

Cold chain equipment costs should be budgeted on a lifetime projection. The purchase and delivery costs comprise on average less than one third of the total lifetime costs of such equipment. Spare parts and tools are the biggest single costs of cold chain equipment and should be planned and budgeted for as a capital item on the basis that a small overstock of spares is less uneconomical than inoperative equipment, leading to ineffective immunization. The recurrent costs, particularly energy costs, are substantial.

Calculation of the annual recurrent cost implications of capital equipment, vehicles or buildings provides a simple means for managers to identify the increase in recurrent costs so that they can increase their budget accordingly.

Source: *Weekly Epidemiological Record* 58(31): 237-240, 1983.

Test Results on Electrolux RCW42 Refrigerators

During 1982 and 1983, 77 countries throughout the world participated in WHO-sponsored field tests of two different models of the RCW42 refrigerator developed by Electrolux. The Government of Luxembourg donated 359 units for the field trials. Performance reports were received from 15 countries (19.5%), four of which were from the Region of the Americas. The data collected from the field trials have been examined quantitatively and qualitatively and are summarized below.

Field Tests

The RCW42 is a 40-liter regrigerator with a 24-liter net vaccine storage capacity. It can freeze 1.1 Kg of ice within a 24-hour period. The RCW42 is available in five models: three absorption types and two compression types. The field trials evaluated the performances of only two of the absorption models, the electric-gas (EG) and electric-kerosene (EK). Twenty one percent of all models tested were electric-gas models.

The EK and EG models can both function on electricity; in addition, the EK model can run on kerosene and the EG on bottled gas in areas with limited or no electrical supply. In the range of small, low capacity vaccine-storage regrigerators, the RCW42 models are the only appliances which can be operated both on electricity and another fuel source.

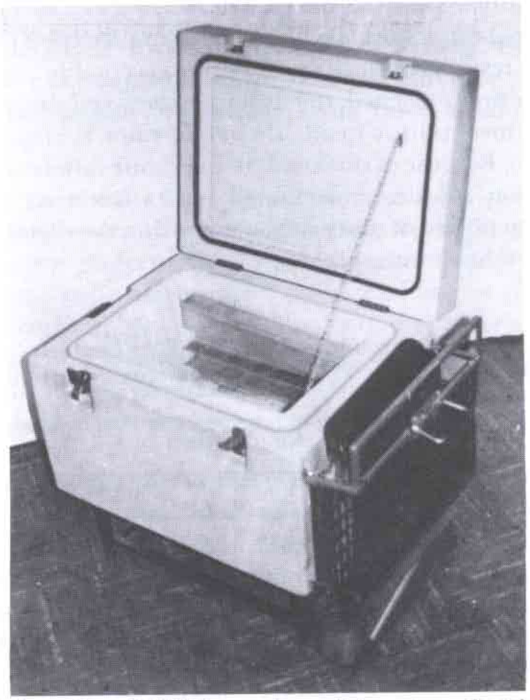
The 15 reports revealed that the refrigerators maintained appropriate vaccine storage temperatures (1 to 8°C) 83 percent of the time (1,439 out of 1,713 running days).

Table 1 shows the percentage of time that various internal temperature ranges were maintained, based on the reports received. The 274 days (17%) which do not fall within the acceptable temperature range of 1 to 8°C may have been due to prolonged power cuts (more than 13 hours in a 24 hour period) and lack of kerosene or gas, or to wrong adjustment of the flame length when kerosene models were in operation. There have been reports of difficulties in adjusting the flame length and consequently in stabilizing the internal temperatures in EK models, but this is mainly attributed to the poor quality of kerosene used.

TABLE 1. Internal temperature range of RCW42 models based on field trials

Internal temperature (°C)	Number of days	Percentage of total
-20 to -5	81	5
-4 to 0	113	7
1 to 8	1,439	83
9 to 20	72	4
21 to 43	8	1
Total	1,713	100

The mean ambient temperature in which the field tests were carried out was approximately 29°C with a range between 9°C and 42°C.



Electrolux RCW42 vaccine refrigerator, electric-kerosene model. *(Photo: PAHO/EPI)*

Laboratory Tests

The field results described above are in agreement with the laboratory tests which show that acceptable internal temperatures for vaccine storage can be maintained in both the EK and EG models at external temperatures of 32°C and 43°C. One laboratory test shows that when an EG model is operated on an electrical supply in 32°C and 43°C external temperature, an acceptable internal temperature is obtained without changing the thermostat setting (with the thermostat on 5).

The laboratory test results for the EK model operating on kerosene are comparable to the field trial results, and confirm the difficulties in adjusting the flame to stabilize the internal temperatures. A test has been conducted on the EK model operating with polluted kerosene at 32°C external temperature. The result indicates that routine maintenance (cleaning the burner and trimming the wick) should be carried out approximately every three days to maintain a stable internal temperature. The same test concludes that the burner should be examined more frequently in higher external temperatures, when a higher flame is required.

The EK and EG models can bring the internal temperature to 10°C in approximately 3.5 hours at 32°C ambient temperature (based on laboratory tests).

The present evaporator of the RCW42 is not designed specifically to freeze ice packs. The freezing capacity of the units has been laboratory tested by using ice trays (Table 2). The tests indicate that when an acceptable internal temperature is reached, the difference between the coldest and warmest points inside the refrigerator is very small (Table 3). Because of this small temperature difference, the thermostat should be accurately set to freeze ice in an optimum period of time without exposing the vaccine to a freezing temperature.

TABLE 2. Ice freezing capacity of RCW42 models in Kg per 24 hours, at 32°C and 43°C external temperature

Model	Kg ice frozen	
	at 32°C	at 43°C
EK	1.1	Not tested
EG	1.35	0.5
EKG*	2.40	1.5

* Electric, Kerosene and Gas (two absorption units operating simultaneously)

TABLE 3. Temperature difference between warmest and coldest points inside refrigerator, at 32°C and 43°C external temperature

Model	Temperature difference (°C)		Mean internal Temperature (°C)
	at 32°C	at 43°C	
EK	Not available	1.2	6.5
EG	1.5	1.2	4.25

New evaporators have been developed to enable the RCW42 models to freeze four standard ice packs (1.3 liters) in 24 hours at 32°C ambient temperature. The RCW42 refrigerators produced from 1984 onwards will all be equipped with these new evaporators. Conversion kits will be offered to enable the users to change the evaporators of currently existing units so that they can freeze ice packs.

The holdover times for the RCW42 models are 12.5 and 6.5 hours at ambient temperatures of 32°C and 43°C respectively. Holdover time is defined as the time necessary for the temperature inside the refrigerator to reach 10°C after the power supply has been cut off.

When subjected to ambient temperature fluctuations of 43°C to 15°C, such as would occur during the day and night in a desert area, the RCW42 models performed very well. The maximum and minimum internal refrigerator temperatures recorded in the laboratory were between 4°C and 8°C.

However, the laboratory test indicates that when the EK model is operating on kerosene, the internal temperature is not as stable as it is with electricity. The flame height needs to be readjusted for day and night time temperatures.

Table 4 shows the energy consumption for the RCW42 models based on laboratory tests. It is difficult to compare energy consumption of the EK and EG models with other similar refrigerators, mainly because of the difference in size. However, the RCW42 can certainly be said to be more energy efficient in comparison to a larger refrigerator which is being used unnecessarily.

TABLE 4. Energy consumption at 32°C and 43°C external temperature

Model	Source of Energy	Energy consumption		Unit of measurement
		at 32°C	at 43°C	
EK	Electricity	2.2	2.2	Kwh 24 hrs.
	Kerosene	0.3	0.4	Liters 24 hrs.
EG	Electricity	—	—	—
	Gas	0.13	0.2	Kg 24 hrs.
	Electricity	2.4	3.1	Kwh 24 hrs.
EKG*	Kerosene	—	—	—
	Gas	—	—	—

* Electric, Kerosene and Gas (when two cooling units operating simultaneously)

General Conclusions

From the available data the follow conclusions can be drawn:

- The present form of the evaporator is not capable of freezing ice packs efficiently.
- The thermostat display is not easily understood by a number of users. Sometimes the divisional numbers on the thermostat scale are taken for internal temperatures.
- No baskets have been provided with the appliances. Therefore, some of the vaccine load must be removed to enable the ice trays to be loaded and unloaded.
- The performance of the burner (EK model) varies greatly with the quality of kerosene used.

Reported Cases of EPI Diseases

Number of reported cases of measles, poliomyelitis, tetanus, diphtheria and whooping cough, from 1 January 1984 to date of last report, and for same epidemiological period in 1983, by country

Subregion and Country	Date of last report	Measles		Poliomyelitis		Tetanus: Non-neonatorum		Tetanus: Neonatorum		Diphtheria		Whooping Cough	
		1984	1983	1984	1983	1984	1983	1984	1983	1984	1983	1984	1983
NORTHERN AMERICA													
Canada	9 Jun.	2,333	472	—	—	1	1	...	...	1	8	549	899
United States	25 Aug.	2,185	1,205	2	4	39	48	...	...	—	—	1,260	1,456
CARIBBEAN													
Antigua and Barbuda	7 Jul.	1	3	...	—	—	1	—	—	—	—	—	—
Bahamas	28 Jul.	29	2,803	—	—	1	—	—	—	—	—	—	7
Barbados	14 Jul.	3	3	—	—	2	5	—	—	—	—	—	—
Cuba	21 Apr.	1,552	1,316	—	—	1	8	—	—	—	—	39	126
Dominica	21 Jul.	4	—	—	—	—	—	—	—	—	—	—	10
Dominican Republic	28 Apr.	1,514	890	—	6	26	34	1	—	71[a]	41	52	87
Grenada	4 Aug.	5	268	—	—	—	—	—	—	—	—	—	—
Haiti	*	...	...	...	...	...	...	...	...	...	...	...	...
Jamaica	7 Jul.	167	1,029	—	—	1	—	1	—	4	9	15	59
Saint Lucia	9 Jun.	9	51	—	—	—	1	...	...	—	—	—	—
St. Vincent and the Grenadines	3 Mar.	4	25	...	...	...	...	...	...	...	...	...	...
Trinidad and Tobago	16 Jun.	2,838	1,307	—	—	7	8	—	—	—	—	—	—
CONTINENTAL MIDDLE AMERICA													
Belize	11 Aug.	—	9	...	...	—	—	—	—	—	—	1	1
Costa Rica	14 Jul.	3	10	—	—	3	2	—	1	—	—	96	20
El Salvador	7 Jul.	2,013	1,170	6	39	35	25	18	18	9	10	243	241
Guatemala	31 Mar.	868	867	5	31	28	30	...	...	2	6	450	297
Honduras	7 Jul.	459	812	18	3	8	18	5	—	—	—	237	300
Mexico	*	...	...	...	...	...	...	...	...	...	...	...	...
Nicaragua	31 May	84	57	—	—	...	66	...	...	—	3	30	36
Panama	31 Jul.	243	445	—	—	3	4	3	8	—	—	112	108
TROPICAL SOUTH AMERICA													
Bolivia	21 May	...	...	...	...	...	...	...	...	12	—	...	...
Brazil	24 Mar	11,028	7,087	1	9	535	527	138	127	680	632	4,612	8,484
Colombia	*	...	...	...	...	...	...	...	...	...	...	...	...
Ecuador	19 May	3,782	486	—	4	31	30	20	29	38	8	178	476
Guyana	25 Feb.	2	—	—	—	2	—	...	...	—	—	—	—
Paraguay	21 Jul.	233	355	—	8	38	26	53	64	7	2	—	—
Peru	19 May	153	120	11	1	9	12	1	—	—	—	179	170
Suriname	19 May	16	9	—	—	2	...	...	...	—	1	228	134
Venezuela	4 Aug.	5,714	...	—	...	...	...	...	...	1	...	814	...
TEMPERATE SOUTH AMERICA													
Argentina	2 Jun.	2,566	534	2	—	82	77	...	...	8	14	6,117	820
Chile	11 Aug.	2,112	2,722	—	—	17	21	...	...	79	56	266	94
Uruguay	30 Jun.	4	4	—	—	5	—	—	—	—	—	58	180

[a] 31 May

* No 1984 reports received, therefore 1983 data not shown.

— No cases
... Data not available

- Even with a relatively acceptable quality of kerosene, flame adjustment is not easy on the EK model.
- The rate at which the glass chimneys break is high. The number of spare glass chimneys that are supplied with the EK model is not sufficient.

The field and laboratory test results indicate that performance of the RCW42, EK and EG models, is acceptable for storing vaccine. They are unique in the range of low capacity vaccine-storage refrigerators in that they offer two power source options on one unit.

The units are suitable for areas with limited and/or no electricity. Due to their low energy consumption, the EK and EG models are recommended for outlying health centers where fuel is supplied at regular intervals.

The units have the ability to maintain safe temperatures in areas where day and night temperature differences are very high.

Finally, the EK and EG models are economical to run.

Source: Adapted from WHO publication EPI/CCIS/83.10 (complete article available on request to the editor).

Newsbriefs

EPI Evaluations

Panama, Venezuela, and the Dominican Republic plan to evaluate their immunization programs this year in order to improve program effectiveness. The Dominican Republic will hold its evaluation between 24 September and 5 October, while Panama and Venezuela's evaluations will take place in October.

Multidisciplinary teams will use an evaluation methodology developed by PAHO/EPI to document progress made and problems which are impeding program implementation. The teams will also recommend possible solutions to the problems identified and develop a chronogram of activities to be carried out over the next two years.

The evaluations use both quantitative and qualitative indicators to document progress and problems in the following areas: information system; programming and organization; vaccination tactics and strategies; human, physical and financial resources; cold chain; vaccine supplies and logistics; training; supervision; epidemiology and surveillance; community participation, and health education.

Summaries of the results of these evaluations will be published in forthcoming issues of the *EPI Newsletter*.

Training

Refrigerator Technicians' Repair Course

Brazil will hold an EPI refrigerator technician's repair course 17-28 September in Goiania. Thirty participants will be trained in problem diagnosis and repair of domestic-type refrigerators. The course methodology calls for a review of the basic principles of electricity and refrigeration, together with a substantial amount of laboratory work in the actual diagnosis and repair of refrigerators. Students will take a pre and post-test which will be used to measure course effectiveness. Subsequent visits to some of the students are planned to assess how the skills mastered in the course are being put to use in the field.

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References to commercial products and the publication of signed articles in this newsletter do not constitute endorsement by PAHO/WHO, nor do they necessarily represent the policy of the Organization.

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