CHAPTER 25

Transport management

SUMMARY

Unreliable transport for pharmaceutical supplies is a major problem in many health care programs. Good transport practice demands reliability, efficiency, safety, accountability, timeliness, affordability, and sustainability.

Transport is difficult to plan and manage well. Politicians and senior program managers generally assign greater priority to other, more visible, aspects of health care delivery. However, policy makers and administrators need to appreciate that effective and responsive health service depends on always having medicines available when and where they are needed, which requires the secure and proper transport of pharmaceuticals and medical supplies. If the pharmaceutical sector has to compete with other services for planned and emergency logistics, the consequences may be critical to public health.

Transport is provided for pharmaceuticals and related supplies either by the subject facility, by the supplier, or by an outsourced transport service. The type, volume, frequency, and duration of transport services required are determined by the nature of the health service. For practical purposes, main stores or central medical stores require major transport when moving pharmaceuticals from port to warehouse. If the store has branches in different parts of the country, it will need to transport the supplies to the branches. Facility-level transport requires a sophisticated transport network, involving in-house vehicles, rental services, or supplier delivery.

When planning transport system improvements, managers must—

- Thoroughly review and understand the existing transport system
- Select suitable vehicles
- Ensure adherence to standard operating procedures
- Ensure that vehicles are used for their intended purpose
- Maintain vehicles properly
- Replace vehicles before they wear out or become too expensive to operate
- Provide funds for vehicle maintenance and replacement
- Consider the formation of a vehicle pool system
- Consider alternatives, such as third-party and private-sector contracts

Major determinants of the transport system, which require special attention, are the vehicles and their operation and management. The costs of purchasing, running, and maintaining vehicles are high. If funding is inadequate, transport services will not be sustainable.

Transport services require effective management, which is particularly difficult to achieve in countries where transport is challenging and the pool of qualified managers is relatively small. When a shortage of transport exists, health service vehicles are frequently misused for the personal benefit of health service staff. Strong management is necessary to eliminate abuses and to ensure that vehicles are used appropriately. Although cost is a limiting factor, the logistics needs of the pharmaceutical sector can be adequately met if vehicle costs are shared with other services.

In many countries, the burden of managing transport and transport maintenance services can be reduced by contracting out these services to private or parastatal companies that specialize in such operations and are able to provide competitive rates. Before taking such action, the private or parastatal sector must be assessed based on its capacity and past performance, and existing operating costs must be accurately assessed so that a realistic cost comparison can be made. Transport contractors should then be carefully selected and monitored, and contract terms should be clearly drawn up and enforced. These measures also make monitoring transport costs easier.

Contracting out transport services will be inevitable where air transport, and to a large extent, sea or river distribution is involved. However, in many developing countries with scarce transport resources, efficient private-sector transportation companies are still evolving and may not be sufficiently competitive or efficient. In such situations, regional and interregional cooperation and collaboration among various government agencies, nongovernmental organizations (NGOs), donors, and the private sector can help maximize available transport resources.

Effective quality assurance procedures are needed to ensure that pharmaceuticals are correctly handled before, during, and after transit, to avoid damage.

25.1 Planning in-house transport systems

The existing transport system should be thoroughly reviewed to make efficient and rational use of existing resources. Current operating costs should be accurately assessed and compared with the projected cost of alternative systems. This section examines the issues that must be considered when planning improvements in a transport system.

Understand the existing transport system

To understand the existing transport system and its problems, one needs an assessment to provide a clear understanding of the health system's purpose and organization. This assessment requires a determination of—

- Frequency, type, and payload of transport needed according to the nature of the health service, including the amount of inventory holding, which determines the frequency of resupply.
- Location and scope (mapping) of transport needs of all warehouses and health facilities.
- Performance record of the existing pharmaceutical transport system. A detailed inventory must be made of vehicles in use at every level in the distribution system, listing age, condition, operational status, and actual versus intended use. Obtaining this information is an essential starting point for any transport assessment and should be carried out thoroughly. The data collected may be used to determine whether the existing transport fleet, in its current state, is capable of satisfying program needs.
- Estimated costs for the repair of defective vehicles.
- Location and availability of spare parts, and vehicle servicing capacity.
- Location and availability of fuel.
- Geographical, climatic, and political factors that affect transportation.
- Population distribution. Transport costs per capita are much higher in sparsely populated areas than in areas of high population density. This factor is important to take into account so that funds can be targeted in a balanced manner.
- The condition, capacity, and limitations of road, rail, air, water, and other transportation networks.
- Alternative transportation resources at every level. These resources include vehicles belonging to other government agencies, to NGOs, and to private-sector carriers. Vehicle sharing between programs is often a good option for reducing costs and improving reliability. Public transport should also be considered where suitable. Unconventional forms of transport such as bicycles or boats may be highly cost-effective, particularly for smaller-volume distribution in rural areas. For low-volume, time-critical, and high-value products, an international commercial shipper is a useful and dependable alternative. Such services are available in bigger towns.
- The annual cost of the existing transportation system. A crude index of performance can be obtained by considering this cost as a percentage of the value of pharmaceuticals delivered.
- Staff management issues related to transport, including the availability of key staff and management time available to devote to transport management.

If information is not already available, it should be collected using a structured survey (see Chapter 36). Total cost analysis is a good method for compiling cost data (see Chapter 40). Most information requires regular updating if it is to remain useful. Some data, such as vehicle breakdown reports, are required at monthly to quarterly intervals. Other data, such as road improvement information, need only occasional updating.

Plan routes and schedules

Pharmaceutical delivery routes should be planned at every level to make the best use of available resources. The following guidelines should be adopted—

- Arrange delivery routes and schedules so that vehicles start each journey fully loaded. Using a large vehicle to deliver small quantities of medicines is inefficient. Unless full loads are being dropped off at a single delivery point, a delivery circuit may be cheaper to operate than a series of trips back and forth.
- Always seek out a return load to maximize vehicle use, or alternatively, try to combine deliveries with supervisory visits.
- Make maximum use of good roads. Shortcuts along poor roads may save fuel and time, but driving on good roads improves vehicle life. Isolated travel routes also pose security concerns.
- Use vehicles that are appropriate to the route. Using four-wheel-drive vehicles on surfaced roads is a waste of resources.
- Arrange routes so that the vehicle can be parked in a secure compound during overnight stops.
- Plan routes to take account of fuel availability. If fuel is scarce, carrying fuel drums or fitting vehicles with long-range fuel tanks may be necessary. This need will reduce the space available for carrying supplies.
- Consult experienced drivers before deciding on the route. Drivers often have the best knowledge of local road conditions, fuel availability, weather, and security hazards. Their advice can be extremely valuable.

Country Study 25-1
Determining the appropriate fleet mix needed to transport pharmaceuticals in Zambia

The following analysis uses three sets of data from Zambia to plan a transport fleet based on deliveries from the Medical Stores Ltd. (MSL) to district health management teams (DHMTs) and hospitals. Below is an example of a schedule, for Route A.

			CYCLE 1			CYCLE 2			CYCLE 3		
Route A		Delivered at (departure date plus × days)	Order to stores	Truck departs stores	Delivery at health facility	Order to stores	Truck departs stores	Delivery at health facility	Order to stores	Truck departs stores	Delivery at health facility
	Drop Point 1	1	23-Dec-04	3-Jan-05	4-Jan-05	20-Jan-05	31-Jan-05	1-Feb-05	17-Feb-05	28-Feb-05	1-Mar-05
	Drop Point 2	1	23-Dec-04	3-Jan-05	4-Jan-05	20-Jan-05	31-Jan-05	1-Feb-05	17-Feb-05	28-Feb-05	1-Mar-05
	Drop Point 3	1	23-Dec-04	3-Jan-05	4-Jan-05	20-Jan-05	31-Jan-05	1-Feb-05	17-Feb-05	28-Feb-05	1-Mar-05
	Drop Point 4	2	23-Dec-04	3-Jan-05	5-Jan-05	20-Jan-05	31-Jan-05	2-Feb-05	17-Feb-05	28-Feb-05	2-Mar-05
	Drop Point 5	2	23-Dec-04	3-Jan-05	5-Jan-05	20-Jan-05	31-Jan-05	2-Feb-05	17-Feb-05	28-Feb-05	2-Mar-05
	Drop Point 6	3	23-Dec-04	3-Jan-05	6-Jan-05	20-Jan-05	31-Jan-05	3-Feb-05	17-Feb-05	28-Feb-05	3-Mar-05
	Drop Point 7	3	23-Dec-04	3-Jan-05	6-Jan-05	20-Jan-05	31-Jan-05	3-Feb-05	17-Feb-05	28-Feb-05	3-Mar-05
	Drop Point 8	3	23-Dec-04	3-Jan-05	6-Jan-05	20-Jan-05	31-Jan-05	3-Feb-05	17-Feb-05	28-Feb-05	3-Mar-05
	Drop Point 9	4	23-Dec-04	3-Jan-05	7-Jan-05	20-Jan-05	31-Jan-05	4-Feb-05	17-Feb-05	28-Feb-05	4-Mar-05
	Drop Point 10	4	23-Dec-04	3-Jan-05	7-Jan-05	20-Jan-05	31-Jan-05	4-Feb-05	17-Feb-05	28-Feb-05	4-Mar-05
	Drop Point 11	4	23-Dec-04	3-Jan-05	7-Jan-05	20-Jan-05	31-Jan-05	4-Feb-05	17-Feb-05	28-Feb-05	4-Mar-05
	Drop Point 12	5	23-Dec-04	3-Jan-05	8-Jan-05	20-Jan-05	31-Jan-05	5-Feb-05	17-Feb-05	28-Feb-05	5-Mar-05

The next set of data outlines the number and weight of cartons for each drop on the route and establishes a minimum and maximum loading weight. For example, the spreadsheet below shows that information for Chiengi DHMT. Combine with the route timing information above to develop fleet mix data for each route with the times for each delivery.

	Jan-04		Feb-04		Mar-04		Apr-04		May-04		Jun-04		Totals		Average		Max		Min	
Station	No	Wt	No	Wt	No	Wt	No	Wt	No	Wt	No	Wt	No	Wt	No	Wt	No	Wt	No	Wt
Chadiza DHMT	61	878	154	1,089	98	1,014	16	608	60	840	52	612	441	5,041	74	840	154	1,089	16	608
Chama DHMT	113	959	155	1,213	183	1,262	37	956	93	1,680	31	316	612	6,386	102	1,064	183	1,680	31	316
Chavuma DHMT	103	968	6	228	119	838	10	328	105	742	23	233	366	3,337	61	556	119	968	6	228
Chavuma Mission H					3	6			4	6	86	1,023	93	1,035	16	173	86	1,023	3	6
Chibombo DHMT	104	1,601	119	1,052	132	1,720	51	1,246	189	2,181	33	1,021	628	8,821	105	1,470	189	2,181	33	1,021
Chiengi DHMT	80	386			88	407	74	814	35	448	38	304	315	2,359	53	393	88	814	35	304

The weight for each route will determine the payload required for each vehicle. The payloads (shaded) are not large, but they help to create the appropriate fleet mix. Other information to consider in the calculation includes the average time the driver spends waiting at delivery and whether the facility accepts deliveries on Sunday.

			Average		Driving Time	
From	Location	Station	Boxes	Kg	Dry	Rain
Route A						
MSL	Mkushi	Mkushi DHMT	85	861	5	5
Mkushi	Serenje	Serenje DHMT	96	704	2	2
Serenje	Milengi	Milengi DHMT	30	409	14	16
Serenje	Samfya	Samfya DHMT	80	1,244	6	6
	Chilubi (leave at Samfya)	Chilubi DHMT	29	495		
Samfya	Lubwe	Lubwe Mission H	19	142	8	10
Lubwe	Kasaba	St. Margret H	30	272	3	4
Kasaba	Mansa	Mansa DHMT	169	1,696	9	10
		Mansa GH	135	1,112		
Mansa	Mwense	Mambilima H	36	124	2	2
	Mwense	Mwense DHMT	74	1,252	1	1
Mwense	Mbereshi	Mbereshi H	34	307	2	2
Mbereshi	Kawambwa	Kawambwa DHMT	93	974	1	1
Kawambwa	Nchelenge	Nchelenge DHMT	69	904	2	2
		St. Pauls H	95	819	0	0
Nchelenge	Chiengi	Chiengi DHMT	53	393	4	5
Chiengi	**MSL**				23	23
	Total		**1,127**	**11,708**	**79**	**86**
					106	**113**

- Compare the costs of alternative combinations of routes and vehicles before making a final choice. Country Study 25-1 describes Zambia's approach to vehicle selection. Transport cost assessment is described in Section 25.5.
- In the case of air transport, consider periodic deliveries (for example, monthly or quarterly), and select air transport contractors through public tenders, when applicable.
- Where sea or river distribution is involved, periodic deliveries to or collections by health facilities may be arranged by using boats owned or hired by the health facilities.

Analyze transport alternatives

The following are major transport options—

- Trucks, vans, and cars are the most common means of transporting medicines and supplies, but there are many other potential forms of transport.
- Air transport is frequently used for delivering emergency, costly, or heat-labile products, such as vaccines. Commercial air-freight charges are high, although packaging costs may be lower than with land transport. Theft may also be less common where airport security is good. In some settings, such as countries with many islands or challenging terrain, air transport may be not only the most cost-effective option, but also the only option for routinely transporting medicines. Light aircraft may be used to transport medicines and health workers to remote and otherwise inaccessible outposts and in emergency relief situations.
- Boats are appropriate in some areas with island communities, coastal settlements, navigable rivers, or large lakes. Pharmaceuticals transported by boat must be packaged and stored to protect them against water damage.
- Railways are an excellent and cheap means of transport, provided the service is reliable. Rail transport is particularly suitable for bulk shipments between major depots. One disadvantage is that the supplies usually need to be transferred to another form of transport at the end of the rail journey. Trans-shipment increases the risk of theft and damage.
- Private-sector trucking companies can offer a cost-effective delivery service, especially between major population centers. This issue is discussed in Section 25.6.
- Box trailer units increase load-carrying capacity without the need to buy additional trucks. Small trailers, towed behind cars or pickup trucks, can also be used to transport medicines in rural areas.
- Buses, minibuses, and other means of local passenger transport can be used by health workers for transporting small quantities of medicines.
- Transport resources owned or accessed by other government, nongovernmental, or donor agencies can be shared.

Many programs also use so-called intermediate transport to augment the major transport mechanisms. Table 25-1 compares the capacity and daily range of common intermediate transport mechanisms.

Prepare a transport plan

After the existing transport system has been analyzed and the transport alternatives assessed, the logistics team should choose among the various options and balance sometimes conflicting priorities. A detailed transport plan should then be prepared that describes how all warehouses and facilities will be served. Figure 25-1 shows an example of a multisite transport plan. Such a plan must include resource ownership; transportation routes and schedules; schedules of people, transportation equipment, and related sources; information on movement of vehicles, people, and goods; distances from the source to the delivery points; overnight stops; people driving and accompanying deliveries; fuel needs; per diem and contingency funds; alternative routing in emergencies; and accompanying documents, such as waybills, travel permits, logbooks, and vehicle and driver details.

Any arrangement including items held in a duty-free bond—at an airport or shipping port, for example—introduces a new set of variables to plan for, including securing the release of the shipments and transporting them by the client or forwarding agent to their required destination.

An inventory of special environmental and legal route-use requirements must be maintained for trip planning; for example, weigh stations, seasonal blockage by rain, security-restricted routes, security checkpoints, and toll roads. If a national security office exists, it can supply information to ensure safe driving through certain security-sensitive areas, such as recommending joining a convoy if the situation dictates.

Transportation planning systems help calculate the volume that needs to be transported to a certain location and at what time. Transportation planning systems provide management with details on multiple routes, schedules, operators, and the type and volume of loads. Such a system can be maintained manually or electronically, and it can be used to analyze transport operations and costs. A global positioning system (GPS) makes possible the monitoring of physical movement and location of vehicles.

Table 25-1 Performance characteristics and relative costs of some intermediate forms of transport

Vehicle	Maximum number of people carried[a]	Supplies carried (kg/m³)	Maximum speed (km/hr)	Maximum range (km)	Route limitations	Relative cost[c]
Porter	—	25–35 0.25 m³	5	20	Unlimited	0–10
Standard bicycle	1	20[b] 0.25 m³	20	60	Reasonably flat	50–90
Load-carrying bicycle	1	25–100[b] 0.35 m³	10–15	30–40	Reasonably flat	60–100
Bicycle and trailer	1	150 0.5 m³	10–15	30–40	Reasonably flat, wide track	90 –150
Bicycle and sidecar	1	150 0.4 m³	10–15	30–40	Reasonably flat, wide track	90–150
Tricycle	1	150 0.5 m³	10–15	30–40	Reasonably flat	150–200
Pack animal	—	50–200[b] Varies	5	20	Unlimited	Variable
Animal-drawn cart	Varies	500–3,000 Varies	5	20	Reasonably flat, wide track	100–180
Motorcycle	1	50–75[b] 0.25 m³	40–90	100–200	Steep hills	250–600
Motorcycle and sidecar/tricycle	1	200–300[b] 0.5–1.0 m³	30–60	80–150	Moderate hills, wide track	350–800
ATV (quad bike)[d]	1	50–75[e] 0.5 m³	30–60	60	Rough, hilly terrain	750–1,500
Single-axle tractor and trailer	Varies	1,500 Varies	15–20	50	Steep hills, wide track	1,500
Utility vehicle	Varies	500–1,000 2.0 m³	60	60	Steep hills, wide track	3,000

Source: Adapted from Hathaway 1985.

[a] Number of people carried with full load of goods.
[b] The maximum load weights for these intermediate modes of transport are 50 percent of the values quoted by Hathaway (1985). Figures have been reduced to take account of the risk of damage to valuable commodities if unstable vehicles fall over when heavily loaded. In many cases, the volume carried, not the weight, is the limiting factor.
[c] Typical ranges are quoted. These are relative costs—no specific currency is implied.
[d] All-terrain vehicle, two-wheel drive and four-wheel drive.
[e] Payload given is without trailer. Trailers can be attached to all-terrain vehicles

25.2 Vehicle acquisition and disposal

This section examines various methods of vehicle procurement, policy options for vehicle replacement, the process of selecting appropriate vehicles, and methods for disposing of broken or obsolete vehicles.

Select method of vehicle procurement

A health program can procure vehicles, boats, or aircraft in four ways: purchase, donation, lease, or rental from the private sector. Contracting out transport to a private carrier should be considered as an alternative to procurement.

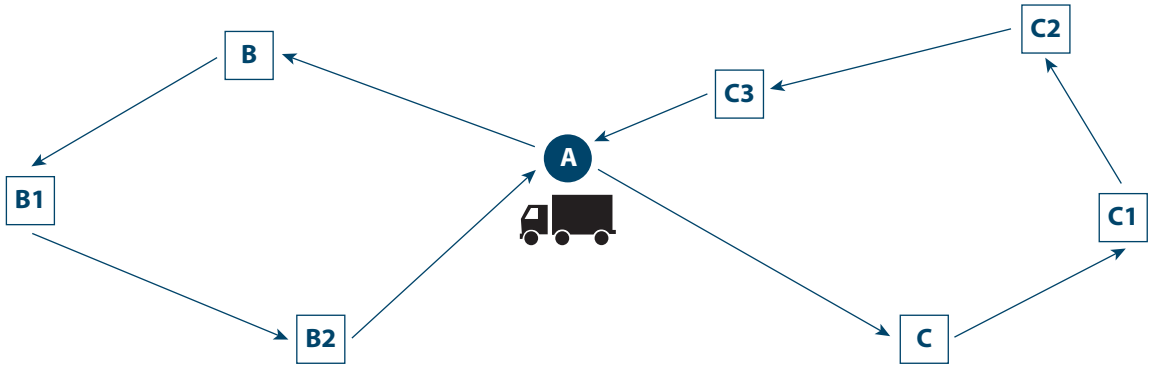
Purchase. Health programs generally acquire vehicles through purchasing, which involves capital expenditure. This method builds the capital base of the institution and makes the vehicle readily available. Recurrent costs include vehicle insurance, servicing, and maintenance. A cost-recovery system can be introduced that makes the vehicle available for contracting out or personal use for a mileage-based fee when not needed by the program.

Donation. Vehicle donations are useful in some situations; in some countries, donations are the main source of vehicles. This arrangement usually does not involve capital expenditure, although importation taxes and duties may still need to be budgeted. There may be disadvantages, however. Donors may not fund insurance, servicing, and maintenance, and the health program will have to pay these expenses. Donors may wish to supply vehicles manufactured in the donor country, whether or not spare parts and maintenance skills are locally available, which can lead to serious problems. Careful analysis of the advantages and disadvantages should be made before soliciting or accepting vehicle donations. It is important to keep in mind that

Figure 25-1 Multisite transport plan

Plan 1: Start of trip from central store (A) to first destination site (B).
Continue to sites B1 and B2 and return to central store (A) after completing delivery.

Plan 2: Start of trip from central store (A) to first destination site (C).
Continue to sites C1, C2, and C3 and return to central store (A) after completing delivery.



Distribution plan	Route	Schedule	Mileage	Travel time	Vehicle tag	Driver/assistant
1	A to B	Depart A on Mon 12 May at 8.00 Arrive B on Mon 12 May at 10.00 Deliver at B at 10.30 Continue to site B1	45 km	2 hrs	XD 23401	Bob Ray/Mike Todd
1	B to B1	Depart B on Mon 12 May at 13.30 Arrive B1 on Mon 12 May at 15.00 Deliver at B1 at 15.30 Overnight at B1	30 km	1.5 hrs	XD 23401	Bob Ray/Mike Todd
1	B1 to B2	Depart B1 on Tue 13 May at 8.00 Arrive B2 on Tue 13 May at 12.00 Deliver at B2 at 14.00 Overnight at B2	70 km	4 hrs	XD 23401	Bob Ray/Mike Todd
1	B2 to A	Depart B2 on Wed 14 May at 8.00 Arrive A on Wed 14 May at 12.00	65 km	4 hrs	XD 23401	Bob Ray/Mike Todd
2	A to C	Depart A on Mon 12 May at 8.00 Arrive C on Mon 12 May at 13.30 Deliver at C at 14.00 Overnight at C	85 km	5.5 hrs	XD 10002	Bill Ryan/Ted Able
2	C to C1	Depart C on Tue 13 May at 8.00 Arrive C1 on Tue 13 May at 10.30 Deliver at C1 at 11.00 Continue to C2	25 km	2.5 hrs	XD 10002	Bill Ryan/Ted Able
2	C1 to C2	Depart C1 on Tue 13 May at 11.30 Arrive C2 on Tue 13 May at 13.00 Deliver at C2 at 14.00 Continue to C3	25 km	1.5 hrs	XD 10002	Bill Ryan/Ted Able
2	C2 to C3	Depart C2 on Tue 13 May at 14.30 Arrive C3 on Tue 13 May at 16.30 Overnight at C3	40 km	2 hrs	XD 10002	Bill Ryan/Ted Able
2	C3 to A	Deliver at C3 on Wed 14 May at 8.00 Depart C3 on Wed 14 May at 8.30 Arrive A on Wed 14 May at 11.00	50 km	2.5 hrs	XD 10002	Bill Ryan/Ted Able

Notes: Time for meals and rest must be taken into consideration. The recipient facilities must be given advance notice of the delivery so that they can make receipt arrangements prior to the arrival of the delivery van.

sustainability is the key issue, whereas donor agreements are of limited duration. The health system may not have the capacity to maintain vehicles; if it does not, the donated vehicles will have a limited life.

Lease or rental. If an in-house transport system is to be maintained, the costs of leasing and purchasing should be compared. Leasing or rental companies provide vehicles on a short- or long-term basis and may also be able to supply drivers for an additional charge. An advantage of leasing or rental is that additional vehicles can be obtained readily, and broken-down vehicles can be replaced as part of the contract agreement at no cost to the system.

Contracting out. Private or parastatal trucking companies may have better transport management capacity than government agencies. Trucking companies are likely to be most competitive on the major routes. Contracting out the major routes means that the health service does not need to acquire and manage heavy vehicles, nor does it need to train drivers and maintenance staff for these vehicles. However, when outsourcing transportation services, managers need to have the skills to administer and monitor the contracts (see Chapter 39).

Establish vehicle replacement policy

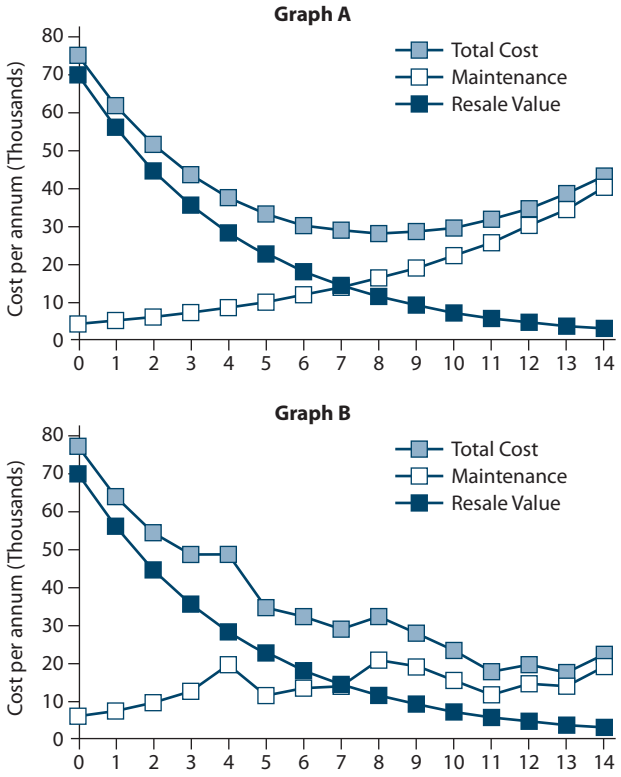
Implementing a transport plan is only the first step; in-house transport systems quickly collapse if there is no vehicle replacement policy.

Reviewing the transport plan regularly and analyzing vehicle operating costs carefully are essential. Most important of all is to negotiate adequate funding to maintain the system. As vehicles get older, the cost of servicing and repairing them increases. Eventually, they will have to be replaced. The balance between capital and recurrent expenditures therefore changes from year to year. This fluctuation can pose a problem, particularly when many new vehicles are suddenly acquired from a donor. These vehicles will deteriorate at similar rates and will need to be replaced at about the same time.

Four basic policy options are available for vehicle replacement—

1. A target life is set for each category of vehicle. All vehicles in a category are replaced when they reach this set age, regardless of mileage or condition.
2. A target mileage is set for each category of vehicle. All vehicles in a category are replaced when they reach this mileage, regardless of age or condition.
3. Vehicles are replaced, regardless of age or mileage, when they exceed a preset maintenance cost.
4. Vehicles are replaced when their operational availability (reliability) falls below a defined level. The aim should always be to operate a dependable fleet with a manageable number of breakdowns to address.

Figure 25-2 Replacement policy graphs



In practice, some combination of these four alternatives will probably be needed. For instance, a policy could be based on target life and mileage. Replacement occurs when one or the other of the two targets is exceeded. The chosen approach depends on the availability of funds and patterns of vehicle use. Commercial organizations have to operate their fleets as profit centers. Traditionally, government organizations and NGOs view their transport fleets as cost centers. Institutions that lease or rent vehicles from the private sector should follow similar replacement policies, because dependability and safety are also concerns for these vehicles.

Figure 25-2 shows two graphs indicating the decline in resale value compared to the rise in maintenance costs over time. Graph A illustrates an idealized model for determining the best time to replace a vehicle. If this model is used, vehicles are replaced as soon as annual maintenance costs exceed the capital value of the vehicle—in this example, after seven years. In practice, vehicle resale value is difficult to predict accurately over a long period, especially when operating conditions are harsh, and the resale value of older vehicles is determined more by condition than by age. Moreover, maintenance costs do not rise in a smoothly increasing curve over time; rather, the maintenance cost curve is "lumpy," as illustrated in Graph B, with peaks occurring whenever major components have to be replaced. Maintenance costs still exceed capital value after seven years, but by a smaller

and fluctuating amount. Moreover, a significant proportion of these maintenance costs are fixed costs: preventive maintenance, tire replacement, and other costs that cannot be avoided, whatever the age of the vehicle.

The replacement policy should be reviewed regularly, based on an analysis of real data obtained from vehicle maintenance costs and operational reliability records. The operational costs of vehicle breakdowns should also be taken into account. These costs can be controlled to some extent by carefully planned preventive maintenance, but as vehicles age, the risk of unforeseen failure increases.

The condition of every vehicle in the fleet should be reviewed annually and compared with its planned life span and replacement target. If a vehicle has to be replaced prematurely, it is important to understand why.

Transport plans should be adaptable to respond to changing circumstances. For example, when funds are short, a vehicle may be kept beyond its planned replacement life, provided the vehicle is reliable and spare parts are still available.

Select appropriate vehicles

Over the years, programs often acquire a random mix of vehicles from a wide range of manufacturers, which complicates maintenance and support. Selecting vehicles wisely is essential, whether they are purchased or donated. Vehicle type, fuel, spare parts, temperature control, and need for refrigeration are critical issues.

Determining the size and mix of the transport fleet must be done based primarily on the weight of the shipments that the fleet must carry for each established route, as well as the basic characteristics of those routes, including the number of days needed to complete a route and any restrictions, such as the working hours at health facilities. Country Study 25-1 shows how to analyze data to determine the appropriate mix.

Vehicle type. Limit the variety of vehicles to simplify maintenance and enable vehicles to be interchanged within the distribution system. Choose vehicles that are in common use throughout the country. Nationwide availability of spare parts and maintenance capacity are the most important considerations in choosing a vehicle. If feasible, choose the same type of vehicles as other programs use. This strategy allows spare parts and servicing skills to be shared among programs.

Choose vehicles that are simple in design, robust, easy to maintain, and suited to local road conditions. Buying or securing four-wheel-drive vehicles is an ineffective use of resources if they will be used exclusively on paved roads. Choose vehicles that have interchangeable components, particularly items such as tires, batteries, engines, and transmissions. If an emergency arises, or if a vehicle is badly damaged, vehicles with interchangeable components can be used as sources of spare parts for others in the fleet. Vehicles that are tropicalized hold up better in difficult tropical and underdeveloped areas. Tropicalized vehicles are outfitted to withstand adverse climatic and road conditions such as excess heat, humidity, and rain. Features of a tropicalized vehicle may include heavy-duty tires and high traction to manage rough roads and mud, an extra fuel tank for long-distance driving, flood lighting for dark driving, air-conditioning, and a dust guard.

If possible, choose vehicle manufacturers that do not redesign models frequently. This strategy helps ensure the continuous availability of spare parts. In addition, assessing a vehicle's reliability is easier if it has been sold for a number of years, and maintenance personnel need less retraining.

Fuel. Diesel-powered vehicles are usually more cost-effective than gasoline-powered vehicles. They are more expensive to buy and maintain, but they are more fuel efficient and may be more reliable and longer lasting. However, at temperatures below –5° to –10°C, diesel vehicles can be difficult to operate unless fuel-line heaters or special low-temperature fuel is available. If fuel quality is a problem, select vehicles that can be adjusted to run on low-octane or adulterated fuel. If transport distances are long and fuel availability is unstable in rural areas, buying cars with an extra, built-in fuel tank is advisable.

Accessories and spare parts. Every vehicle should carry a tool kit, first-aid kit, fire extinguisher, and spare tires. Purchasing an adequate supply of spare parts, including oil filters, tires, and batteries, is essential. The quantity purchased will depend on future funding arrangements. If adequate funds for recurrent expenditures are ensured, the stock of spare parts can be renewed annually. If availability of such funds is not assured, vehicles should be purchased with several years' worth of spare parts. This precaution should be taken particularly with donated vehicles.

Temperature control. Vehicles should be painted white to reduce internal temperatures during hot weather (where applicable). They may also need to be fitted with ventilator units. In India, unrefrigerated but insulated vehicle bodies have been used to control transport temperatures. Most pharmaceuticals should not be stored for prolonged periods at temperatures above 30°C. Even in temperate climates, this temperature can be exceeded when a vehicle is parked in the sun. Some medicines, vaccines, and blood products can be damaged by exposure to temperatures even well below 30°C. These items should be transported in cold boxes or refrigerated vehicles.

In very cold climates, blood products and some pharmaceuticals and vaccines need protection against freezing during transport. Goods compartments may need to be heated; alternatively, products can be transported for limited distances using vaccine cold boxes fitted with "warm packs."

Refrigerated vehicles. Refrigerated vehicles are more difficult to maintain than conventional vehicles and should be used only in countries with a good maintenance

infrastructure. Rather, it may be best to choose vehicles that have independent body units. The refrigerated body lasts longer than the vehicle to which it is attached and may be transferred to a new chassis.

Refrigeration units that can be powered by an independent engine will continue to operate even if the vehicle itself breaks down. All units should have electrical backup power units for use during overnight stops, and suitable power outlets should be provided at the stopping points.

When refrigerated vehicles break down, the shipment can be exposed to unacceptable temperatures within a few hours. It is important to ensure that adequate contingency plans (such as extra cold boxes) exist for this hazard.

In countries with cold winters, refrigerated vehicles should be fitted with a heating circuit to prevent sensitive products from freezing.

Manage vehicle disposal

As a general rule, any vehicle that has been broken for six months should be discarded. Most countries have committees that are responsible for deciding when to dispose of obsolete vehicles and equipment, which is the most accountable and transparent method. However, this procedure can be cumbersome, and large numbers of broken vehicles can be left to accumulate. These vehicles can be used to advantage in some countries. For example, they can be sold or dismantled for spare parts. The main constraint on sales is that proceeds usually accrue to the finance ministry rather than to the health ministry. Arranging for this money to be reallocated to the health service may be difficult.

25.3 Vehicle use

This section examines the issues involved in managing vehicles efficiently, safely, and cost-effectively and suggests ways to minimize system abuse.

Use onboard computers

The use of onboard computers helps a central transport operation to manage and monitor its vehicle fleet. Such technology is probably only worthwhile for large fleets that cover long routes. A system that uses GPS and short message service (SMS) allows the fleet manager to communicate directly with the driver and track the vehicle in real time.

System capabilities include—

- Alarms
- Engine monitoring (e.g., oil pressure, water level)
- Vehicle abuse monitoring (e.g., engine over-revving, harsh braking, speed violation)
- Tracking based on time or route

Prevent vehicle misuse

In-house transport systems often fail because the system is abused. Government vehicles are frequently used for private purposes, particularly by drivers and senior managers, and especially in countries where vehicles and fuel are scarce or salaries are low.

Planning and managing vehicle use and controlling misuse are difficult, but these activities are the key to sustaining a successful transport operation. Leadership and support are required from those people who have the authority to control negligent management practices.

The transport manager should control vehicle use, allocate transport resources, and be accountable for operational failures. Standard operating procedures to which drivers and users subscribe will help ensure adherence to proper use of vehicles and other transport resources. Transport should be planned and managed to achieve the following goals—

- Allocation of transport resources to meet the needs of the organization rather than those of the individual
- Prevention of unauthorized vehicle use
- Assignment of the most appropriate vehicle and driver for each purpose
- Use of alternatives, such as public transport, where appropriate and cost-effective
- Clear definitions of allowable uses by program staff and managers, to be respected by all users
- Assignment of vehicles to the primary user department, so that the department will be accountable and protect their use

Regular users should prepare written schedules of their transport needs at least a month in advance. The transport manager can then prepare a plan that makes the best use of available resources. Time for preventive maintenance should be allocated in the plan. When possible, journeys should be combined so that vehicles travel full and do not make wide detours. A detailed weekly or monthly plan should be prepared and later compared with the actual course of events, with analysis and follow-up of discrepancies. Health department lettering and insignia should be painted legibly on the vehicle to discourage unauthorized usage.

Methods of monitoring for abuses include—

- Checking the mileage recorded on the odometer every week and comparing this reading with the driver's official log.
- Requiring that the primary user/passenger sign a ledger kept by the driver when initiating and terminating a trip.
- Instituting a waybill system to document movement of the vehicles, involving the authorizing person at the point of origin and the receiving officer at destination.

- Assigning one operator to a vehicle and requiring that any transfer to another operator be accompanied by a handover note that details mileage, condition, inventory of parts, and similar details.
- Installing tachographs. These devices are legally required in European countries, but larger vehicles everywhere should be equipped with them. They record comprehensive details of every journey and can provide a check on the accuracy of the driver's log. The tachograph record also shows whether adequate rest stops have been taken.
- Introducing incentives for health facilities to prevent abuse by implementing good monitoring methods.

Misuse of motorcycles, light vans, and other small vehicles is more difficult to control, especially when vehicles are allocated to facilities in remote areas. Staff members may be encouraged to purchase motorcycles and other small vehicles from the health service at low cost; this strategy reduces vehicle abuse, generates income for vehicle replacement, and gives staff an incentive to maintain vehicles properly. An approach adopted in Zimbabwe was to sell vehicles to health workers on extended repayment terms and then to pay a mileage allowance. The health worker was free to use the vehicle for private purposes but also had an incentive to maintain it. After five years, the vehicle became the worker's property.

When vehicle misuse is discovered, the problem must be dealt with firmly and quickly. Allowing an abuse to continue ensures that it will become part of the system.

Train drivers and motorcycle riders

Drivers play a critical role in the optimal operation of transport services. Well-trained drivers and motorcycle riders have fewer accidents and better vehicle maintenance than those who are poorly trained. Driver-training modules are available from a number of sources. A driver or rider should—

- Drive or ride carefully and without aggression toward other road users
- Inspect the vehicle carefully at least once a day and after every stop for signs of damage, wear, and accidents
- Know which passengers are allowed in accordance with legal and corporate policies
- Drive within the allowable speed limit
- Be able to carry out preventive maintenance, minor servicing, and emergency repairs
- Be thoroughly knowledgeable about the routes and well informed about road and weather conditions and the location of service and refueling facilities
- Know what to do in case of an accident (requirements for immediate reporting, documentation, how to ensure the safety and security of the load)
- Be capable of administering basic first-aid treatment

Employing drivers with many years of experience and knowledge of the local road conditions will positively affect the performance and life of vehicles. Driver-mechanics (drivers with additional technical training) have the added skills to perform preventive maintenance and handle minor problems on the road.

It is important to ensure that drivers have a legal, active license, that their vision is tested regularly, and that vehicles are duly registered and carry current ownership, insurance, and inspection documents. Taking strong disciplinary action against those who drive after consuming alcohol or taking drugs is also important; vehicle damage often results from accidents caused by driving under the influence.

Ensure vehicle security

Vehicle security is a serious problem in many countries. Vehicles are stolen for resale or for spare parts, and pharmaceuticals may be stolen in transit. Precautions to take include—

- Keeping vehicles in locked compounds or garages.
- Employing security guards.
- Planning delivery routes so that vehicles can be securely parked during overnight stops.
- Instructing drivers never to leave vehicles unattended during transit.
- Avoiding driving at night, especially in countries where vehicles are poorly maintained or have no lights. Security problems are often worse after dark.
- Installing burglar alarms, immobilization devices, or both. Fit security dead bolts on cab doors and goods compartments. Where security is extremely difficult, it may be necessary to fit grilles around the cab interior.
- Buying vehicles with sleeping compartments for drivers if long delivery trips are required.
- Ensuring that every vehicle is fitted with a fire extinguisher. Tools and spare parts should be carried so that the driver can make simple repairs without having to leave the vehicle unattended.
- Installing a mobile communication radio for communication with the base.
- Ensuring that the vehicle and goods are checked at the start of a trip and at every point along the route for any suspicious devices that could be used by saboteurs.
- Engraving vehicle registration details onto windshields.

Ideally, all vehicles carrying valuable loads should have a second driver or a driver's assistant. On long journeys, a

second driver is necessary to reduce the risk of the driver's falling asleep. If a breakdown or an accident occurs, one person can guard the vehicle while the other gets help.

25.4 Vehicle maintenance

Planned maintenance is an essential aspect of the transport system. It includes ensuring availability of spare parts, managing repairs—whether for land vehicles or boats—and disposing of waste products.

Provide spare parts and consumable supplies

Vehicles cannot be serviced and repaired without an adequate supply of spare parts and consumables—lubricants, brake fluid, tires, batteries, and oil filters. If vehicles are not serviced, they quickly become unreliable.

Senior logistics managers are responsible for emphasizing that pharmaceutical deliveries cannot be guaranteed without adequate funding for spare parts and consumables. Politicians and budget control officers must be persuaded to understand the importance of adequate recurrent funding or to consider contract alternatives to in-house transport.

Manage vehicle maintenance

A consistently high standard of maintenance increases the fleet's reliability; this standard can be achieved only if the maintenance policy is clearly defined, enforced, costed, and monitored.

Vehicle maintenance can be divided into four levels—

1. Preventive maintenance, as defined in the manufacturer's service manual, includes lubrication, oil changes, replacement of oil filters and brake pads, tire changes, and other measures that keep the vehicle operating safely and efficiently. All these can be foreseen and planned for.
2. Overhauls involve the dismantling or replacement of major components, such as engines, clutch linings, or transmissions. The mileage at which a specific overhaul is required varies from vehicle to vehicle, but overhauls can be foreseen and planned for.
3. Minor repairs include replacement of broken headlights and minor body work. They do not require the tools or skills of a specialist. Many of these will be unforeseen but can be managed if parts are available.
4. Major repairs are needed in the case of crash damage or other unforeseen problems that require specialized tools and skills.

Preventive maintenance and minor repairs can be carried out in simply equipped workshops by relatively unskilled mechanics, and require only a small selection of frequently used spare parts and consumables. Preventive maintenance for every vehicle should be scheduled in advance as part of the management of vehicle use. Major repairs and overhauls must be carried out in well-equipped workshops by skilled mechanics, and require access to a comprehensive stock of spare parts.

A health program often needs a combination of maintenance levels. For instance, the health program can perform preventive maintenance and minor repairs in its own workshops, and major repairs and overhauls can be contracted out to a central government workshop or a private garage.

The following examples indicate the range of options for organizing maintenance services. These options are based on the assumption that the health program is government run, but they are also relevant to NGOs.

Workshops operated and funded by the health program. The main advantage of this option is that workshops, maintenance staff, and the stock of spare parts are directly controlled by the health program. The main disadvantages are that transport maintenance services may be duplicated among government agencies, often when few trained staff members are available, and that the health program may have trouble tracking the true costs to make meaningful comparisons. Duplication wastes funds and can result in maintenance units that lack proper staff or are too small to operate cost-effectively. This result is less likely if only preventive maintenance and minor repairs are carried out.

Workshops operated and funded by another government agency. A network of vehicle maintenance workshops operated by the ministry of works can be used to maintain all government vehicles. This is a traditional administrative solution. It can be satisfactory, provided that workshops are fully equipped, staff members are well trained, and the government is committed to upgrading equipment and retraining staff as vehicle technology changes. A disadvantage is that the health program has no direct control over the quality of service, and no sanctions can be applied if the service is unsatisfactory.

Privatized government maintenance services. Workshop services owned and operated by government may be transferred or franchised to a parastatal organization or to a private company. Government agencies can then buy back the service at a rate that is periodically renegotiated. Privatization of government services has been widely advocated and has been adopted in many countries. Disadvantages include the possibilities of overcharging and corrupt and abusive pricing and billing practices.

Tendered maintenance contracts with private companies. An arrangement involving private maintenance contracts that run for one or more years has several advantages—

- The health program does not have to provide workshops or maintenance staff or hold stocks of spare parts. Capital investment is thus reduced, and the health program can concentrate on core activities.
- Cost control may be better: the service contract can set a flat rate per year for maintaining each vehicle, which includes the cost of normal spare parts. Only unforeseeable items (such as accident repairs) need to be paid for, on the basis of individual invoices.
- Quality assurance clauses can be built into the contract. These can impose financial penalties whenever the service quality fails to meet set targets. Bonus payments to the contractor may also be justified if reliability exceeds target norms.

Contracts of this kind succeed only in countries with well-developed private vehicle-maintenance sectors. Tenderers must use sophisticated costing techniques if they are to offer realistic quotes, and they must have well-equipped workshops and reliable sources of spare parts and consumables. Government must have good monitoring, reporting, and accounting procedures. Otherwise, unsatisfactory service or corrupt practices may go undetected.

Private workshops run by agents of the vehicle manufacturer. These workshops may be more expensive, but they are more reliable than other private workshops because the agents have a greater sense of responsibility to maintain the manufacturer's reputation. However, such workshops may be restricted to larger urban areas, with no accessibility to them in rural or remote areas.

Private workshops with services paid by invoice. This option has advantages but provides no cost certainty or quality assurance. It is generally used only for emergency repairs or when no other maintenance facilities are available.

Ensure safe disposal of waste products

Vehicle servicing produces toxic waste products. Oil, lubricants, tires, and batteries must be disposed of safely to avoid creating public health risks. The health program should require that the vehicle service organization adopt a safe disposal policy that complies fully with local regulations.

25.5 Measuring transport performance using key indicators

Using a set of key performance indicators can help determine a transport system's efficiency.

Vehicle capacity usage

The volume that the fleet carries seriously affects costs. When calculating product costs, vehicle capacity must be maintained at the highest levels to minimize the unit cost of transporting the product. This indicator depends on the frequency and size of orders. For example, if the fleet's total pallet capacity is 240 for twelve vehicles, and the fleet carried 200 pallets on a day, the capacity usage for that day would be 83 percent. The capacity percentage varies each day, and a cumulative percentage helps determine if the size and mix of the vehicle fleet meets the system's needs.

Vehicle time usage

A vehicle costs money whether it is being used or not. Keeping the vehicle working as much as possible (consistent with good maintenance practice) is most efficient. This indicator identifies the proportion of hours that each individual vehicle is in use compared with the total fleet. For example, the fleet of twelve vehicles from the example above has an operating day of ten hours for each vehicle, or 120 hours for the fleet. If the actual number of operational hours recorded for all twelve vehicles is ninety, time usage is only 75 percent. In addition, if customers were encouraged to change their delivery times, the number of hours available for the fleet to operate would increase further. The more the vehicles work, the more efficient the system and the less cost per delivery. Transportation planners need to maximize the operation of the fleet while considering the realities of their environment.

This indicator can also identify individual vehicles that are being used less than needed because of recurring mechanical problems, driver and personnel problems, and so on.

Vehicle total usage

A critical measurement of the fleet's effectiveness is the combination of the above two indicators. If the whole fleet is used for four hours out of ten at 100 percent capacity for those four hours, most transport managers would be happy. However, overall usage would only be 40 percent because of the remaining six hours of operational time left in the day for the whole fleet. Combining the results of the previous two indicators, which individually appear to be good, can show a different result when combined. For example, capacity usage of 83 percent multiplied by time usage of 75 percent equals a total usage of 62 percent, which shows room for improvement.

Average drops per vehicle and cases per drop

The average number of shipment drops per vehicle can be used to calculate the cost per drop. And while the number of drops may be acceptable, if the number of cases per drop is small, then the cost per delivery may be too high. These indicators may lead to a review of delivery frequency, thresholds for order sizes that can be delivered, and charges for delivery.

Table 25-2 Comparison of commercial, government, and mixed fleets

Factor	Commercial fleets	Government fleets	Mixed fleets
Government capital expenditure on vehicles	No	Yes	Yes, but reduced
Government expenditure on maintenance, insurance, wages, supervision, and per diems	No	Yes	Yes, but reduced
Flexibility to meet demand peaks	Yes	No	Yes
Fast transport beyond normal commercial routes	No	Yes	Yes
Security of pharmaceuticals in transit	Can be expected to be good	Variable	Variable
Running costs	Lowest for large loads and long hauls	Lowest for stable requirements	Can provide an optimum mix
Flexibility to change route and schedule at short notice	No	Yes	Variable
Experience in and care of transporting special products	Limited, and may cost extra to add such elements	Yes	Variable

Vehicle operating cost

Because most work activities revolve around the number of orders to deliver and the case/tons/pallet volumes associated with each order, this indicator is important. The cost of processing an order and then delivering it helps determine the level at which inappropriately sized orders should be managed differently.

25.6 Contracting transport services

This section examines the advantages and disadvantages of contracting out transport services to private transport companies. It also presents the costing decisions that need to be made and details procedures for selecting, working with, and monitoring contractors.

Private-sector transport issues

Private transport companies in some countries can offer better and cheaper pharmaceutical delivery service than the government is able to provide. These advantages are most likely to be gained in countries with a well-developed infrastructure and a good range of well-managed private transport companies. Where choice is limited, competition may be insufficient to produce real cost savings.

Private carriers will probably be most competitive on routes between major population centers. On these routes, vehicles are likely to carry a return load, an efficiency that lowers overall costs. By contrast, private carriers may be comparatively expensive when delivering to remote areas, where there is no potential for return loads; however, this cost premium may not apply if existing delivery routes already serve these areas. The health program may be able to enter into a joint agreement with another agency that needs transport arrangements from the periphery to the center. Agricultural cooperatives are one possibility.

Whenever possible, pharmaceutical deliveries should be organized so that the transport contractor is supplied with full loads. Low transport costs depend on maximum use of vehicle capacity. Contract transport may improve the security of pharmaceuticals, provided the contractor is made responsible for any losses in transit. The health program or facility must be proactive in requiring transport companies to ensure that pharmaceutical supplies are not damaged during transport and layovers. Many private transport services are small and individually owned and may not have the capacity to maintain quality service. In such cases, using larger and more economically viable companies is preferable.

Table 25-2 compares the advantages and disadvantages of private-sector, government, and mixed transport fleets.

The preceding remarks relate principally to road transport contractors, but rail, air, river, and sea transport services may also be used for pharmaceutical deliveries. The following issues apply equally to those forms of transport.

Cost assessment

A thorough cost analysis should be conducted before a decision is made to contract out transport services. A decision to introduce private-sector transport can have far-reaching implications. For instance, existing vehicles will have to be sold if they are no longer needed. If many vehicles are sold, government workshops may no longer have sufficient work to remain viable. Unless these issues are taken into account, the overall effectiveness and efficiency of the government transport operation may decline rather than improve. Country Study 25-2 provides a sample analysis of alternatives.

In-house transport costs

Any comparison of public- and private-sector transport alternatives requires a realistic assessment of public-sector vehicle operating costs. The annual operating costs for a vehicle are made up of the following elements—

- Fixed costs
  - Amortized cost of the vehicle over its anticipated lifetime
  - Interest costs
  - Transportation taxes
  - Insurance premiums
  - Wages and overhead for the drivers
- Variable costs, based on anticipated annual mileage
  - Fuel
  - Preventive maintenance (filters, lubrication, brake pads, tires)
  - Repairs
  - Per diem payments to drivers for meals and accommodation
- Carrying costs of public-sector transport
  - Cost of transport administration
  - Cost of parking and garaging

Total cost analysis (see Chapter 40) can be used to compile cost data. When costs have been calculated, they can be used to assess the delivery cost per ton on specific routes. This cost can then be compared with quoted rates for alternative forms of transport. If the preliminary assessment indicates that private-sector transport is more economical, formal tenders to provide services should be conducted, as described in Chapter 39.

25.7 Maintaining pharmaceutical quality

Transport managers are responsible for ensuring that pharmaceuticals are not damaged during transit. It is essential that medicines be properly packed (see Figure 25-3).

The pharmaceutical manufacturer's original outer packing should withstand normal handling and transportation,

Country Study 25-2
Contract-or-buy analysis in Zimbabwe

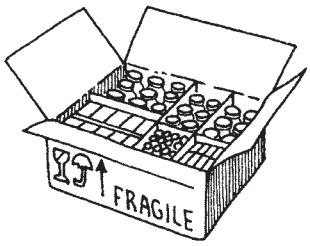
In Zimbabwe, the cost of running the drug delivery routes from the central medical stores (CMS) to the provincial stores using CMS vehicles was compared with the cost of using private-sector carriers. The results of the analysis were used to decide which routes should be contracted out to the private sector. The operating parameters and costs for CMS vehicles were as follows:

Payload of each truck	5 tons
Annual mileage of all vehicles	468,000 km
Fixed costs	USD 0.37 per km
Variable costs	USD 0.03 per km
Fixed + variable costs	USD 0.40 per km

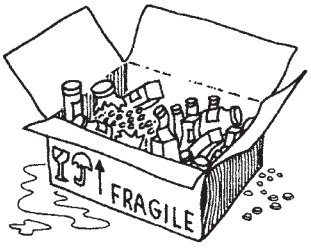
These figures were used to calculate the cost of running each route using CMS vehicles and private carriers. Results are shown in the accompanying table, which reveals that for loads that are multiples of 5 tons, using CMS vehicles is cheaper. Although the cost differential decreases with increasing distance, using CMS vehicles remains cheaper even for distant destinations. The full cost advantage is obtained only if the trucks are hauling loads in both directions. An empty CMS truck costs the same per kilometer as a fully loaded one, but the private carrier does not charge for the return journey. If the CMS vehicle has no load to carry back, using hired transport to Gweru, Bulawayo, and Binga becomes more economical. The cost ratio in all three cases is less than 2.0.

					Ratio of tariff cost to own costs per 5 tons	
Destination	**Distance (km)**	**One-way cost of using own fleet (USD 0.40 per km)**	**Private-sector tariff (USD per 100 kg)**	**Cost of transporting 5 tons**	**If full for return**	**If empty for return**
Chinhoyi	110	44.00	2.94	147.00	3.35	1.67
Gweru	275	110.00	3.94	197.00	1.80	0.89
Masvingo	292	116.80	5.16	258.00	2.22	1.10
Bulawayo	439	175.60	4.73	236.50	1.36	0.67
Binga	880	352.00	7.69	384.50	1.09	0.55

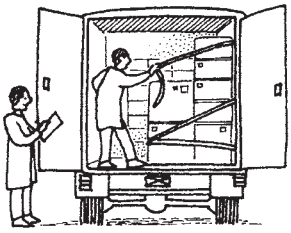
Figure 25-3 Transporting pharmaceuticals safely



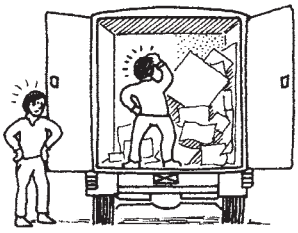
Fill voids in cartons with packing material



Prevent breakages

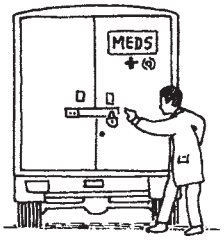


Load vehicles carefully and systematically first-in/last-out

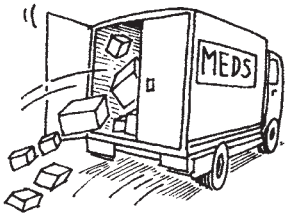


Save time when unloading

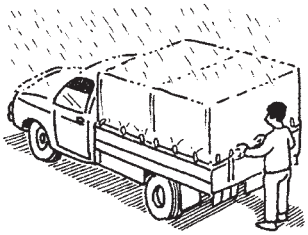
Prevent physical damage



Secure vehicle doors

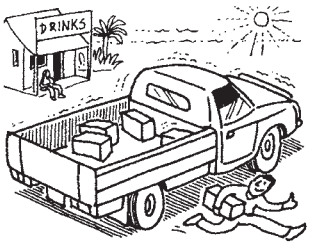


Prevent losses or theft



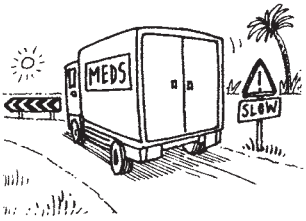
Protect supplies from sun or rain

Stay near the vehicle

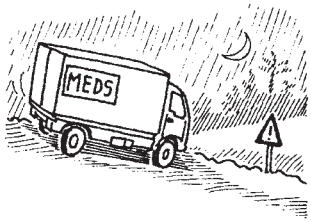


Minimize deterioration of pharmaceuticals during transit

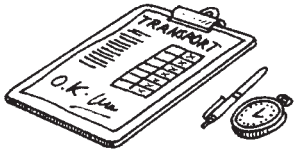
Guard against theft



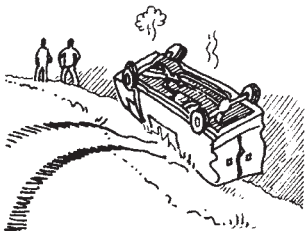
Start early in the day and drive with care, especially on hazardous roads



Avoid nightime driving



Ensure safe and timely delivery



Prevent accidents

although standards may differ in developed countries, where palletized handling exists throughout the system. At the intermediate stores, this outer packing often must be removed to allow the assembly of small consignments; these must be repacked for transport in strong cartons or reusable crates. Empty spaces in partly filled cartons or crates should be filled with newspaper, straw, wood shavings, or other loose material to stop the contents from rattling about and prevent cartons from being crushed. If mechanical handling equipment is available, loads may then be assembled onto pallets.

Pallets, cartons, or crates should be carefully and systematically loaded into vehicles on a first-in/last-out basis. They must then be held secure by straps, nets, or other means. The vibration caused by travel over rough roads can damage tablets and other breakable products; long journeys over rough roads should be avoided whenever possible.

Delivery journeys in very hot or cold weather may damage temperature-sensitive products. Appropriate precautions must be taken, as discussed earlier in this chapter. Water damage during heavy rain can be avoided by ensuring that pharmaceuticals are unloaded directly into a building and not left standing outside. Make sure that vehicles have the necessary materials to protect loads from direct sun, dust, rain, and pilferage. Canvas covers and straps are as essential as spare tires and need to be carried at all times. ■

References and further readings

★ = Key readings.

★ Abdallah, H. 2004. *Guidelines for Assessing Costs in a Logistics System: An Example of Transport Cost Analysis*. Arlington, Va.: John Snow, Inc./DELIVER, for the U.S. Agency for International Development.

★ Archando-Callao, R. S., and A. Faiz. 1994. *Estimating Vehicle Operating Costs*. World Bank Technical Paper no. 234. Washington, D.C.: World Bank. <http://siteresources.worldbank.org/INTROADSHIGHWAYS/Resources/338993-1115667319236/1095944-1115669285546/wbtp-234.pdf>

Dawson, J., and I. Barwell. 1993. *Roads Are Not Enough: New Perspectives on Rural Transport Planning in Developing Countries*. London: Intermediate Technology Development Group.

Elsenaar, P., and S. Abouraad. 2005. *Road Safety Best Practices—Examples and Recommendations*. Geneva: Global Road Safety Partnership. <http://www.grsproadsafety.org/themes/default/pdfs/Road%20Safety%20Best%20Practices.pdf>

Hathaway, G. 1985. *Low-Cost Vehicles: Options for Moving People and Goods*. London: Intermediate Technology Development Group.

Hugos, M. H. 2006. *Essentials of Supply Chain Management*. 2nd ed. Hoboken, N.J.: John Wiley & Sons.

Rushton, A., J. Oxley, and P. Croucher. 2010. *Handbook of Logistics and Distribution Management*. 4th ed. London: Kogan Page.

Stroh, M. B. 2006. *A Practical Guide to Transportation and Logistics*. 3rd ed. Dumont, N.J.: Logistics Network.

Transaid. 2008. *Introduction to Transaid's Transport Management System Manual*. London: Transaid. <http://www.transaid.org/images/resources/TMS%20Consolidated%20Manual%20Revised%20Aug08.pdf>

WHO/EPI (World Health Organization/Expanded Programme on Immunization). 1994a. *Guidelines for Introducing Motorcycles into a Primary Health Care Programme*. Geneva: WHO/EPI. <http://whqlibdoc.who.int/hq/1994/WHO_EPI_LHIS_94.10.pdf>

———. 1994b. *Monitoring Vehicle Use: A Guide for Transport Officers*. Geneva: WHO/EPI. <http://whqlibdoc.who.int/hq/1994/WHO_EPI_LHIS_94.6.pdf>

———. 1994c. *Riders for Health: Manual for Motorcycle Instructors*. Geneva: WHO/EPI. <http://whqlibdoc.who.int/hq/1994/WHO_EPI_LHTM_94.1.pdf>

———. 2010. *Model Requirements for the Storage and Transport of Time- and Temperature-Sensitive Pharmaceutical Products*. Geneva: WHO/EPI.

★ WHO/V&B (World Health Organization/Vaccines and Biologicals). 2000. Transport. In *Product Information Sheets*. 12th ed. Geneva: WHO/V&B. <http://whqlibdoc.who.int/hq/2000/WHO_V&B_00.13.pdf>

ASSESSMENT GUIDE

Existing transport system

- Does the program have a transport management department?
- What are the major transport problems?
- Who provides the transport budget? (Compare the transport budget with actual expenditures.)
- What types of vehicles are used? (List all types used and the source, model, quantity, age, mileage, condition, and location of each.)
- Are vehicles shared with vertical programs, such as WHO's Expanded Programme on Immunization? Do availability and reliability vary among programs? If so, why?
- Do existing transport routes make effective use of vehicles?
- How are supervisory visits currently made?
- Is there a vehicle replacement policy? If so, how is replacement funded?
- Is there a policy for writing off broken-down vehicles? Is it implemented?
- Is there a preventive maintenance policy? Is it effective?
- What percentage of vehicles is in working condition? Describe by type and location of vehicle.
- Is there a policy to control and monitor vehicle use? Is it effective?
- Is there a driver training program? Is it effective?
- Is there a policy on transport security? Does it control losses?
- Are vehicles loaded correctly?
- What is the number of vehicles, compared to the number of drivers?

Transport alternatives

- What are the transportation terms for overseas and in-country suppliers? Could these be changed to require direct delivery to lower-level stores?
- Which of the following modes of transport are available?
  - Program vehicles
  - Motor pool vehicles
  - Buses
  - NGO vehicles
  - Intermediate forms of transport
  - Railways
  - Water transport
  - Commercial, government (including military), NGO flights

Private-sector transport alternatives and cost comparisons

- Do vehicle rental and leasing companies exist? What are the charges?
- Are commercial carriers available? Are they capable of transporting pharmaceuticals at rates equal to or lower than costs of in-house transport?
- Is the private transport alternative dependable? Does it have experience in transporting special products like pharmaceuticals?

Maintenance alternatives

- Are health program or other government workshops offered?
- Are privatized government workshops available?
- Are contracts with the private sector a possibility?

Monitoring and evaluation

- Are there effective systems for monitoring and evaluating transport costs and performance? If not, which elements are missing?
- Is a checklist used to ensure timely registration, licensing, and renewals?
- Are standard operating procedures (SOPs) in place for transport operation?
- Are vehicles checked regularly after making a long trip?
- Do the SOPs contain guidelines on what to do in the event of an accident?
- Are vehicles checked daily for safety using a checklist?