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The new company was given the sole authority for importation, warehousing and distribution of pharmaceutical products. In the same year a comprehensive project was worked out for starting a pharmaceutical manufacturing unit in Taiz. Taiz was selected for the following reasons:-

(a) Temperate climate throughout the year.

(b) Better availability of women workers particularly suitable for the pharmaceutical industry.

(c) Availability of suitable land for making glass on the shore of nearby port city of Mokha. (The management of the company thought of starting a glass factory at a later date).

Land was purchased and the building was completed short of roof. Orders for machinery and equipments were ready to be placed. At this stage the project had to be abandoned due to political reasons.

Subsequently the company has been reorganised with 100% Yemeni capital. The name of the company now is the Yemen Drug Company for Industry and Commerce. (YEDCO). At present it is engaged in importation of pharmaceutical products and selling them to the trade. The company has also a few retail outlets of its own in various parts of the country and has a plan to open more.

Origin of the project

YAR is one of the least developing country in the world. The country lacks mineral resources but has a big manpower supply. Unfortunately the people suffer from wide spread endemic and epidemic diseases and mulnutrition. One of the biggest challenges the country is facing is how to make the human resources adequately productive. "The Government is aware that the socio - economic development of the country is very much dependent on people's health. The delibated man suffering from disease and or mulnutrition is unable to work and help economy. Sick children may remain mentally retarded and fail to acquire the level of education which will enable him to contribute to the development of the country". (1)

(1) YAR, Ministry of Health - National Health Programme 1976/1977 - 1981/1982.

Government health programme, however, is very much handicapped due to high prices and non-availability of the imported drugs. The Ministry of Health is very much anxious to see that at least the essential drugs are manufactured in adequate quantities in the country and some of the valuable foreign exchange is saved. The local production will also make the drugs more easily available to the hospitals and the public.

"During the meeting on Establishment of Pharmaceutical Industry held in Budapest in 1975 the representative of the YAR stressed the needs and technical assistance required for developing the pharmaceutical industry to the UNIDO representative to the meeting".

Objective of the project

"To develop the Pharmaceutical Industry and its quality control laboratory". The objective has been sub-divided into following sections:

I) Study and evaluate the existing reports on the Yemen Pharmaceutical Industry.

II) Review the quality and quantity of drugs used in the country and make projections for the next five years.

III) Evaluate the existing production unit and, if needed, recommend a most suitable technology for improvementof the quality of drugs produced locally for domestic use.

IV) Prepare a list of machines and equipment needed for the development of the existing unit.

V) Prepare a programme for training of technicians.

VI) Recommendation for future action.

Duration of the project

Project was approved in February 1977; duration of the project was for six months. Project came into operation on the 31st May 1977 and terminated on the 30th November same year.

Co-operating agency

The project was carried out in co-operation with:

(a) Ministry of Health - YAR.

(b) Yemen Drug Company for Industry and Commerce.

(c) ACDIMA (The Arab Company for Drug Industries and Medical appliances).

(d) Technical organ of the Council of Arab Economic Unity.

(e) Mr. Neville Milner of WHO, Aden.

Contributions

UNIDO contribution approximately $26,000
Government contribution - not applicable.

For the purpose of convenience each of the subdivisions of the objective is dealt with a separate section of the report. Relative findings and recommendations are included in each section. Appendices at the end of the report are correspondingly numbered in accordance with section to which they refer.

SECTION I

Evaluation of the existing reports on the Pharmaceutical Industry of YAR.

I.1 Feasibility study of Dr. Abdel Fattah M. Shawky.

In 1971 the Supreme Board for Drugs and Medical Appliances was formed to supervise the quality of imported drugs and medical appliances. For all practical purposes the board started functioning after it was re-organized in 1975. During September 1975 Dr. Fattah Shawky of the Technical Organization of the Council of Arab Economic Unity came to Sana'a to help the Ministry of Health in drafting the objectives of the Supreme Board. During this visit, Dr. Shawky was requested by the Ministry of Health to work out plan for a pharmaceutical manufacturing project which will fulfil the requirement of the hospitals for important drugs. Dr. Shawky made a project report completed with working drawings for the manufacturing building made by an Architect from Cairo and a feasibility study. The feasibility study and the drawings were eventually passed on to the YEDCO (Yemen Drug Company for Commerce and Industry). YEDCO being responsible for the pharmaceutical industry in YAR thought it appropriate to take up the project for themselves. Accordingly a land was purchased on the Sana'a Wadi road about 5 kilometer West of Sana'a city. The foundation stone for the factory was laid by the President of YAR on the 13th June 1977.

Unfortunately the production facilities proposed by Dr. Shawky are too large for the requirement of hospitals. On the other hand they are too small to fulfil the requirement of YEDCO because YEDCO's project should eventually meet the country's requirement for most of the important drugs. It is therefore, necessary to make projection of the country's requirement upto 1981 and workout a master plan for a factory to cover this requirement.

I.2 Report of Mr. Neville Milner.

Ministry of Health feels the necessity of having proper production facilities for some of the special and important products needed by the hospitals. Manufacture of these products will not be feasible in an industrial project at least at the initial stage. At the request of the Ministry Mr. Milner, a WHO pharmacist, presently stationed in Aden, visited Sana'a from 27th March to 22nd April 1977 to advise the Ministry among other things, on the above matter, Drug registration and training of pharmaceutical man power.

Mr. Milner found that some of the hospitals in Sana'a and Taiz prepare a number of products for the needs of the patients attending each unit but the facilities available are unsatisfactory. He therefore recommended that Ministry of Health establishes a central production unit for pharmaceutical products needed for the pharmaceutical service in the hospitals and public health centres. Central production unit will produce those items the demand for which is limited and therefore uneconomical for large scale production or items of a specialised type that would normally be found in a hospital department or for particular patients. He points out that for obvious reasons there should not be competition by duplication of products as between the production unit to be established by the Ministry of Health and the factory to be established by YEDCO.

Mr. Milner also found that some of the hospitals in Sana'a and Taiz make transfusion fluids for their own requirements. Here again under unsatisfactory condition, he therefore recommends that production of transfusion fluids also should be centralised at the new Central Public Health Laboratory building where plans for the production of transfusion fluids have been included in the amenities to be provided in the building. Mr. Milner however, expresses disatisfaotion about the layout of the rooms and their location with respect to other activities to be carried out in the building. He also criticised some of the facilities forseen for the produotion of transfusion fluids.

During the review of the technical details of the three projects e.g. :-

(a) The pharmaceutical factory to be established by YEDCO.

(b) The central production unit for special pharmaceutical products for hospitals.

(c) The central production unit for transfusion fluids for hospitals.

With the representative of the Ministry of Health it was felt that the best thing will be to invite Dr. Shawky and Mr. Milner to Sana'a and settle all the details of the respective projects in joint discussions. It was also decided to invite along with Dr. Shawky Dr. Abdau Mahmoud Sallam, the Chairman of ACDIMA and one other technical person from ACDIMA to take advantage of their wide experience in pharmaceutical industry in the Arab countries and also to keep ACDIMA informed about the developments in YAR.

I.3 Discussions with Mr. Milner.

Mr. Milner visited Sana'a from 4th to 10th July. discussions were held covering the following matters :

1) Quality control of imported drugs including registration.

2) Central production unit for special pharmaceutical products.

3) Central production unit for transfusion fluid.

It was possible to work out the details required for the transfusion fluid. With respect to the central production unit for special pharmaceutical products, Mr. Milner's report was reviewed and decision were taken on future action programme. Representatives from the Ministry of Health participated in all these discussions. Minister of Health accepted Mr. Milner's recommendation to establish central production unit for special pharmaceutical products in the building presently occupied by the Central Public Health Laboratory. This building is

likely to fall vacant by the end of 1977 when the laboratory will be shifted to the new building.

It was agreed that Mr. Milner will extend his report to incorporate decisions and conclusions arrived at during these discussion. It is to be mentioned here that no fund has been earmarked for either of the two projects recommended by Mr. Milner. Ministry of Health will have to provide it from their general budget.

I.4 Discussions with Dr. Shawky and representatives from ACDIMA.

Meetings were arranged between 16th to 20th July. Representatives from YEDCO and Ministry of Health participated in the discussions. Among the representatives of YEDCO mention may be made of Dr. Salem Bahobeshi the Director designate of the project and the counterpart for the writer. He is a pharmacist and is from Yemen. The Health Minister and the Chairman of YEDCO were also present during most of the discoussions. The following areas were covered:-

1) Projection upto 1981 was made.

2) Production volume required for the first phase of the project were finalised.

3) The site of the proposed factory was approved subject to availability of water. The area of the land to be purchased was 30.000 square meter.

4) The layout of the floor plan of the factory was made (Appendix - I.1). As it is not possible, at this stage, to make a fairly accurate projection for the requirement upto 1985 the master plan may be made flexible to accommodate deviation from projection.

5) A tentative list of products to be manufactured during the first phase was made. The list will be submitted by the Health Ministry for approval of the expert committee composed of the representative, from the Medical profession and Ministry of Health. His Excellency the Health Minister is the chairman of the committee (Appendix I.2).

6) List of machinery and equipments required for the first phase of production will be made by the writer. YEDCO will procure them from the most suitable source.

7) Formulae and the manufacturing procedures for the products to be manufactured may be made available from Egypt.

8) The chief engineer, packaging supervisor and an expert in sugar coating of tablets will be appointed from outside YAR.

9) Initially two pharmacists from YAR, one for oral solids and liquid dosage forms and other for injectables and opthalmic formulations will be trained in Egypt for six months. Subsequently one other pharmacist to be in charge of the quality control will be sent for training. The possibility of training three girls from YAR in Egypt in packaging operations and management of packaging lines will be looked into.

10) The construction of the company will be entrusted to a suitable firm operating in Sana'a who will work under the supervision of a local architect both to be appointed by the Chairman of YEDCO.

11) The architect in Cairo, who made the plan under direction from Dr. Shawky will act as consulting architect.

12) The local architect will visit Cairo at a suitable time for consultation with the consulting architect.

13) The writer and Dr. Salem will visit Cairo during the 1st week of August. The purpose of the visit will be:

a) To obtain manufacturing formulae and procedure for the products to be manufactured during the first phase.

b) To find the source and availability of the raw and packaging materials required for the products.

c) To study the machinery and equipments used in Cairo and their suitability for the proposed project.

d) Finalization of the training programme in Egypt.

14) The Health Minister, Dr. Sallam and Dr. Shawky recommended that a new company should be formed for the purpose of financing and management of the Pharmaceutical manufacturing project. Government, YEDCO, members of the Medical profession and of the Pharmaceutical trade of YAR should participate in the capital formation of this company.

SECTION II A

Review of quality of drugs used in YAR.

IIA-1 Present situation

At present all drugs consumed in the country are imported. As mentioned earlier some of the hospitals in Sana'a and Taiz do prepare a number of products but only for the need of the patients attending each unit. Mr. Milner has reviewed in his report the condition of hospital pharmacy in YAR.

Prior to 1975 drugs were allowed to be imported without any control from the quality point of view. In 1975 the supreme Board for Drugs and Medical appliances was re-organized and empowered to take necessary steps for the quality control of imported drugs. Ordiance No.30 of 1975 has defined the responsibilities and duties of the supreme Board, (Appendix IIA-1). In summary the following important steps were taken.

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UNITED NATIONS INDUSTRIAL
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RP/YEM/77/001

YEMEN ARAB REPUBLIC

Project findings and recommendations

Prepared for the Government of the Yemen Arab Republic

by

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Expert of the United Nations Industrial Development Organization

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1) Prior resitration with Supreme Board for importation of any drug was made compulsory.

2) The Supreme Board was empowered to examine all requests for importation of drugs from technical aspect and only when the request was cleared by the Supreme Board, importers could get necessary licences from the Ministry of Economy.

3) Any drug found in the country which has not been approved by the Supreme Board for importation was liable to be confiscated and the law of smuggled goods will be applicable.

II A.2 Defficiencies in the present situation.

There is no control at the port of entry. The Supreme Board has no feed back as to when the Drug has been imported and in what quantities. The imported drug need not be accompanied by the corresponding certificate of analysis.

II A.3 Recommendations.

II A.3.1 Essential steps for quality control.

The quality control of imported drugs will involve the following steps:-

1) Registration

2) Quarantine and control at the port of entry

3) Regular periodical Inspection of stocks at various outlets

4) Analysis of random samples picked up by the Inspection staff.

II A.3.1.1 Registration.

Mr. Milner, in his report, has reviewed the present system and identified the problem areas.

He recommended improvement in two stages.

1) Steps to be taken as soon as possible. The changes suggested are mostly in the areas of procedural details and are internal matters.

2) Steps to be taken at an appropriate time ensuring a smooth change over from the present system to the new one. The ministerial resolution No.143 of 1975 lays the terms and conditions governing drug registration and prices, (Appendix II A-2) which, inoludes the perquisites and enclosures which were to be produced with the application for registration. The recommendation is for revising and extending the present regulations so as to cover the following additional information.

   a) Clinical use: a clear statement should be required from the manufacturer as to the recommended clinical use of the product. At the present time this is required only in the form of a package insert or label.

   b) Dosage schedules: these should be clearly stated apart from the information given on the package insert. They should also include reference to particular age groups i.e infants, children, adults.

   c) Side effects: present regulations specify that side effects be stated on the package insert. This should be extended to specifically include contra indications, warnings precautions in use, symptoms of overdosage and recommended treatment including any antidotes.

   d) The manner in which the names of ingredients are to be stated should be specified; that is whether the international non-proprietary name, pharmacopeia name or chemical name.

e) Details should be required of the total formulation of the produot including any solvents or vehiole; colour or flavour or perfume. Present regulations require only a statement of active ingredients.

f) Brief details of the method of manufacture.

g) Specifications and analytical procedures for controlling the raw materials used in the formulation and the finished product.

h) Details should be given of the researoh carried out to determine the bio-availability of the formulation.

i) In the case of product for topical use details of possible systemic absorption should be given.

j) Results of the stability tests carried out for the formulation.

k) Shelf life and storage conditions. If the product contains ingredients whose action is not known then flowing further informations should be provided.

l) Toxioity - Results of toxicity studies inoluding effeots of long term administration. Indication should also be given of any known or postulated effect on the foetus.

m) Results of clinical trials carried out with the formulation.

Much of the above information is already being submitted by some manufaoturers. But it is recommeded that revised regulations should be made applicable to all re-registration of produots and as well to new applications received after middle of 1978.

II A.3.1.2 Quarantine and control at the port of entry.

Invoices of all incoming consignments should have the certificate of analysis from the manufacturer for all the batches included in the consignment. If the manufacturer is unknown to the Supreme Board then Supreme Board should ask for, during registration and subsequent importation, certificates from the responsible health authorities of the exporting country in standard forms prescribed by WHO in their suggested certification scheme on the quality of Pharmaceutical Products in International Commerce (Appendix II A-3).

Anylytical reports together with the specifications and method of analysis (required to be given with the registration documents) will be found useful for the proposed training of the drug analysts in the cental Public Health Laboratory. On arrival the drug should be put in quarantine at the port of entry. Suitable ware house with cool store facilities will have to be built for this purpose. Supreme Board should have inspection staff at all important port of entry. Customs will release the drug to the consignee only after obtaining clearance from the Inspector with regard to the quality of the drugs.

If the Inspector has any doubt about the quality of the drug he will take samples as per procedure laid down. One sample will be sent to the quality control laboratory of the Supreme Board. The stock will remain in the quarantine until the sample has been found to be of required quality.

Check list for controlling the drug at the port of entry.

In the normal course the Inspector should check:

(a) that all outer containers are in good condition and that the labels are legible;

(b) that all outer containers are properly labelled with the name of the product, name of the manufacturer, country of origin, date of manufaoture, date of expiry if any and batch number.

The batch number should tally with the batch number mentioned in the invoice and certificate of quality control;

(c) that the drug has been imported as per the condition of the license and from the proper source;

(d) that the labels and cartons of the individual pack (inside the outer container) have not become soiled during the transit.

(e) that all information e.g description of the product, batch No, date of manufacture, date of expiry etc. appearing on the labels of the inner most container or packet and those appearing on all the outer wrappers or containers are identical in all respect.

Although not directly connected with the quality control, it is recommended that all import licenses issued should have a validity period with in which the drugs will be required to be despatched. This will prevent the importer from creating an artificial shortage of drugs. During shortages, the authorities controlling quality are usually under pressure to relax their control measures.

II A.3.1.3 Inspection.

At present there is no separate inspection staff under Supreme Board. Senior officials from the Supreme Board and Medical supplies department manages to visit the drug stores as and when possible. There are more than two hundred drug stores and pharmacies in the country. Very few of them have qualified pharmacists. For the first time, this year, (1977) registration certificate are being issued to the existing drug stores by the Ministry of Health and no new drug store will be allowed to open without prior approval from the Ministry. Initially the certificate has been made valid for one year.

It is recommended that three pharmacists are employed exclusively for inspection. One in Sana'a, one in Taiz and one in Hodeidah. The one in Hodeidah can also be made responsible for controlling drugs imported through this port. Inspectors will be required to visit all outlets for drugs in the country such as warehouses and drug stores (wholesale and retail); warehouses and pharmacies attached to hospitals, to ensure that the drugs are genuine and are stored under proper conditions. The inspectors will be required to send their reports in a prescribed form (Appendix II A.4) to the Supreme Board and also to write their inspection report in a visit book kept in all premises they will visit.

The inspectors will visit the hospitals where pharmaceutical products and transfusion fluids are made and report on the facilities available and procedures followed for the manufacture.

Storage of drugs.

It may not be out of place here to emphasise that stability of many of the drugs depend on their storage condition. The available facility with the Ministry of Health is not satisfactory. The authority is aware of this fact and has a plan to construct suitable storage facilities for the drugs and medical appliances received by them. While budgeting for such a warehouse the cost of racks, pallets and pallet trucks should be taken into account. Racks will make better utilisation of the height of the warehouse. All stocks removed from cases should be arranged on the racks. If the warehouse is large then each position of the racks should be numbered. While placing the stock on the rack, the "position number" should be noted in the stock card for easy location of the stock when needed. All stocks should be issued on first come first go basis.

Products sensitive to emperature should be stored at the recommended temperature.

Narcotics and dangerous drugs should be stored separately under lock and key and separate stock register has to be maintained as per the provisions of the law.

All date expired stock should be removed from the shelf. For non dated products the stock should not be issued after three years from the date of receipt without getting it checked by the inspection staff of the Supreme Board.

Temperature and humidity of all the important ware houses should be recorded during the year.

Good management of warehouse will reduce breakage due to unnecessary shifting of stocks, labour and supervision cost, detorioration of stocks due to unnecessary long and improper storage and finally it will reduce pilferage. With good management, drugs can be made available promptly when needed in emergency.

The same inspectors will, in future, be required to inspect the pharmaceutical manufacturing units to ensure that the manufacture is carried out following the good practices for manufacture and quality control. They will also check all records maintained by the ware-house, production and quality control departments. While inspecting manufacturing premises the check list given to the participants of the second seminar on pharmaceutical Inspectors held in Bad Nauheim in West Germany during 12th to 25th June 1977 (Appendix II A.5) should prove useful. The General Manager of YEDCO and the Chief of the Medical Supply department of Ministry of Health Y.A.R. attended this seminar.

Role of Inspectors. (1)

It can be thus seen that the role of inspectors is very important in safeguarding the interest of the consumer and in the enforcement of law. They are the eyes and ears of the administration controlling the quality of drugs consumed in the country. In summary inspector has to perform five main functions:

1) Inspection of sales and manufacturing premises and hospitals.

2) Collection of samples.

3) Surveillance.

4) Investigations.

5) Prosecutions if necessary.

Responsiblities of inspector. (2)

The inspector, as a representative of the administration carries oonsiderable responsibility. He visits dootors, dealers and consumers, competence of the administration is judged by his behaviour and performance.

Inspector must be accurate in reporting facts observed by him. he must give close attention to the pertinent details because action is initiated on the basis of his report.

He should not disolose the facts learned during the course of his duties.

He should not accept any favour or gratuties from the industry or trade.

Training of Inspector.

It is obvious that inspector cannot do his functions effectively without suitable training. Some knowledge of law is essential in framing evidences for prosecution. As there is no scope of giving such training in YAR, it is recommended that at least one inspector is given on the job training in a country where Drug Control administration has been functioning effectively.

Sampling procedure. (3)

The main points can be summarised as follows:

1) The person from whom sample is drawn has to be intimated.

2) The sample is to be divided in two equal parts. One is to be sent to the quality control laboratory of the Supreme Board and other to be retained by the inspector.

3) Samples must be properly sealed with an official seal to avoid accidental or international tempering. The party from whom sample has been drawn should be allowed to put his seal on the sample if he desires to do so.

4) A fair price is to be paid for the sample drawn.

II A.3.1.4 Analysis of samples.

At present there is no facility for testing samples. A new Central Public Health Laboratory for the Ministry of Health is under construction and the building is expected to be ready by the end of 1977. This project is being financed by the Kuwait Government. Technical support is being provided by WHO. This laboratory will have a wing for drug analysis. Suitable staff will have to be trained for carrying out analysis (see recommendation under training in Section V).

(1), (2), (3) Proceedings of the WHO seminar on good manufacturing practice held in Bombay in 1969.

It is recommended that a pharmacist is made in-charge of the section for Drug Analysis in Central Public Health Laboratory. Functionally he should be under the control of the Supreme Board for Drugs and Medical Appliances.

If the Supreme Board is responsible to check the quality of all drugs consumed in the country; it is imperative that they should have their own inspection staff and testing facilities. The drug testing laboratory should have its own microbiological laboratory. Only for diological testing, the facilities available at the Centre can be made use of.

SECTION II B

II B.1 Review of the quantity of drugs consumed in the country.

No statistics are available on the consumption of drug in the country. Since 1976 statistics are being maintained by the Supreme Board on the value and quantities of drugs for which import licences have been sanctioned by the Board. For the purpose of this study it will be assumed that the value and quantities of drugs for which importation has been sanctioned in 1976 represent the total import and consumption of the same year.

Based on this assumption total value of drugs received in the country through known sources was approximately 60 million Y.R. (Yemeni Rials). A sizeable quantity of drugs also come through the open border. It can be assumed that this will continue to be so until the prices of the drugs available in the country can be brought down to the level at which they are available in the neighbouring country.

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Mention of firm names and commercial products does not imply the endorsement of the United Nations Industrial Development Organization (UNIDO).

At present there are three main importing agencies. 1) Trade which includes the YEDCO. 2) Ministry of Health. 3) Hospitals managed by outside mission (e.g. Kuwait Hospital). In 1976 the value of import through trade was 52 million Y.R. out of which YEDCO's share was 30%. The values of import by the Ministry and the hospitals were 3 million Y.R and 6 million Y.R respectively. In 1977 the importation through trade is going up by 18% out of which YEDCO's share is likely to be 40%. Ministry of Health has doubled its budget. The consumption of hospitals is likely to go up by 15%.

II B.2 Projection upto 1981.

Projection of consumption for future years cannot be based on the value of the imported drugs. The cost of drugs in YAR is high and consequently the value gets inflated. Attempts are being made to reduce the prices of drugs in the coming years. Projection therefore has to be based on the various formulations imported during 1976. On the other hand projection made only on the basis of one year's consumption will not be reliable. For this reason attempt has been made to identify the various factors which determine the drug consumption of a country and to examine their relevancy with respect to YAR in relation to other Arab countries.

II B.2.1 Factors influencing drug consumption

1) Population and its rate of increase
2) National income
3) Number of hospital beds and physicians available
4) Role of Government in the field of public health (Health Insurance Schemes)
5) Age structure of population
6) Local production of pharmaceuticals
7) Cost of drugs.

II B.2.1.1 Population and its rate of increase

The following table gives the population and the rate of increase for the Arab countries:

State	Estimated population in (1000's)	Rate of Increase
Syrian Arab Republic	7346	3.3
Lebanon	3244	3.1
Jordan	2745	3.2
Iraq	11124	3.3
Kuwait	963	5.2
Bahrain	275	5.4
Qatar	144	5.3
United Arab Emirates	251	5.3
Oman	765	3.0
Democratic Yemen	8929	2.9
Yemen Arab Republic	1636	2.7
Libyan Arab Jamahiriya	6524	2.7
Somalia	3193	2.8
Sudan	17759	2.5
Egypt	37232	2.24
Libya	2451	4.2
Tunisia	5612	2.4
Algeria	16753	3.2
Morocco	17311	3.04
Mauritania	1301	2.2
Total	145558	Average: 2.79

Source: "Arab Pharmaceutical consumption and Industries".

Brief report made for ACDIMA

From the above table it can be seen that the increase of population in YAR, though compares favourably with the average increase in the world, is one of the lowest among the Arab countries. Considering the fact that about 1.2 million out of 6.5 million stays out of the country and more or likely to go in search of jobs, the increase in consumption due to increase in population is not likely to be substantial.

II B.2.1.2 National Income

In most part of the world consumption of drugs is closely related with per capita income. During the initial stage of development of a country the per capita consumption of drugs as a percentage of per capita income, increase along with the increase in per capita income. This increase is sustained until the per capita consumption reaches a peak and then it starts declining. Following the same pattern the per capita consumption of drug as a percentage of per capita income is now highest in Japan and is much more than that of U.S.A. (see graph - appendix II B.1).

In YAR per capita income is US$ 120 p.a. 90% of the population engaged in agriculture can barely sustain themselves. Literacy barely exceeds 10%. Thus YAR is one of the least developed country in the world.(1)

The present government has been taking several steps to improve the economy of the country but the situation is not likely to change significantly by 1981.

(1) National Health Programme 1976/77 - 1981/82
YAR Ministry of Health August 1976

II B.2.1.3 Number of hospital beds and physicians available

The following table illustrates that the per capita consumption of drug appears to have some relation with the number of hospital beds and physicians available.

As per statistics of 1975

Country	Per capita Consumption in dollar	Number of physicians per 10,000 population	Number of hospital beds per 10,000 population
Libyan Arab Jamahiriya	17	10.6	41
Qatar	16	8.8	52
Lebanon	10	6.2	37
Morocco	5.5	9	10
Egypt	5	7.8	21.5
Tunisia	3	2.3	29
Jordan	3	4.9	8.7
Sudan	1.5	1.0	10

The following table gives the comparative figures for number of physicians and number of hospital beds available in YAR in relation to other Arab countries in 1975.

States	Population in 1000's	No of physician per 10,000 population	No. of hospital beds per 10,000 population
Kuwait	963	11.5	47.0
Libyan Arab Jamahiriya	2451	10.6	41.0
Qatar	144	8.8	52.0
Morocco	17311	9.0	10.0
Egypt	37232	7.8	21.5
United Arab Emirates	251	7.8	60.0
Bahrain	275	6.5	36.0
Lebanon	3244	6.2	37.0
Jordan	2745	4.90	8.7
Iraq	11124	3.70	19.8
Syrian Arab Rep.	7346	3.70	10.2
Saudi Arabia	8929	2.60	10.6
Tunisia	5612	2.3	29.0
Oman	765	1.80	12.5
Algeria	16753	1.80	27.0
Sudan	17759	1.0	1.0
Democratic Yemen	1636	0.90	9.0
Somalia	3193	0.80	17.0
Yemen Arab Rep.	6524	0.57	5.0
Mauritania	1301	0.60	3.8

Source: "Arab Pharmaceutical consumption and Industries"
Brief report made for ACDIMA.

Here again it is clear that consumption is not likely to increase unless some thing is done to improve the medical facilities available to the people.

II B.2.1.4 Role of Government in the field of public health

This seems to be the most important factor influencing the drug consumption in many Arab countries. In the Arab countries where health insurance scheme has been introduced; per capita consumption of drugs has been noticed to increase to double or triple. In countries, where no such system exsists increase in consumption follows the average pattern. (1)

In YAR as mentioned earlier the government is aware that socio-economic development of the country is very much dependent on the state of health of the people. In the five year plan there is an ambitious health programme particularly for the rural areas.

The table below gives the government's objective for the period 1976/77 - 1980/81 for improving the health status of the population.

Objectives and Targets of the National Health Programme.

Health problems Disease problems	Index	Level 1976	Level 1981
Diarrhoeal diseases	Infant mortality	160	140
Respiratory diseases	1000 live birth		
Measles			
Peri-natal diseases			
Whooping cough			
P.C.M			
T.B.	Prevalence rate per 1000	25	20
Malaria	Incidence rate per 1000	20	10
Schistosomiasis	Prevalence rate per 1000	84	55
Maternal diseases	Maternal mortality rate per 1000 live birth	10	8

(1) Arab pharmaceutical consumption and Industries
Brief report made for ACDIDA

Inflamatory eye diseases	Active prevalence rate per 1000 amongst school children.	450	300
Intestinal parasites and dysentry	Prevalence per 1000	850	800
Anaemias	Prevalence rate per 1000	600	550

Source: National Health Programme 1976-77 - 1981/82
Sana'a August 1976

Efforts will be made in two directions -

(a) Improvement in effectiveness of the exsisting facilities by consolidating and strengthening their services.

(b) Creation of new facilities in area where not enough facilities or none exists at present.

The Health programme aims at reducing the present low coverage of the country by building up a net work of services. At the lowest level to serve a set of villages of 2500 people would be the Primary Health Care Unit (PHCU). At the next level, to serve 10,000 population, the dispensary. And highest in the system would be the Health Centre for a population of 50,000. Government's target in these areas is as follows:

Health service units	Present number	Objective number by 1981
Health Centres	27 including Health sub centres	37
Dispensaries	13 with 355 beds	97 each having 25 beds
PHCU	75 rural health units	259
Hospitals	25	31
Hospital beds	2988	3618

Ministry of Health in its plan upto 1981 has given priority in the control of the following diseases.

(a) Malaria
(b) Schistosomiasis
(c) Pulmonary T.B.

Its budget for these diseases is as follows:

Figures in thousand YR.

Disease	1976-1977	1977-1978	1978-1979	1979-1980	1980-1981	Total
Malaria	-	1500	1500	2000	2000	7000
Schistosomiasis	45	63.6	111.3	111.3	111.3	442.5
T.B.	150	315	227.25	357.25	438.75	1488.25

It is obvious that all these activities need the support of adequate number of trained personnel. Both government and WHO is aware of it and priority has been given in Health Man Power training. The following table gives the present strength and additional requirement of Health Man Power by 1981.

Catagory	Present strength	Additional personnel required by 1981
Physicians	366	185
Dentist	18	4
Pharmacist	41	26
Qualified nurses	360	266
Others	1014	2349 *

* Includes professional, intermidiate and auxiliarly levels and field worker.

Source: YAR Ministry of Health, Department of Health Statistics.

For professional personnel YAR depends in meeting its demands on fellowships abroad and on expatriates. According to available information the number of Yemenis who are studying abroad and will finish their study by 1981 is as follows :

In Medicine - 324
In dentistry - 11
In pharmacy - 35

WHO has offered scholarships for study in Medicine - 56 and in Dentistry - 2. For some of the non professional level personnel, training will be given in the Health Man Power Institute which has been functioning since 1972 with the help of UNDP, WHO and UNICEF..

II B.2.1.5 Age structure of population

1975 census indicates that 47% of the population (Average Arab countries 45%) are in the age group 0-14. Consumption of drugs in this age group is normally three times more compared to that of the other age groups.

II B.2.1.6 Local production of pharmaceuticals

It has been the experience in most of the Arab countries that consumption has increased with the commencement of local production of pharmaceutical products because of easier availability and reduced price of locally produced drugs.

II B.2.1.7 Cost of drugs

Within the course of last twelve months Ministry of Health issued two price control orders to regulate the selling price of the imported drugs. The first order became effective from August 1976 and the second from 1st July 1977. Total impact of these two orders is likely to reduce the price of the majority of drugs by about 10%. Reduced price is expected to stimulate consumption.

II B.2.2 Conclusion

It can be concluded from the above analysis that mainly due to government Health Programmes there will be an increasing trend in the consumption of drugs but in the next few years it is not likely to be significantly higher than the average yearly increase because drugs will be required only after the health care services have been established. It can be safely assumed that upto 1981 the yearly increase will be around 20%.

ABSTRACT

Government Health Programme in Yemen Arab Republic (YAR) is very much handicapped because of the high prices and non-availability of the imported drugs. The Ministry of Health is very much anxious to see that at least the essential drugs are manufactured in the country. With this objective in mind the representative of the ministry asked UNIDO's technical assistance for developing Pharmaceutical Industry in YAR. In this connection the writer was deputed as a Pharmaceutical Expert to Sana'a for six months from 31st May to 30th November 1977.

The emphasis of the project has been on determining the most appropriate technology, equipments and manpower training programme necessary for the production of quality drugs in adequate quantities in YAR.

To start with a review has been made of the quality of drugs presently consumed in the country. For all practical purpose all the drugs consumed in the country are imported from outside, yet there is no control on the quality of drugs coming into the country. Different steps involved in the importation and distribution of drugs have been identified and recommendation has been made for introducing adequate control at each step.

Some of the hospitals in Sana'a and Taiz produce a few products including transfusion fluid for the need of the patients attending these hospitals but the production is carried out without proper supervision and under unsatisfactory condition. Recommendation has been made to centralise such production for better supervision and control.

Feasibility of starting an industrial scale production unit has been considered and in that context the following studies have been made:

1) Various steps involved in setting up of a pharmaceutical factory have been enumerated and recommendation has been made about the necessary measures that are to be taken in each step in order to achieve and maintain required standard in quality.

It is recommended that the results of the various government programmes to be executed during this period should be closely followed because the consumption after 1981 will very much depend on the success or failure of these plans.

Based on the figures of the importation in 1976 and taking on yearly increase of 20% the requirement of various pharmaceutical formulations by 1981 works out to be as follows :

Formulation	Unit	Projection for 1981
Tablets	Number in millions	344
Capsules	Number in millions	59
Oral liquids	Number of bottles in million	3.5
Injectable	Number of ampoules in millions	17
Antibiotic vials	Number of vials in millions	11
Ointment	Number of tubes in millions	0.75
Drop solution opthalmic	Number of vials in thousands	120
Drop solution for ear and nose	Number of vials in thousands	256
Drop solution oral	Number of vials in thousands	122
Ointment opthalmic	Number of tubes in thousands	
Value	Y.R in million	150

It will be of interest to compare these figures with the actual production of Egypt in 1976. Production figure of Egypt has been chosen for the following reason:

(1) Egypt and Iraq may be taken to give a representative picture of pharmaceutical sector in Arab countries. The two countries together represent 48% of population, 23% of drug consumption and 55% of drug production.

(2) Percapita consumption in Egypt in 1976 was US $ 5. Average per capita consumption of Arab countries in 1976 was US $ 5.5 and YAR should reach this figure by 1981.

(3) Disease pattern in Egypt and YAR is somewhat similar.

Population of Egypt is 36 million and that of YAR is 6 million Egypt produced 88% of its requirement in 1976. If per capita consumption of YAR reaches $5 in 1981 then consumption of YAR in 1981 should be 1/6 of Egypt's production in 1976.

The interesting facts that comes out of this comparison (Appendix II B.2) is as follows :

Where as value wise YAR's consumption matches that of Egypt in 1978; quantity wise YAR remains far behind. This is because, as explained earlier, the cost of drugs in YAR is higher than that of Egypt and per capita consumption value wise gets inflated.

SECTION III

Technology for production of quality drugs.

It has been reported earlier that no industrial production unit exsists in YAR and that the government is keen to have one. The writer therefore, has recommended various steps that are to be taken while setting up of a new pharmaceutical factory in order to achieve and maintain required standard in quality of drugs that will be produced in the factory.

III. 1 Special features of a pharmaceutical factory.

Attitude of the workers.

By necessity a pharmaceutical factory needs somewhat sophisticated infra structure. One of the important factors in maintaining quality of pharmaceutical products is the attitude of the people working in the factory.

One of the problems faced in developing countries is the unhygienichabits of the workmen. They are used to living under unhygienic condition during the major part of the day and the same people are expected to behave in a different way from the time they enter the factory. This change of behaviour and attitude can only be achieved by providing a distinctly different favourable environment inside and around their place of work. While entering the workers are required to remove their outer clothes, wash themselves clean, and change into clean uniforms provided by the management. This practice also helps in changing the attitude of the workers.

Tidy and clean environment also helps to impress the visiting public particularly the members of the medical profession.

III 2. G.M.P and prevention of defects from happening.

Sophistication in industrial pharmaceutical manufacture has brought in two new developments in the area of quality control:

(a) It has been recognized that for ensuring quality of the finished products, it is essential that the products are manufacturered following good practices in manufacture and quality control.

(b) The emphasis now is on the prevention of defects from happening instead of detection of defects at the end of a job. This is based on the old axiom "It is cheaper to make it right at the first".

The prevention programme have to start, if possible, at the first stage that is during the selection of site and designing of the factory. It is not possible, with best of efforts, to produce pharmaceutical preparations conforming to the present rigid standards unless the production facilities available are of adequate standard.

III 3. Steps involved in the setting up of a pharmaceutical factory.

1) Selection of site
2) Determining the source of water and electricity.
3) Design of the factory.
4) Specification of construction material.
5) Determining the initial product mix.
6) Acquisition of equipments.
7) Supervision of construction.
8) Supervision of installations of equipments.
9) Acquisition of manufacturing formulae, method of manufacture, specifications and analytical procedures for starting materials and finished products.
10) Perchasing of starting materials.
11) Hiringof staff.
12) Training programme before start up.
13) Procedures for production planning, inventory control and warehousing.
14) Quality control system; formats for quality control and manufacturing records.
15) Standards for hygiene and sanitation, good practices for manufacture and quality control.
16) Preventive maintenance.
17) Safety regulations.

Adequate measures have to be taken almost in every step to prvent defects from happening.

III 3.1 Selection of site.

The environment around is clean. It is a dry and not a marshy land. There is a possibility of draining out the waste water from the factory. Site is not close to the factory producing or handling toxic materials like pesticides. There is enough land available for future expansion.

III 3.2 Source of water.

Water is the most important raw material for a pharmaceutical factory. Good water in adequate quantity should be available. If the water contains lot of minerals then cost of treatment of water is taken into account while budgeting for the factory.

III 3.3 Site plan.

A master plan is made covering the entire available land clearly demarcating the approach roads and inside roads; sewage and waste water disposal system; fire hydrants. Central energy block, expansion zones, scrap yard, incinerator etc. A proper master plan for the site will be useful for a systematic growth of the factory.

It is recommended that receiving and despatching ware-house, engineering warehouse and central workshop, kitchen and scrap yard are situated near the boundary and are approachable by a side road. This will prevent the outside lorries, and people bringing in the materials and provisions from entering inside the factory area.

III 3.4 Design of the factory and specification of construction materials.

While making the plan of the manufacturing area following aspects have to be taken into account:

1) Requirements of good practices in manufacture and quality control (Appendix III 1).

2) Ease of sampling for in-process control.

3) Proper flow of material and adequate intermediate storage facilities to avoid congestion in the manufacturing areas. Congestion may result in confusion and mixups.

4) Quick flow of material through the production line.

5) Better house keeping with less efforts.

6) In built flexibility for future expansion.

7) Separate washing places for washing of small equipments and empty containers.

8) Separate place near the manufacturing area for cleaning, changing parts, minor repair and routine overhauling of of movable machines.

Some of the important recommendations for designing a factory can be summarised as follows:

Ceiling: Manufacturing and packaging area have suspended ceiling with in-built or recess lighting. Surface should be smooth for easy cleaning. Height of the ceiling 4 meters. In the tablething section, material handling for large volume production becomes easy if the ceiling height is kept at 6 meters.

Energy lines: Lines for water, steam, electricity and compressed air, air conditioning and ventilation ducts are carried inside a 2 meter mezzanine floor situated on the top of the manufacturing area. The energy lines are brought through the ceiling downwards where they are needed. In this system (a) the maintenance, alterations and additions in the energy and ventilation lines can be carried out easily with comparatively less interruption of the manufacturing activities. (b) Settling of dust on the energy lines is considerably less.

Flooring: Flooring is made of seamless synthetic covering placed directly on the concrete. It is convenient if the flooring is laid before setting of the partition wall.

Side and partition wall: These have smooth surface and oovered with washable paint or synthetic material. It will be convenient for making alterations in the room size if the partition walls are designed as modular system. Fittings and furnishing are of such material which permit efficient cleaning of all surfaces and prevent migration of dust.

Air handling system -

The entire manufacturing area has the provision for artificial ventilation with supply of clean air to avoid contamination from outside. Windows in this area will not be allowed to be open unless in emergency.

The air-handling system is so designed so as to avoid cross contamination within the manufacturing area. The following areas have efficient exhaust system without recirculation of air:

1) Entire tabletting section.
2) Central weighing room.
3) Syrup manufacture.
4) Capsule filling and closing (hard gelatin capsule).
5) Bottle washing.
6) Ampoule washing and drying.
7) Autoclave for sterilizingampoules.

The following areas have no recirculation of air and have negative pressure compared to other areas so that material from these areas cannot enter to the adjacent areas.

1) Areas where antibiotics or other potent substance are processed.
2) Microbiological laboratory.

Design of a warehouse for starting materials:

In pharmaceutical production warehousing of starting materials is an integral part of the manufacturing process. Hence the proper designing of the warehouse is as important as that of the manufacturing area.

The ware house should be of even height. If necessary the roof is insulated to keep the ware house cool. It should be dry, well lighted and properly ventilated. Floor is constructed of suitable material so as to stand movement of heavy materials and the surface is smooth enough to permit proper cleaning. Openings are covered with suitable mesh to prevent birds coming in.

Proper cool store facilities is provided for storing heat sensitive substances.

The quarantine area is physically separated from the rest of the ware house by suitable partition.

There is some advantage if the floor of the ware house is kept at the road level. In this system the unloading of materials from the lorries is somewhat difficult but subsequent movements of materials to the manufacturing area is very easy. The cost of construction of the ware house is considerably less.

Design of the area for services like changing rooms, toilets and canteen:

The servioes are provided in an annex linked to the production building so that the services are situated outside the production area yet the workman can reach them without coming in the open. It is recommended that the food is not cooked in the canteen. The kitchen should be situated at a distance from the production building.

III 3.5 Acquisition of equipments.

The selection of right equipments suitable for the intended volume of production is not easy and needs considerable experience. As per the recommendations of the good practices in manufacture and quality control "Manufacturing equipment should be designed and maintained in such a way as to:

1) be suitable for its intended use;

2) facilitate thorough cleaning where ever necessary;

3) exclude any contamination of drugs and their containers during manufacture;

4) minimise the risks of confusion or the omission of processing step such as filtration or sterilization".

All parts coming in contact with the processing material should be made of stainless steel.

The following equipments seen in Egypt during the visits to various factories arranged by ACDIMA and Council of Arab Economic unity will be of interest to the proposed project in YAR.

	Name of the equipment	Location
1)	Draiz planetary type wet mixer for granulation; capacity 50kg.	Alexandria factory
2)	Prewitt oscilating granulator with variable speed.	Hoechst factory
3)	Jagenberg semiautomatic labelling machine for bottles.	Hoechst factory
4)	Uhlman strip sealing machine with attachment for automatic feeding for capsules.	Nile factory

	Name of equipment	Location
5)	Bonapace semiautomatio machines for filling and closing of hard gelatin capsules.	Alexandria factory
6)	Strunk semiautomatic ampoule washing machines.	Alexandria factory
7)	SP8 - 46001 automatic piston type liquid filling machine.	Kahira factory
8)	Manesty - Boots dust remover for tablets.	Almost all factories
9)	Thermocompressor type distilled water manufacturing unit.	All the factories

As far as possible the equipments are not grouted on the floor but placed either on wheels or on suitable pallets so that they can be moved when required.

III 3.6 Acquisition of manufacturing formulae, method of manufacture, specifications and analytical procedure for the starting materials and the finished products.

Manufacturing formulae and method of manufacture:

The writer and his counterpart Dr. Salem visited Cairo and Alexandria from 5th to 13th of August. Dr. Shawky and executives of ACDIMA arranged visits to the factories of the Nile, Kahira, Alexandria (all Egyptian government concerned) and Hoechst. Discussion were held with responsible persons of these factories. In Alexandria ACDIMA also arranged a meeting with Dr. Taher Habib El-Robei, the Chairman of the Samara pharmaceutical factory in Iraq and the vice president of ACDIMA. Help was assured from the government factories

2) A list of products required to be produced during the first phase has been prepared.

3) A projection has been made for the country's requirement of drugs upto 1981 and from this the initial production volume for different formulations have been worked out.

4) A list of suitable equipment and accessories that will be necessary to achieve the required volume of production and to maintain the requisite standard in quality has been made.

5) Requirement of technical personnel at various level of the organization and their profile have been established and suitable training programmes for different level of personnel have been recommended.

6) Finally the strength and weakness of YAR with respect to starting a pharmaceutical factory have been identified and based on these recommendation has been made that YAR at this stage should start a production unit in a modest scale and refrain from starting something with heavy capital investment.

and also from the Samara factory in the form of manufacturing procedures and training of personnel. There will be no problem in transfer of technology with respect to generic and pharmacopoeial products. With respect to specialities suitably arrangement either on the basis of royality or manufacture under licence will have to be made.

The Egyptian factories manufacture wide range of pharmaceutical products in large quantities. They also make specialities for many of the reputed multinational comapnies. The country meets 88% of their requirement from local production; as such they are well conversant with manufacturing techniques. The layout, air handling, material flow and good practices in manufacture and quality control in the three government factories, however, cannot be considered to be satisfactory.

Specifications:

Drawing up of specifications for all starting materials and finished products is very important.

In YAR at the initial stage almost all the starting materials will have to be imported. To avoid complications and upsetting the inventory level it is important that all materials received are of required quality. And this is not possible unless the specifications of the materials ordered are clearly defined while placing the purchase orders.

Standards for most of the raw materials are universal and can be found in pharmacopoeias or other reference books but same is not applicable to packaging materials. Specification for packaging materials has to be drawn up taking into consideration:

1) the nature of the products to be packed;

2) the type of the machine to be used;
3) climatic condition of the country where the product will be consumed;
4) Expected shelf life of the product;
5) profit margin of the product and
6) finally the quality of packaging material available in the country. It is a difficult job and the quality control manager should give enough importance to this matter during his training period.

The importance of specifications for finished product has been adequately stressed in the "Principle of Pharmaceutical Quality Control" (Appendix III 2). It says "In order to ensure that all batches of a given drug are equally efficacious and safe it is essential to establish adequate specifications for the drug and its dosage forms. The desired quality can then be achieved by strict adherence to these specifications". "The aim of the quality control is to achieve sustained and uniform manufacture of products of defined quality. The essential factors in this respect are product quality, specifications and production control".

III 3.7 Hiring and training of staff.

In any organizationthe most important resource is its men. It has been mentioned earlier that the quality control calls for a team work of people from various departments. Hiring personnel and their training should receive its due importance from the management.

The profile of the personnel required for a pharmaceutical industry and their training needs has been delt separately in section V.

III 3.8 Warehousing.

As has alreaay been said warehousing is an integral part of manufacturing operation and in process control starts with the arrival of the starting materials in the warehouse.

Warehouse is maintained in a clean and orderly condition free from insects, accumulated debris and waste.

Every material on arrival is placed on pallets and thereafter moves on pallets. Special cages (made of wire mesh) built on pallets have been found to be useful for storing many of the packaging materials and particularly printed materials like lables, cartons, literatures, outer boxes etc. Normally they are received in bundles wrapped by papers. At times during movements the wrapper is torn and the bundle gets loose. There is always a chance of mix up unless these bundles are placed inside a cage.

All materials on arrival are suitably labelled and kept in quarantine until approved by quality control. Damaged and leaky containers are to be handled carefully to avoid cross contamination. The stocks are kept in such way that the sampler can conveniently take sample from each container.

All rejected, obsolete and date expired stocks are kept in a separate place alloted for the purpose.

All materials are issued on 'first come firstgo' basis unless instructed otherwise by the quality control. All containers should be in clean condition before they are moved to the manufacturing area.

III 3.9 Quality control system: formats for production and quality control records.

Quality control system:

Main points of the quality control system, recommended in the "Good practices for Manufacture and Quality Control of Drugs" can be summarised as follows:

1) The quality control department should be autonomuos in the areas of responsibility assigned to it.

2) The department controls all starting materials, monitors the quality aspects of manufacturing operations, controls the quality and stability of the finished products.

3) Quality control department should be promptly informed of all changes and modifications in the manufacturing procedures and relevant instructions.

4) The department maintains adequate analytical records concerning the control of each batch of drugs manufactured.

5) The department is responsible for the full examination of returned drugs and determins whether such drug should be released, reprocessed or destroyed. Adequate records of the disposition of such drugs should be maintained.

The quality control department now is also responsible to control bio-availability of the formulation whereever applicable.

Samples (in the original pack offered for sale) from each batch of all products are retained by the quality control department as reference samples.

Shelf life study:

At the initial stage of production, samples from every regular production batch are kept for shelf life studies. During the study the samples are stored in the worst climatic condition at which the product is likely to be stored for most of the time in the drug stores and hospitals. Once the quality control department is satisfied with the stability of a particular product the frequency of the study is reduced and finally only random samples are kept for shelf life study.

Drug recalls:

Even with the best of controls, drug recalls cannot be altogether ruled out. The despatch section, therefore, maintains adequate records of despatches so that if necessary, all unsold stocks of a particular batch of a product can be withdrawn from sale.

Manufacturing records:

Manufacturing records for every batch are maintained as per the procedure recommended in the 'good practices for manufacture and quality control'.

III 3.10 Standards for Hygiene and Sanitation Premises

Manufacturing premises is maintained clean and in an orderly condition free from accumulated waste and insects. There are no open drains in the production area. Good practices for Manufacture and Quality Control recommends that a written sanitation programme is made out indicating areas to be cleaned, cleaning intervals, cleaning procedure, cleaning aids to be used and the personnel responsible for cleaning.

It is recommended that all free land within the factory are covered with grass or suitable vegitation. Tall leafy trees are planted along the boundary and within where ever possible. These measures will reduce dust.

The scrap yard is clearly demarcated and is away from the manufacturing area. Any waste which is likely to attract insects and stray animals are disposed off promptly.

It pays to have some order in the scrap area. Well sorted scrap bring better return.

Personnel:

All employees are medically examined before appointment and thereafter once in a year. The girls who are required to do visual inspections are tested also for their eyesight.

On arrival all personnel engaged in the manufacturing and packaging areas proceeds to the central changing room, remove their outer clothings, wash themselves clean and put on clean uniforms issued to them. Uniform includes washable foot-wear. Hair is completely covered with suitable washable or disposable caps (for men) or scarf (for women). Those who work in the injectable section are required to change again or put on an overall before entering the filling and sealing room.

"Eating, smoking and unhygenic practices should not be permitted in the manufacturing areas".

III 3.11 Good Practices for Manufacture and Quality Control.

Standard for such practices cannot be universally applicable and are required to be flexible depending on the available facilities provided that the minimum is done. At the initial stage it will not be possible to achieve the desired objectives in all respects. The quality control department, however, has to be persistantly vigilant and should gradually lead the organization to perfection.

III 3.12 Preventive maintenance.

Best of equipments will not produce consistantly quality products unless they are maintained properly. There should be good inventory control for spare parts so that wornout parts can be promptly replaced. While calculating the capacity of a machine or making the production plan unavoidable down time for routine maintenance has to be taken into account.

SECTION IV

List of equipments required to achieve the yearly production volume for the first phase.

The volume of production for different formulation was decided during the meeting held between 16th to 20th July (see paragraph I.4.1.)

IV 1. Intended volume of production:

Tablets - 400 million per year
Coated tablets - 25 million per year
Hand gelatin capsules - 40 million per year
Oral liquids, No. of bottles - 5 million per year (mostly 100 ml).
Ointment, No. of tubes - 5 million per year
Drop solution, No. of vials - 4 million per year
Suppositories - 1 million per year
Injectable, No. of ampoules - 15 million per year

Note: The capacity of the equipments have been calculated on the basis of one shift of 8 hours working per day and 300 working days per year.

IV 2. Requirements of equipments.

IV 2.1 Requirements of equipments for tabletting section.

	Type of machine	Number required
(1)	Sifting machine For sifting powder like starch, talcum powder etc. Capacity approx. 200kg/hour.	One
(2)	Comminuting machine - With suitable sieves, for pulverising sugar, calcium gluconate etc. and also for dry sifting of granules (similar to fitz mill).	One

	Type of machine	Number required
(3)	Planetary mixer For wet mixing of powders for granulation capacity of the mixing vessel - 125 litres (working capacity for approx. 100 kg mass).	One
(4)	Planetary mixer Working capacity - 50 kg mass.	One
(5)	Oscilating granulator - With variable speed, sieves of different size, made of perforated stainless steel or plastic wiremesh and not of stainless steel wire mesh.	Two
(6)	Hot air oven - With two trucks having 20 - 24 stainless steel trays in each truck. Working capacity 100 kg of dried granules; heating with steam and electricity.	Two
(7)	Fluid bed drier - Designed to have required safety measures, heating with steam; capacity 100 kg.	One
(8)	Stainless steel Blender, double cone or 'V' type - For mixing granules with lubricating agents. Working volume 200 litres. (Working capacity about 200 kg of granules).	One
(9)	Blender similar to No.8 - Working volume 100 litres.	One

	Type of Equipment	Number required
(10)	Rotary tablet compressing machine - Capacity 30,000 to 40,000 tablets per hour (Dies and puches to be decided later)	Two
(11)	Rotary tablet comparessing machine - Capacity 80,000 to 100,000 tablets hour (Dies and punches to be decided later)	Two
(12)	Dust remover for tablets - For removing dust from tablets as they come out of the compressing machines.	Four (One for each tablet compressing machines)
(13)	Visual inspection belt - For inspection of tablets and coated tablets.	Three
(14)	Hot water bath - About 30 cm diameter for making granulating solution.	Two
(15)	Punch polishing unit -	One
(16)	Aluminium storage tank - Capacity 2000 lit - for storing denatured spirit or Isopropyl alcohol required for granulation.	One
(17)	Pump with flame proof motor - For pumping alcohol.	One

IV.2.2. Requirement of equipment for tablet coating section.

	Type of Equipment	Number required
(1)	Stainless steel coating pan - Complete with hot air supply and exhaust system. Capacity 100 kg of tablet cores.	One
(2)	Stainless steel coating pan - Similar to No 1. Capacity 50 kg of tablet cores.	One
(3)	Polishing Drum - For polishing coated tablets capacity 100 kg of coated tablets.	One
(4)	Room dehumidifier - For the dehumidified room of the coating section.	Two
(5)	Stainless steel pan - Electrically heated, with tilting device or bottom outlet. Capacity 25 lit for making sugar syrup for coating.	One
(6)	Portable high speed stirrer, medium size - For mixing colour or talcum powder in sugar syrup.	One
(7)	Stainless steel storage tank - Side or bottom outlet. Capacity 100 lit, for storing syrup.	One

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Note: If conventional sugar coating is replaced by film coating then item No 5 and 7 will not be required.

IV 2.3. Requirement of equipments for the in process control in the tableting and coating section.

	Type of Equipments	Number required
(1)	Weighing machine dial type - Capacity 200 kg.	One
(2)	Weighing machine dial type - Capacity 25 kg.	One
(3)	Balance - For checking average weight of tablets	Three
(4)	Monsanto hardness tester for tablets -	Two
(5)	Vernier Callipers -	One
(6)	Apparatus for testing friability of tablets -	One
(7)	Apparatus for testing disintegration time for tablets -	One
(8)	Magnifying glass -	Two

IV 2.4. Requirement of equipment for oral liquids and drop solution

	Type of Equipments	Number required
(1)	Stainless steel syrup kettle - Jacketed for heating with steam or cooling with cold water, suitable for applying pressure (about 1kg) or vacuum; fitted with high speed stirrer (flame proof) motor), thermometer, deep stick for measuring volume, bottom out let, working capacity 1000 lit; for making syrup and suspension.	One
(2)	Stainless steel jacketed pan - Jacketed for heating or cooling; bottom outlet, working capacity 250 lit, for making auxiliary solutions for syrup or suspension.	One
(3)	Stainless steel solution kettle - Suitable for applying pressure (about 0.5kg) or vacuum, fitted with high speed stirrer, deep stick. For making drop solution working capacity - 100 lit.	One
(4)	Portable high speed stirrer medium size -	Two
(5)	Turbine homogenizer - with variable speed for batch size 250 lit.	One

(6)	Filter press - With stainless steel plates capacity for normal syrup 500 lit par hour.	One
(7)	Stainless steel transfer pump fitted with flame proof motor.	Two
(8)	Milipore filter unit - 316 mm diameter for filtering drop solution.	One
(9)	Stainless steel mixing tank - suitable for applying pressure or vacuum fitted with high speed stirrer (flame proof motor) bottom outlet. capacity 2,000 lit.	One
(10)	Stainless steel mixing tank similar to No.9 capacity 1000 lit.	One
(11)	Stainless steel storage tank similar to No.9 but without stirrer capacity 2000 lt.	One
(12)	Stainless steel storage tank similar to No.9 but without stirrer capacity 1000 lit.	One
(13)	Stainless steel portable vessel suitable for applying pressure or vacuum capacity 25o lt.	One
(14)	Stainless steel portable vessel similar to No. 13 capacity 100 lt.	Two

	Type of equipments	Number required
(15)	Weighing machine dial type capacity 200 kg.	One
(16)	Weighing machine dial type capacity 25 kg	One
(17)	Hydrometer for checking specific gravity of syrups.	Two

IV 2.5. Requirement fo equipments for capsule.

(1)	Stainless steel blender double cone or 'V' type capacity working volume 100 lit for mixing capsule mixture.	One
(2)	Automatic hard gelatin capsule filling and closing machine capacity 20,000 capsules/hour.	One
(3)	Room dehumidifier for dehumidifying the filling room -	One
(4)	Small vacuum cleaner.	One
(5)	Visual inspection belt for inspecting filled capsules.	One
(6)	Balance for checking fill weight of the capsules.	One

IV 2.6. Requirement of equipments for ointment.

	Type of equipments	Number required
(1)	Mild steel steam jacket pan working capacity 100 kg for melting waxes.	One
(2)	Stainless steel planetary mixer variable speed, working capacity of the mixing vessel 125 lit for incorporating powders in to the molten base.	One
(3)	Stainless steel homogeniser (colloid mill type) jacketed for heating with hot water or cooling with cold water.	One
(4)	Stainless steel turbine homogenizer with variable speed for batch size 25 litre.	One
(5)	Stainless steel slow speed stirrer (about 50 revolution/minute) medium size.	One
(6)	Mild steel transfer pump for transfering molten base.	One
(7)	Stainless steel cylindrical storage containers	
	capacity 125 lit	Four
	" 50 lit	Two
	" 30 lit	Two

	Type of equipments	Number required
(8)	Hot air sterilising oven with supply of filtered cool air for cooling the oven after sterilisation, capacity to hold four to five thousand collapsible metal tubes of 4 gram capacity, for sterilising empty metal tubes for opthalmic cintment.	One
(9)	Semi automatic oitment filling machine should close, crimp and emboss batch number on the closed tubes capacity 1500 tubes/hour.	Two
(10)	Weighing machine dial type capacity 200 kg	One
	(1) weighing machine dial type capacity 25 kg.	One
	(2) Balance for checking fill weight of the ointment tubes.	One

IV 2.7. Requirement of equipments for Injectables.

(1)	Semi automatic ampoule washing machine capacity 12000 to 15000 ampoules/hour for washing 1 ml to 10 ml ampoules and 10 ml vials for opthalmic dropsolution.	One
(2)	Conveyor belt 5 meter long for transporting empty ampoules (arranged on washing trays) from the arranging room to washing room.	One

	Type of equipment	Number required
(3)	Drying tunnel with suitable conveyor belt supply of filtered cool air for cooling the ampoule after drying; for drying and heat sterilising the washed ampoules and vials.	One
(4)	Ampoule filling and sealing machine two filling needles, capacity 3000 ampoules/hour size 1 ml to 10 ml.	Four

Note: Ampoule filling and sealing machines can work only 6 hours out of 8 hours shift because the ampoules filled and sealed, must be sterilised on the same day. Filling of ampoules therefore has to stop early.

(5)	Two door autoclave suitable for applying vacuum before letting in steam. Fitted with manometer and automatic temperature recording devise; should have its own vacuum pump capacity being enough to hold 50,000 2ml ampoules for sterilising filled ampoules and drop solution vials.	One
(6)	Stainless steel solution kettle jacketed for applying steam or cold water, mirror finish inside for proper cleaning, suitable for applying pressure (about 0.5kg) or vacuum, fitted with manometer, thermometer deep stick, high speed stirrer, kettle to be emptied through a discharge pipe going upto the bottom of the kettle, no out let at the bottom or at the side. Working capacity - 100 lit for making solution.	Two

	Type of Equipment	Number required
(7)	Round bottom glass flask fitted with stainless steel lid, suitable for applying vacuum or pressure for succing in or pressing out solution from the flask. Flask is protected with a cylindrical stainless steel casing, mounted on wheels. Capacity 25lit, for transporting solution.	Four
(8)	Spare flasks for No 7	Four
(9)	Milipore filter unit 316 mm diameter, for sterile filtration of solution.	
(10)	Lamps for visual inspection of filled ampoules.	Twelve
(11)	Weighing machine dial type, capacity 50 kg.	One
IV 2.8.	Requirement of equipments for packaging of tablets granules and capsules (most of the tablets and capsules are to be packed in strips)	
(1)	Strip sealing machine with automatic feeding attachments for tablets and coated tablets. Capacity 60,000 tablets/hour.	One

	Type of Equipment	Number required
(2)	Strip sealing machine similar to No - 1, capacity 30,000 tablets/hour	Three
(3)	Strip sealing machine with automatic feeding attachment for capsule, capacity 20,000, capsules/hour	One
(4)	Batch printing attachments for strip sealing machine	Five (one for each machine)

Note: Capacity of the strip sealing machines has been calculated on the basis of two shifts working per day.

(5)	Semi automatic counting machine for tablets and capsules.	Two
(6)	Semi automatic counting machine for coated tablets.	One
(7)	Semi automatic heat sealer for polyethylene bags.	Two
(8)	Automatic packaging for granules for pckaging granules in sachets, 50 grams to 200 grams of granules in each.	One

IV 2.9. Requirement of equipments for packaging oral liquids and drop solution.

	Type of Equipment	Number required
(1)	Bottle washing machine Capacity 3000 - 3500 bottles/hour for washing 60ml to 200ml bottles.	One
(2)	Bottle brushing machine for oleaning occasional dirty bottles or bottles for reuse.	One
(3)	Turn table for transferring washed bottle to the filling machine.	Three
(4)	Automatic liquid filling machine 4 to 6 heads piston type, capacity 3500 bottles/hour, size of bottles 60 ml to 200 ml.	One
(5)	Semi automatic liquid filling machine two head piston type for filling bottles of 60 ml to 200 ml.	One
(6)	Semi automatic liquid filling machine Capacity 2000 vials/hour for filling 10ml to 20ml vials of drop solution.	One

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	Type of Equipment	Number required
(7)	Automatic capping machine for sealing bottles with pilferproof caps.	One
(8)	Semi automatic capping machine for sealing bottles with pilferproof caps.	One
(9)	Automatic labelling machine for round bottles, size 60ml to 200ml. Capacity 3500 to 4000 bottles/hour.	One
(10)	Semi automatic labelling machine for round and flat bottles, capacity about 2000 bottles/hour.	One
(11)	Semi automatic capping machine for closing vials of drop solutions.	One
(12)	Automatic labelling machine for ampoules and vials. Ampoule size 1ml to 10ml, vial size - 25-30 mm diameter. Capacity 4000-5000/hour.	One

IV. 2.10. Requirement of equipment for packaging injectables and opthalmic drop solution.

	Type of equipments	Number required
(1)	Inprinting machine for ampoules for ampoule size 1 ml to ml capacity 3000 ampoules/hour.	Three
(2)	Semi automatic liquid filling machine capacity 2000 vials/hour for filling 10 ml vials.	One
(3)	Semi automatic capping machine for closing vials of opthalmic drop solution.	One

IV 2.11. Requirement of general equipments for the packaging section.

(1)	Conveyor table 6 meter long.	Four
(2)	Happa batch printing machine for over printing labels and cartons.	Two
(3)	Leaflet folding machine.	One
(4)	Gluing rollers for applying adhesive on the labels.	Six
(5)	Gum tape dispenser	Six
(6)	Balance capacity - 12 kg for checking weight of the finished packets.	Four

IV 2.12. Requirement of equipments for suppositories.

(1)	Stainless steel jacketed pan working capacity - 25 kg	One

	Type of equipment	Number required
(2)	Portable high speed stirrer suitable for No.1	One
(3)	Automatic machine for moulding suppository in preformed plastic mould.	One

IV 2.13. Requirement of equipments for material handling and central weighing centre.

(1)	Fork lift capacity 3 ton.	Two
(2)	Stacker capacity 1 ton.	One
(3)	Hand operated pallet truck capacity 1 ton.	Six
(4)	Weighing machine dial type	
	250 kg (with large plat-form)	One
	100 kg	One
	30 kg	Four
	4 kg	Four
	2 kg	Four

IV 2.14. Requirement of general equipments for production area.

(1)	De mineralising column capacity 1000 lit/hour	Two
(2)	Distilled water plant Thermocompression Distillation type capacity 200 lit/hour	One

	Type of equipment	Number required
(3)	Stainless steel storage tank for demineralised water capacity 2000 lit	One
(4)	Stainless steel storage tank for distilled water, insulated and with heating arrangement for maintaining the temperature of the distilled water at 80°C. capacity 1,000 lit.	One
(5)	Stainless steel pump for pumping demineralised and distilled water.	Two
(6)	Compressor to produce oil free air capacity 100 m^3/hour, pressure 4 kg.	Two
(7)	Storage tank for the compressed air.	One
(8)	Floor washing machine	One
(9)	Industrial vacuum cleaner with different attachments.	Two
(10)	Fire extinguishers as per the advise of the fire prevention department.	

IV 3. Accessories required for production.

	Type of accessory	Number required
(1)	Aluminium containers	
	50 kg capacity	12
	25 kg	20
	15 kg	15
	for transporting weighed materials from the weighing centre to the manufacturing areas.	

	Type of accessory	Number required
(2)	Aluminium drums capacity about 50 kg of granules for storing granules and powders	50
(3)	Stainless steel buckets	6
(4)	Storage containers for tablets made of plastic or stainless steel or aluminium; suitablly shaped for easy stacking of empty containers.	200
(5)	Cardboard boxes each holding 400 ampoules of 2 ml for storing sterilised filled ampoules, awaiting quality control approval.	2000
(6)	Pallets made of light but strong metal	500
(7)	Stainless steel scoop	
	large	12
	medium	20
	small	12
(8)	Wooden or stainless steel paddle	
	large	3
	medium	3
	small	3
(9)	Stainless steel spatulas	
	large	6
	medium	6
	small	3

	Type of accessory	Number required
(10)	Ampoule washing trays made of aluminium or stainless steel each holding 100 ampoules	150
(11)	Trolley large small for carrying materials and small equipments within the production area.	 8 12
(12)	Trolley for carrying drums	4
(13)	Stainless steel containers capacity 10 lit for taking coating syrup	6
(14)	Large spoons for putting syrup on the tablet cores.	6
IV 4.	Equipments required for quality control laboratories.	
(1)	Electric Shaker	One
(2)	Micro melting point apparatus with microscope.	One
(3)	P.H. meter	Two
(4)	Polarimeter with accessories	One
(5)	Refractometer - Abbe type	One
(6)	Viscometer	One
(7)	Spectrophoto meter U.V and vissible range.	One
(8)	I.R. Sepctrophotometer	One
(9)	Flame photometer	One

Type of equipment	Number required
(10) Colorimeter	One
(11) Electric sensitive analytical balance	Two
(12) Physical balance	Two
(13) Balance, Mettler make 2 or 4 kg capacity	One
(14) Hot water bath - electrically heated	Two
(15) Sand bath	One
(16) Hot air oven for drying washed glass apparatus	Two
(17) Hot air oven small	One
(18) Vacuum oven	One
(19) Muffle furnace about 2000 w. for operating temperature - 1100°C.	One
(20) Laboratory microscope with binocular	One
(21) Karl fissher apparatus	One
(22) Moisture determination balance infrared heating	One
(23) Rotatory evaporator	Two
(24) Centrifuge table type 6000 R.P.M.	One
(25) Disintigration tester	Two
(26) Hardness tester	One
(27) Friability tester	One
(28) Vacuum desicator	Two
(29) High vacuum pump	Two
(30) Refrigerator large size	One
(31) Bunsen burners	Twelve
(32) Heating mantels 500 ml	Four
(33) Magnetic stirrer with hot plate	Two

Special equipments for Microbiological laboratory.

(1)	Laminer flow system	Two
(2)	Membrane filter system	
(3)	Incubator - water heating with thermostat control.	Three
(4)	Hot air sterilising oven temperature range 30° - 200°C.	One
(5)	Hot air oven for drying washed apparatus	Two
(6)	Turbidemeter	One
(7)	Projector (Zone reader)	One
(8)	Microscope with binocular	One
(9)	Refrigerator	One
(10)	Physical balance glass apparatus	One

Note: No provision has been made for a biological laboratory. It is recommended that samples for pyrogen tests are sent to the Central Public Health Laboratory.

The list of equipments for Quality Control Laboratory has been made with the help of Dr. Mahmoud El-Shazly, Director of Research and Quality Control, Nile Company, Cairo.

SECTION V

Programme for training of technicians:

V 1. Levels of technical personnel required for the factory.

1) Factory Manager or Director in-charge of the factory.

2) Production:
   (i) Production Manager - Pharmacist
   (ii) Production supervisors - "
   (iii) Packaging Supervisor - Pharmacist if not available graduate in chemistry.

(iv) Manufacturing male operators
Manufacturing female operators } - skilled

(v) Packaging female operators - skilled

3) Quality control:

(i) Manager quality control - Pharmacist

(ii) Senior Analytical chemist - graduate in chemistry

(iii) Assistant analysts - skilled

(iv) In-process control inspectors - skilled

4) Maintenance:

(i) Chief Engineer - graduate in mechanical engineering

(ii) Electrical supervisor - graduate or diploma in electrical engineering.

(iii) Maintenance mechanic

Auto mechanic
Electrician
Plumber
Carpenter
Mason
} - skilled

An organization for the proposed factory (when in full operation) has been recommended in appendix V 1.

In order to formulate a suitable training programme for any position in an organisation, it is necessary to understand what is expected of a person holding the position by analysing his duties and responsibilities.

For each level attempt has, therefore, been made to draw a profile of the person required to fill up the position and to prepare his job description before recommending the training programme.

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V 2. Training programme.

V 2.1 Training of production manager and production supervisors.

Technical training for both production manager and supervisors will be same. In addition Production Manager should have more training in management.

Profile of a Production Manager or Supervisor.

1) Educational qualification - minimum graduate in pharmacy from a recognised university.

2) Age - for supervisors, below 30 years. Age limit may be retained for the Manager if a suitable person is available.

3) Job knowledge -

   i) Knowledge of the jobs he is expected to supervise.
   ii) Understand under-lying principles of all functions he is expected to carry out.
   iii) Know the correct and safe use of the machines under his control.
   iv) Know safety regulations and antidotes, if any, for the toxic materials used under his control.
   v) Converscent with G.M.P and in-process control.
   vi) If required to handle narcotics and habit forming drugs; he should know the rules covering their usage storage and record keeping.

4) General aptitude.

   i) Has leadership and supervisory qualities.
   ii) Can get along with people.
   iii) Can and like to train people working under him.
   iv) Should have sence of descipline, cleanliness and personal hygiene.

v) Should be safety conscious.

vi) Should be prepared to work with his own hand.

Selection:

No experienced pharmacist is available within the country. As such there may not be much soope of selection, stress therefore has to be given on training so as to develope and make best use of the available talents.

Training needs.

Needs can be classified under four headings.

1) Trainingin general pharmaceutical manufacturing technics.

2) Training in G.M.P and in-process control.

3) Training in the manufacture of specific products intended to be manufactured in the proposed factory.

4) Training in supervisory skill and management technics.

Ideally training in G.M.P and in process control should be along with training in general pharmaceutical manufacturing technics. But if the training in general manufacturing technics can only be arranged in factories where conditions are not ideal for training in G.M.P and in-process control then separate arrangement will have to be made for training in the later.

In any case it is recommended that the pharmacist even before starting his training should carefully read :

1) Principles of Pharmaceutical Quality Control

and 2) good practices in the Manufacture and Quality Control of Drugs.

Formulated by WHO (Appendix III 2 And III 1) and try to understand their implications.

Programme for technical training:

When the construction of the factory has been taken in hand the pharamacist is sent for six months training first in general manufacturing technics and then in the technics for specific products; these training can be conveniently arranged by ACDIMA or the Technical Organ of the Council of Arab Economic Unity in some of the factories in Arab countries. All the products intended to be manufactured in YAR are being manufactured in Egypt and Iraq.

At the end of this training the pharmacist returns to YAR and gets involved in the erection of machines including special air handling system and safety arrangements.

The pharmacists, with their six months training will not be able to start and maintain production at the initial stage without the help from experienced pharcists and technicians from out-side. Here again ACDIMA and Council of Arab Economic Unity can arrange to send pharmacists and technicians from the same factories where pharmacists from YAR have received their training. They will give the pharmacists from YAR on the job training in the new factory.

During this stage WHO or UNIDO can help by arranging to send experts for introducing G.M.P. and inprocess control. This timing is important.

It may be recorded here that during the discussion with Dr. Ahmed Borhan, Chairman of the KAHIRA Company, the writer was told that Iraq had established their factory but were having difficulty in starting production.

Iraq asked help from Egypt. A team of fourteen exoerts from various field were sent to Iraq. Dr. Borhan was theleaderof the team. This team worked for four years in Iraq and put the factory in operation. To day this Samara factory produce 50% of the country's requirements and is now planning to start another factory asits branch. Recently Dr. Borhan has been requested by the Kuwait government to help them to start a pharmaceutical factory in Kuwait.

V.2.2. Training for a packaging supervisor:

Training programme for a packaging supervisor will be similar to that of the production supervisor except that the job of a packaging supervisor calls for special profiency in some areas.

Packaging supervisor has to supervise number of lines at the same time. Packaging operation needs variety of different components in large numbers; shortage of one of them will render a line with several operators idle. There are various types of operation and consequently the number of things that can go wrong is also large.

Packaging supervisor has to manage maximum number of personnel compared to any other supervisor in the factory.

The packaging is the last stage of operation. The next person who is going to look at the product is the consumer.

Quality control of packed goods can be done only by opening the pack. Control, therefore, has to depend on good practices in packaging and In-process control.

Packaging supervisor therefore must be good in planning the sequences of his job, alert and vigilant. He has to be good in man management.

These aspects will have to be born in mind while selecting and training a person for the job of a packaging supervisor.

V 2.3 Training in supervisory skill an management technics

Production Manager and supervisors will not be effective unless they know how to 'manage'. There is a strong need for the senior technical personnel to be trained in management technics like information system, probabilities, alternatives, decision making and in specific tools used for problem solving and implementation. They should be trained in management by objectives, setting of priorities, motivation and deligation. The management training has to start at the top most level.

At present there is no facility for training senior management staff in YAR. It is recommended that once the production in the factory has stabilised, senior executives should be sent by turn for attending short term management training programmes.

Training for the first line supervisors can be arranged in the National Institute of Public Administration, Sana'a. This institute made the beginning by arranging a training course for the junior supervisors of the local textiles factory. The writer and Dr. Salem had discussions with the senior members of the institute. They are prepared to give all co-operation in training supervisors of the proposed pharmaceutical factory. They are even prepared to arrange for tailor-made courses for these supervisors if necessary.

V 2.4 Training of Manufacturing and Packaging operators.

Profile of a Pharmaceutical worker.

Very few unskilled workersare required for a pharmaceutical factory. Lowest level of workers in the manufacturing and packaging areas are the skilled operators and in the quality control, skilled assistant analysts.

The work is not physically strenuous but needs high degree of vigilance. The workers must be dependable and should have sense of responsibility. It may be said that in a pharmaceutical factory one may not be punished for making a mistake but sureto loose his job for hiding a mistake.

In addition the worker should have the sense of cleanliness. He is required to keep clean both himself and his working place. It is not easy to develop clean habits so it is desirable to start with a person with proper attitude. In developing countries pharmaceutical workers are not usually drawn from the traditionally so called labour community but from the middle class or lower middle calss educated families. Again girls have been found to be more suitable for most of the jobs except in maintenance.

Selection of personnel.

The normal structure of primary education in YAR is six years course from 6 to 11 years old. At the post primary level, education is divided into (I) a three year lower secondary cycle with general and teacher training courses.

A

(II) a three years upper secondary cycle with option in science, arts or commerce in grade XI and XII. For specific training in pharmaceutical industry, boys and girls who have passed the upper secondary cycle with science group will be most suitable. If one starts primary education at the age of six, he will be 18 years old by the time he finishes upper secondary school. This is the correct age for starting work in a factory.

Job description of a manufacturing operator:

General.

(1) Read and understand the labels on the containers and any special instruction on them.

(2) Write labels correctly for the machines and the containers.

(3) Read and understand the composition and manufacturing procedures given to him.

(4) Write the log book neatly and legibly.

(5) Weigh materials accurately.

(6) Read and record temperature, pressure, vacuum, volume (by the deep stick).

(7) Calculate the sub-batch quantities from composition and standard batch size.

In process control operations.

(1) Check average weight, thickness, disintegration time, friability and hardness for tablets.

Measure volume (by measuring cylinder or syringes).
Check PH and use hydrometer for liquids.
Specific for the job.

(1) Know manufacturing operations.

(2) Operate machines correctly and safely.

(3) Change parts.

(4) Clean and lubricate machine.

(5) Detect common faults in the machines.

Job description for packaging operators.
General.

(1) Read and understand labels, cartons and leaflets and differntiate one from the other.

(2) Stamp date of manufacture, date of expiry and batch number either by hand or by machine.

(3) Count correctly tablets or capsules.

(4) Weigh powder or granules.

weighing centre to the manufacturing areas.

(5) Measure volume of liquids by mesuring cylinder or syringe.

(6) Write log book neatly and legibly.

(7) Calculate and record daily out put.

(8) Keep account of packaging materials issued and consumed.

Specific for the jobs.

(1) Know packaging operations.

(2) Operate machines correctly and safely.

(3) Change parts (not complicated one).

(4) Clean and lubricate machine.

(5) Detect common fault in the machine.

It can be seen from the above job description that the operators need some of theoratical training and good deal of 'on the job' training.

Theoratical training.

Arrangements are being made for training Assistant Pharmaceutical Technicians in the Institute for Health Man Power Development.. Mr. Milner has suggested a curriculum for the course covering theoratical and practical training. The course has been specially designed for hospital pharmacists for the Ministry of Health. But some of the subject matters included in the course will be useful for training the operators and it will be economical if the training in these topics for the operators can be arranged along with the Assistant Pharmaceutical Technicians.

It is recommended that this training is given to both manufacturing and packaging operators so that they can be inter changed, if necessary, by giving 'On the Job' training specific to the operations.

Following topics will be of interest:

Pharmaceutics.

Weights and measures used in pharmacy
Care and accuracy in measurement
Calculations involving percentages, concentrated and dilute solutions, formulae calculations.

Chemistry.

Heating of solid
Heating of liquid
Making a solution
Separation by filtration
Simple distillation
Terms used in chemistry and their meaning.
Water, its composition and properties
Purification of water
Acids, bases and salts.

Mathematics.

Metric system of weights and measures
Fraction, addition, multiplication, subtraction, division
Decimals,
    Addition, multiplication, subtraction, division
Percentage
Ratio
Indices
Graphs

Physics

Density and specific gravity
Measurement of temperature.

(9)	Flame photometer	One

Health and Nutrition.

Personal health and hygiene.

On the job training.

If the Central Production Unit for special items for hospitals starts functioning before the factory comes into operation then the operators can receive their initial training in some of the unit operations in the Central Production Unit. The main training will, however, have to be given in the factory by the pharmacists.

It is recommended that training of the operators should be the responsibility of the permanent supervisors of the factory and not left to the experts who will come from outside. This will have two advantages :

(1) While training the supervisors will learn their job better.

(2) Supervisors will have better control on the operators.

One of the job of the experts will be to train the supervisors in the technics of training.

V 2.5 Training of Quality Control Manager.

Profile of a Quality Control Manager.

(1) Educational qualification - Minimum, graduate in Pharmacy from a recognized university.

(2) Age - preferably between 30 - 35 years.

(3) Good in drug analysis.

(4) Knows administrative functions related to his department.

(5) Conversant with forensic requirements.

(6) Good in management

(7) Dynamic - can motivate not only the people working under him but also his colleagues of the same level as that of his own in the principles of Quality Control.

INTRODUCTION

History and background

Yemen Arab Republic (YAR) with its six and half million population living in an area of 190,000 sq.km is one of the most densly populated country in the middle east. It has however far fewer natural resources than most of its neighbours who seek to maintain much smaller population on rapidly growing incomes supported by oil production. The country's major resource is agriculture. Eighty percent of the people work in agriculture contributing 70% of G.D.P. yet the agriculture imports exceeds agricultural exports. The potential to increase agricultural output is severely limited by the physical features of the country and eratic rainfall.

Many of the YAR's development problems have their roots in the autocratic rule of the Zaidi Imamate. Before the civil war the country had remained isolated from outside world. Internal transport and communications were rudimentary and many parts of the country were totally cut off from each other.

Traditionally all the pharmaceutical preparations were being imported into the country by private importers who are clever, aggressive and influential business community. Government used to buy their requirements from the trade.

The Yemen Arab Republic was formed in 1962 when a republican coup ousted the spiritual and temporal leader. The republican government opened up the country from its long isolation and established contacts with bilateral and multilateral donars (1).

In 1963 with Egyptian colaboration an attempt was made for the first time, to regulate all imports through a central agency and then to start local manufacture of pharmaceutical preparations. With this objective in view a company was formed in 1964 with 49%. Egyptian capital and 51% Yemeni capital. Out of 51% of Yemeni capital; 25% was given to the traders of pharmaceutical products in Yemen. The inclusion of the traders in the company was with a view to reduce their opposition to the new venture.

(1) Gulf guide and diary - 1976

With the increased sophistication in Industrial production of drugs the concept of Quality Control has undergone considerable change. It has been known since long time that analysis of finished pharmaceutical products is not sufficient to ensure adequate quality unless it is supplimented by good practices in manufacture and In-process control.

"The emphasis now is not on the detection of deficiences at the end of the job but on the prevention of the defects from happening. The quality programme for prevention is centered around involvement and team work of all concerned such as the material management (responsible for provisioning, purchasing and warehousing of material). Engineering department (responsible for erection and maintenance) Product development, production and quality control".

"By joint efforts of the team each step of the manufacturing process will have to be checked in order to achieve permanently reproducable quality". (1)

The quality control manager is the key figure in this team and his main function is to make each one of this team quality concious.

Training programme.

Like the production personnel quality control manager will also be sent outside for training in drug analysis and administrative function. If he is sent to Cairo, then he should take advantage of the one year diploma course in drug analysis offered by the Faculty of Pharmaceutics. His training period in this case will have to be for one year. Later on along with production personnel he will receive training in good practices in manufacture and quality control.

(1) Proceedings of WHO symposium on good manufacturing practices in Pharmaceutical Industry held in Geneva from 20 - 23 1971.

(iii) Packaging Supervisor - Pharmacist if not available graduate in chemistry.

Quality control manager also will receive training in management technics at a convenient time.

V 2.6 Training of Senior Analytical chemists.

Job requirement.

(1) Educational qualification - graduate in chemistry.

(2) Age - below 25 years.

An analytical chemist should have an analytical mind and keen power of observation. He should be steady in analysis and be prepared to do repeatative work. Should be reliable and honest in reporting his results and findings.

The job of an analytical chemist is mostly routine and the future prospect of a person in this job is some what limited. Dynamic and ambitious person usually do not stick to this job.

Selection.

Selection will be made out of fresh graduates in chemistry from the university of Sana'a.

Training.

The graduates from the university will be trained in drug analysis. Same training programme will be applicable to the analytical chemists required for the factory and for those required for the quality control laboratory of the Supreme Board for Drugs and Medical Appliances.

A suitable training programme will have to be designed for this purpose.

Duration of training - preferably six months of four weeks each, less one week for public holidays. Taking 6 days per week and 4½ hours per day total available hours for training will be 620.

The following are the outlines of the subject matters to be covered in the proposed training. The course may be divided in three parts.

PART I - Practical only.

Assay of drugs based on the procedures such as acidimetry, alkalimetry, precipitation and oxidation reduction.

Time - 100 hours.

PART II

Theory - Discussions of theories underlying the reactions of qualitative and quantitative analysis with particular referenoe to the law of Mass Action, electrode potentials and other physico-chemical concepts.

Disoussions of principles of volumetric and gravimetric analysis with detailed attention to the sources of error, theory of indicators and solution of stoichiometric problems. Newer methods of volumetric analysis and electrolytic methods of analysis and their applications to pharmaceutical analysis. Limit tests.

Time - 45 hours.

Practical:

(a) Assay of drugs based on gravimetric, volumetric procedures.

(b) Limit tests for arsenic, lead, iron, sulphates and halides.

(c) Analysis of fixed oils, fats, waxes and soaps according to the pharmacopoeia.

(d) Analysis of essential oils and balsams.

(e) Determination of alcohols in pharmaceutical formulations.

Time - 200 hours.

PART III.

Theory:

Quantitative organic analysis with special reference to synthetics drugs and alkaloids.

Theory and practice of:

(a) Colorimetric method of analysis.

(b) Florimetric methods of analysis.

(c) Spectrophotometry - identification and estimation of organic compounds.

(d) Polarography of organic and inorganic compounds and metalo-organic compounds.

(e) Electrometric, conductometric and potentio-metric titrations.

(f) Chromatography.

Time - 55 hours.

Practical:

(a) Assay of alkaloid bearing drugs.

(b) Use of the following instruments in the analysis of drugs and chemicals.

Refractometer, Polarimeter, Colorimeter and Nephalometer, and Calomel electrodes.

(c) Assay of pharamceutical formulations containing one or more drugs.

(d) Elementary organic analysis, estimation of halogens, sulphur, nitrogen and carbon.

(e) Estimation of flowing groups in drugs
Hydroxy, nitro, amino, imino, carboxy and methoxy.

Time - 220 hours.

Training facilities may be provided in the new Central Public Health Laboratory now under construction in Sana'a with WHO and UNDP's assistance. The objectives of the Public Health Laboratory Services Project read as follows :

"To develop the laboratory as a central station for laboratory examinations concerned with:

Clinical pathology, microbiology and serology
A central blood bank
The quality control of pharmaceuticals and biologicals
The control of environment (sanitation, food, and water control).

Specialised training for laboratory personnel and others in modern public health techniques in co-ordination with the Health Centre and Training School project in Sana'a 'Yemen 0008)." The writer was informed by the WHO adviser for the Department of Medical Laboratory Services in the Ministry of Health that the laboratories will have all the equipments required for routine analysis of pharmaceutical preparations. The Public Health Laboratory Services is planning to have a two years training course in various laboratory disciplines required for the quality control of phramceuticals and biologicals. This course will be ment for the students who have already graduated in chemistry. The teaching staff for the training course will be provided by WHO.

V 2.7 Training of Assistant analysts and Inprocess control inspectors.

Qualification and selection of personnel:

Same as process operators.

It is desirable to have the same training programme for both the groups of personnel so that there can be a possibility of job rotation among them.

In this case also advantage can be taken of the training scheme recommended by Mr. Milner for the Pharmaceutical technicians and Assistant Pharmaceutical technicians. Boys and girls selected for the job of assistant analyst and inprocess control inspector will receive the same training as that of the process operators. In addition they will receive training in the following subject matters.

(1) Principles of instruments used in analysis.

(2) Acid-base titration, oxidation reduction titration, use of indicators.

(3) Limit tests for lead, arsenic, iron, sulphates and halides.

(4) Estimation of alcohol in pharmaceutical formulations.

(5) Use of hydrometer, simple viscometer, chemical balance, PH meter, colorimeter, refractometer,

(6) Preparation of standard solutions and common reagents used for analysis.

V 2.8 Training for Engineering Personnel.

There will be no scope for training engineers. Engineers having experience in erection and maintenance of machines (preferably in machines used in the production of pharmaceutical formulations) will have to be hired.

V 2.9 Training of lower level maintenance personnel such as mechanics, electricians etc.

There are several vocational training centres under the Ministry of Education, with international assistance, operating in YAR and more are being started. Suitable people will be available within the country.

Mention may be made of the vocational training centre (with West German assistance) which is expected to start functioning in Sana'a from September 1978. The first batch of the trained personnel will come out by the end of 1980. This centre will have training facilities for maintenance mechanics, electricians, automechanics, plumbers, carpenters and masons.

From April 1979 the same institute will offer three to four months upgrading training courses for people who have been already working in one of the above mentioned trades.

SECTION VI

Recommendation for future action with respect to setting up an industrial scale pharmaceutical production unit.

VI 1. Probable alternatives.

Considering the potentiality of the country in the sphere of pharamceutical industry, there are three alternatives.

(1) Continue importation of pharmaceutical preparations to meet all the requirement of the country.

(2) Start production in a modest scale maily to gain experience and supply only to hospitals. Start packaging of imported bulk drugs into smaller units.
Produce specialities having good turnover in YAR under suitable licensing arrangement.

(3) Start large scale production to meet country's requirement for most of the important drugs.

VI 2. Recommendations.

The first alternative is not recommended because if YAR has to support its future health plan then it is time that at least the nucleus for an pharmaceutical production unit is established. The five year plan has foreseen the setting up of a central letter press project with West German colaboration and a glass factory at Sa'ada. It will be good if the pharmaceutical production unit starts co-ordinating with these two projects, at their planning stage, with respect to its special needs for glass containers and printed materials.

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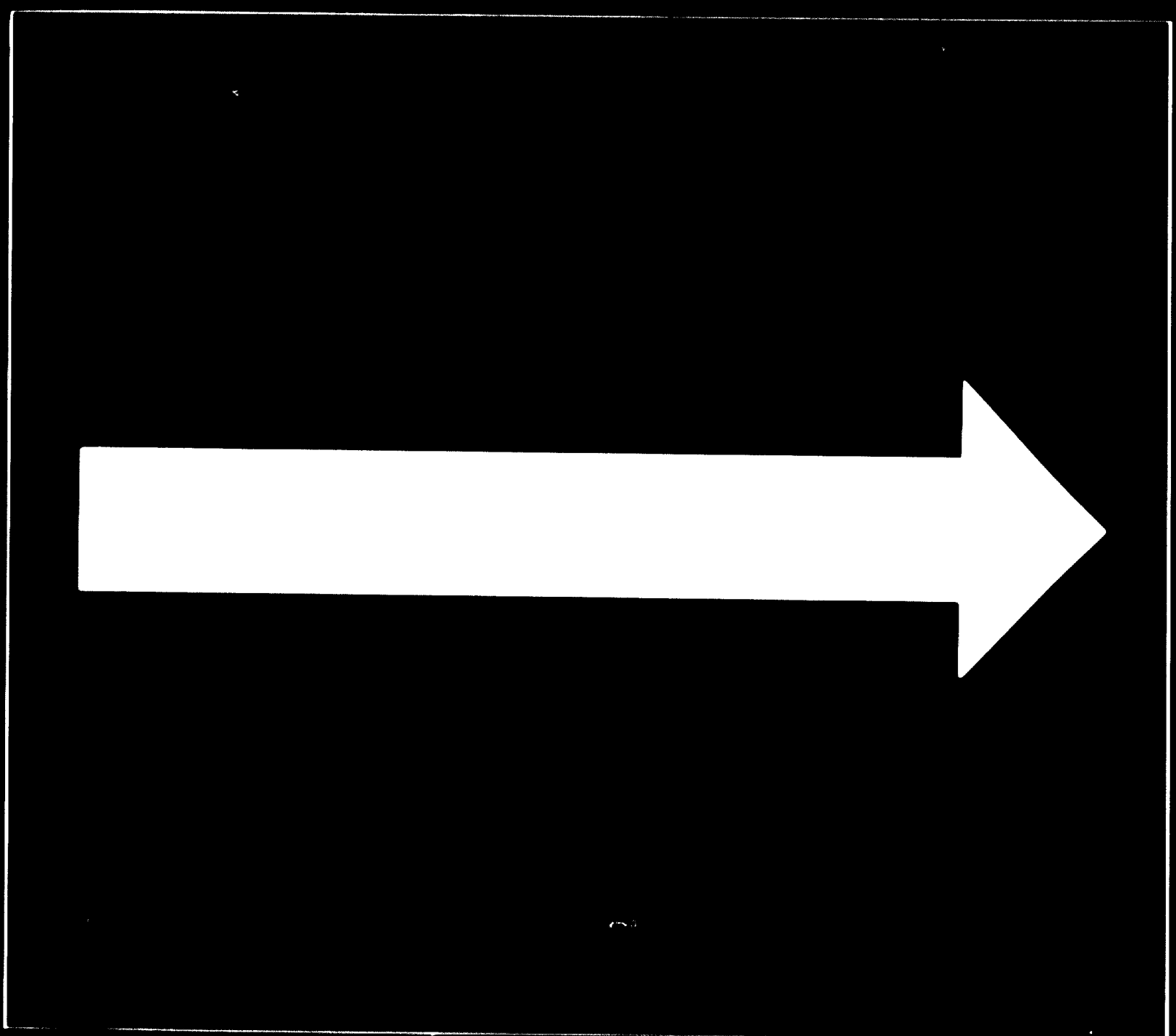

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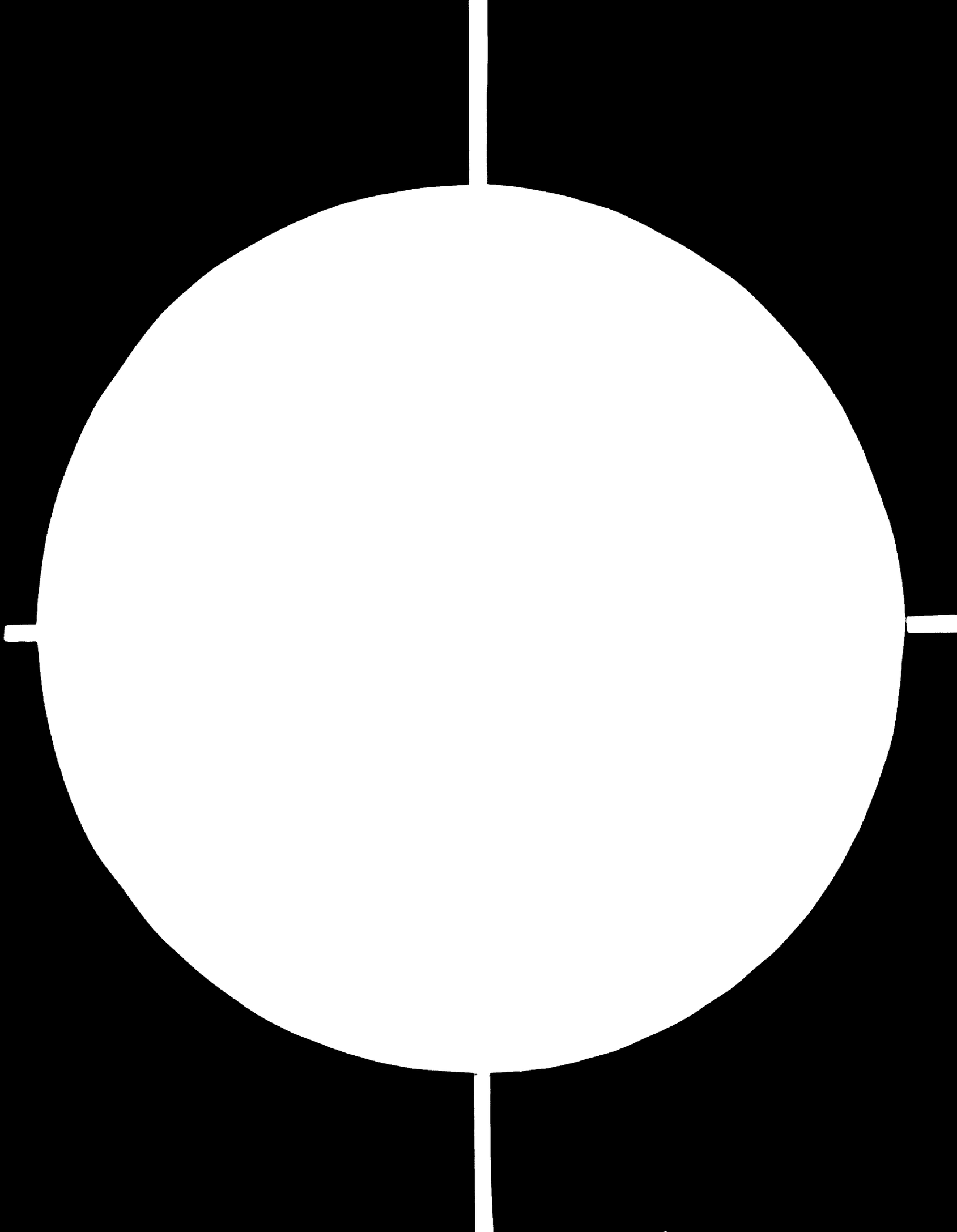

Second alternative - detail feasibility study of different alternatives is beyond the scope of the job description of the writer. On the face of it, this alternative seems to be the most acceptable. With proper mobilisation of the available technical personnel YAR should be able to implement this alternative with some technical assistance from outside. Assistance however, will be needed in all sphere of activities that is :

(1) Design and construction of the factory.

(2) Procurement and installation of equipments.

(3) Management of Material.

(4) Production.

(5) Quality control.

(6) Preventive maintenance.

It may not be prudent to start a large scal production unit until at least the essential packaging materials are produced in the country.

Even for a simple formulation about six different raw materials and equal number of packaging materials are required to be procured. And all these must conform to the specifications laid down by the quality control department. This makes the inventory control in pharmaceutical production some what complicated. It will make things even more difficult if all these items are imported from outside.

Third alternative - at present this alternative can be executed only by giving contract to a suitable outside party, on a turn key basis, for setting up and managing the project until the local people have been sufficiently trained to take over the management.

The feasibility for both the alternatives will have to be examined by taking into consideration the relevant strength and weakness of the country.

Strength:

(1) Free import policy - there will be no difficulty in importing the latest and the best equipments and accessories for setting up the factory. The import license for all starting materials to feed the productionwill also be freely available.

(2) Importation of pharmaceutical products has already been regulated by the Government. Once a product is manufactured in the country it should be possible to restrict the importation of similar items and give necessary protection to the local production.

(3) There are a number of Yemeni pharmacy graduates already working with the government and more are expected to return after completing their study abroad. They will be happy to join the production unit.

Weakness:

(1) Technical knowhow for the products to be manufactured will have to be obtained from outside.

(2) Personnel experienced in management, finance and technical functions will have to be hired from outside. The house rent that has to be paid to an outsider may exceed the present salary of a local pharmacy graduate.

(3) All equipment and accessories will have to be imported.

(4) Inventory of all starting materials will have to be maintained at one year's consumption level.

(5) Cost of labour is high in relation to their produotivity. Even then there is a possibility that the people after receiving training in the factory may leave for the neighbouring countries where wage scale is still higher.

Besides the above internal factors there is one external factor which also has to be taken into account. At present cost of imported drugs in the country is very high. "Announcement by WHO of the German proposal for preferentical pricing systems may yet have a profound effect on the regions (middle east) pharmaceutical industry". "It should be seen as a defensive measure, not just against the WHO's listing of basic medicines, but also aimed at the ambitions of developing countries which see a future for themselves in drug manufacturing. As such it promises to bring some immediate assistance to the middle East's poor countries. But it represents a challange to those in the region who hope to establish a domestic pharmaceutical industry" quoted from an article by Mr. Mike Muller in Meed special report 22 July 1977.

VI 3. Type of construction for the factory.

At present three types of construction are found in YAR for commercial buildings.

(1) Most popular and costliest is the construction with stone (Present rate is about 2000 YR. per square meter).

(2) Next comes the R.C.C structure. This is about 20% cheaper than the first.

(3) Latest is the construction with pre-fabricated structure. Of late a few buildings in Taiz and Sana'a are being built with pre'fab' structure. This is about 40% cheaper than the first.

For the alternative two, pre'fab' system besides cost, has other advantages:

(a) It is easier to build the factory part by part. The expansion is easy and neat, construction with other two systems (particularly in YAR) is messy and consequently future expansion will interfere with the production.

We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used for preparing the master fiche

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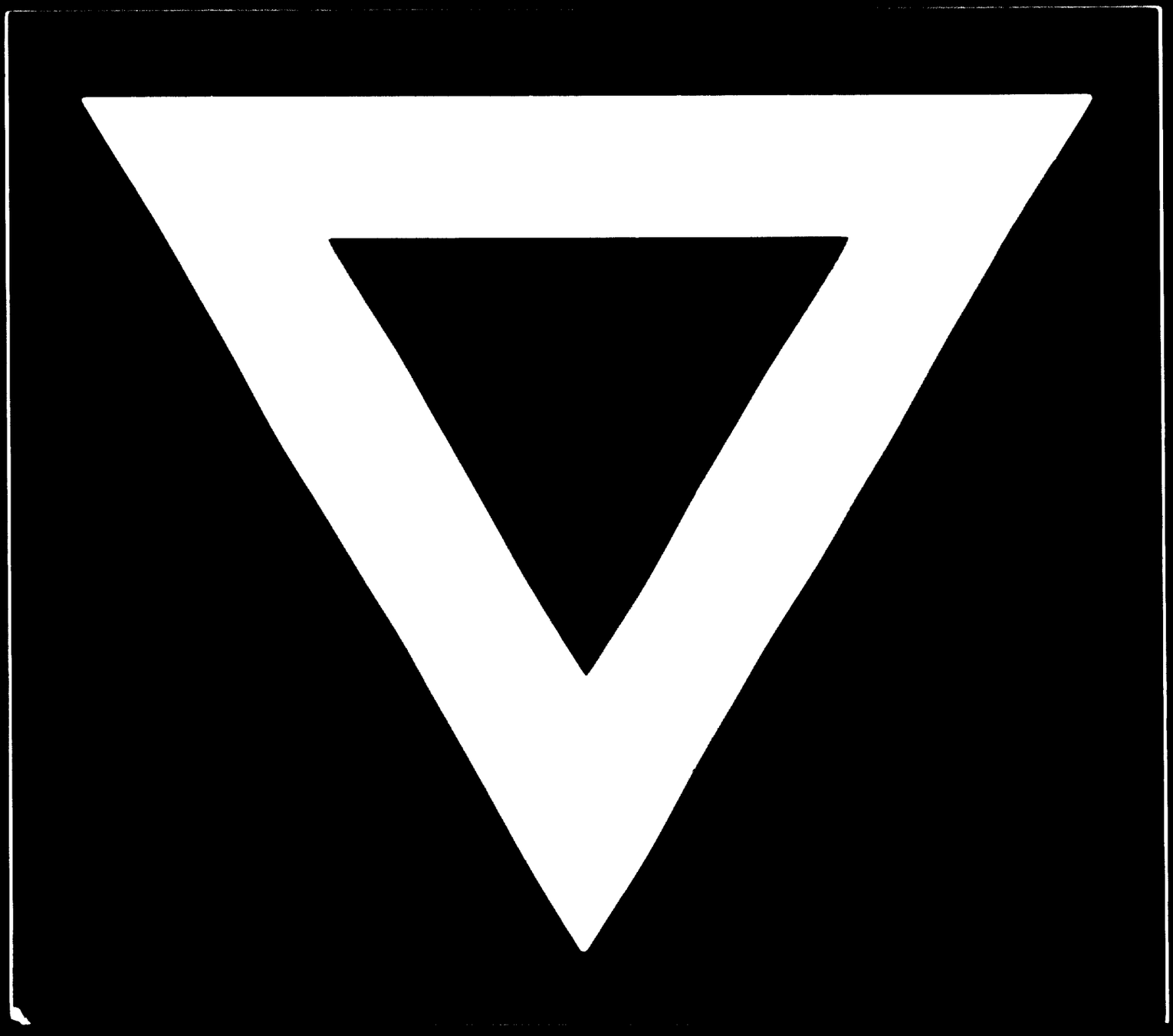

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