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RADIATION AND HEALTH

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(A position-paper, based on the background papers and discussions of the XVIth Annual MFC—meet on Radiation and Health.)

It is customary to give a brief report of the discussion on the theme of the MFC—annual meet in the MFC Bulletin. But it was felt that these reports are too brief, hardly do justice to the various view points and arguments presented. Many times the report does not convey even the consensus in a clear manner. It was, therefore, decided that this time we change this custom and publish a position—paper or consensus paper in the Bulletin to give a clear idea to the readers about the consensus (alongwith major differences, if any) emerged and the basis of such a consensus. In doing so, the paper should draw liberally from the background—papers so that those who could not attend and hence did not get these background papers would get some idea about them.

The discussion in this meet was divided into four broad areas :—

i) Basics of radiation and health and the experience of nuclear power plants;

ii) Health—hazards of common radiological investigations;

iii) Food irradiation;

iv) Other sources of radiation from consume products—Electronic Display screens.

Most of the discussion and background material was focussed on the first area; a clear consensus also emerged and hence this paper will focus mainly on this aspect. In the second topic there was a clear, balanced presentation and not much debate took place after it. It would, therefore, suffice to reproduce this paper alongwith a few additional comments based on the discussion at the annual meet. On food irradiation also, there was a lone background paper. The author, A.T. Dudani had not, however come and Surendra Gadekar made a brief extempore presentation. There was a lively debate and issues raised would be reported at the end of this background paper. Only a few lines are in order about the fourth subtopic. I would end this introduction by reiterating that this position paper is not a report of the discussions at the annual meet. But since there were no sharp differences of opinion, none of the deletions are of major importance.

HEALTH HAZARDS OF NUCLEAR POWER PLANTS

Radiation :

Radiation is the emission and propagation of energy through space of tissue in the form of waves / Sub-atomic particles. Radiation is basically of two types—ionizing and non—ionizing. Ionizing radiation has enouh energy to knockout an electron out of its normal orbit around the nucleus of an atom. This results into two 'ions', i. e. electrically charged particles — one the negatively charged electron and the other, the rest of the atom which now has a net positive electric charge. When unstable atoms are split in a nuclear reactor or in atom bomb, the splitting releases in the form of heat, blast, and radiation. Radiation is in the form of Alpha, Gamma rays, X—rays, neutrons. These cause ionization in surronding area and hence are called ionizing radiations. Visible light, infrared, and ultraviolet rays are non-ionizing radiations. Chemicals releasing ionizing radiations are called radio-active and they have deleterions effects on health on account of their radio-activity.

Effect of radiation at cellular lelel and on health :

Release of energy through radio-activity works through two mechanisms : influx of random energy and ionizations. Dr. Rosalie Bertell in her book, 'No Immediate Danger' describes briefly and lucidly the effect of this energy-transfer on cells and hence on health.

"The result of cell exposure to these microscopic explosions with the resultant sudden influx of random energy and ionization may be either cell death or cell alteration. The change or alteration can be temporary or permanent. It can leave the cell unable to reproduce (or replace) itself. Radiation damage can cause the cell to produce a slightly different hormone or enzyme that was originally designed to produce, still leaving it able to reproduce other cells capable of generating this same altered hormone or enzyme. In time there may be millions of such altered cells. This latter mechanism, called biological magnification, can usually associate with old age. One very specific mutation which can occur within the cell is the destruction of the cell-mechanism for resting which normally causes it to cease reproductive activities after cell division. This inability to rest results in a runaway proliferation of cells in one place, which, if not destroyed, will form a tumour, either benign or malignant. The abnormal proliferation of white blood cells is characteristic of leukaemias; red blood cell proliferation results in what is called polycythemia vera.

If the radiation damage occurs in germ cells, the sperm or ovum, it can cause defective offspring. The defective offspring will in turn produce defective sperm or ova, and the genetic 'mistake' will be passed on to all succeeding generations, reducing their quality of life until the family line terminates in sterilisation and / or death. A blighted or abnormal embrynonic growth can result in what is called a hydatidiform mole instead of a baby.

Exposure to radiation is also known to reduce fertility, i. e. women become unable to conceive or give birth.

Radiation can olso damage an embryo or foetus while it is developing within the mother's womb. This is called teratogenic damage, or the child is said to have a congenital malformation rather than genetic damage. This means the damage is not automatically transmitted. For example, a deaf person, made so by a pre-birth injury may hvae children with normal hearing..

The complex molecules making up living organisms are composed of long strands of atoms forming proteins, carbohydrates and fats. They are held together by chemical bonds involving shared electrons. If the ionising radiation displaces one of the electrons in a chemical bond, it can cause the chain of atoms to break apart splitting the long molecule into fragments, or changing its shape by elongation. This is an 'ungluing' of the complex chemical bonds so carefully structured to support and perpetuate life. The gradual breakdown of these molecular bonds destroys the templates used by the body to make DNA and RNA (the information — carrying molecules in the cell) or causes abnormal cell division. The gradual natural breakdown of DNA & RNA is probably the cellular phenomenon associated with what we know as 'ageing'. It occurs gradually over the years with exposure to natural backgrond radiation from the radioactive substances which have been a part of the earth for all known ages. There is evidence that exposure to medical X-rays accelerates this

breakdown process. There is ample reason to think that fission products within the body will cause the same kind of acceleration of ageing. However, unlike medical X—rays, these radioactive chemicals damage cells by their chemical toxicity as well as their radiological properties.

The gradual breakdown of human bio-regulatory integrity through ionising and breakage of the DNA & RNA molecules, gradually makes a person less able to tolerate environmental changes, less able to recover from diseases or illness, and generally less able to cope physically with habitat variations.

When the DNA of germ plasm is affected by radiation it can result in chromosomal diseases. such as trisomy 21, more commonly known as Down's Syndrome." (1)

" In order to have a quantitative sense of the frequency of the different cell effects caused by radiation exposure, imagine a colony of 1000 living cells exposed to a 1 rad X—ray (about the dose for one X—ray spinal examination). There would be two or three cell deaths, two or three mutations or irreparable changes in cell DNA & about 1 lac ionisation in the whole colony of cells ranging from 11 to 460 ionisations per cell. While cells can repair some damage, no one claims that there is perfect repair even after only one such X—ray." (2)

Radiation and Heredity

" In 1943 Hermann Muller received a Nobel Prize for his work on the genetic effects of radiation and was a dominant figure in developing early radiation exposure recommendations made by the International Commission on Radiological Protection (ICUP).

" Muller predicted the gradual reduction of the survival ability of the human species, as several generations were damaged through exposure to ionising radiation. This problem of genetic damage continues to be mentioned in official radiation-health documents under the heading " mild mutation " but these matations are not 'counted' as health effects when standards are set or predictions of health effects of exposure to radiations are made. There is a difficulty in distinguishing mutations caused artificially by radiation from nuclear activities from those which occur naturally from earth or cosmic radiation. A mild mutation may express itself in humans as an allergy, ashtma, juvenile diabetes, hypertension, arthritis, high blood cholesterol level, slight muscular or bone defects, or other genetic 'mistakes'. (3)

It should be obvious from the above account that accelerated cancers is only the tip of the iceberg of health—hazard of radiation. But so far the debate about radiation —hazards has been primarily focussed on whethar there has been cancers or not.

Safe level and Permissible level :

There is in fact, no safe level of of radiation. There is always some cellular damage from any radiation and part of it cannot be repaied. Regulatory agencies have therefore set up permissible levels of radiation for workers in nuclear—industry and general population. Permissible level is a trade off between the facilities made possible by nuclear-industry and 'acceptable' level of damage to health. Uniformed, helpless citizens give passive consent to the unnecessary bartering of health for 'progress' as defined by the powers that be. As scientific knowledge of health—hazards of radiation increased and people's consciousness rose, the permissible level for workers decreased from 50—70 REM per year in 1934 to 5 REM per year in 1956 .... (4) (REM is the measure of radiation absorbed in human tissue. It may by noted that 5 REM is equivalent to 170 chest X—rays.) For the general people, the permissible level is one tenth of the occupational permissible level. Recently, the National Research council of the U. S., the official research agency in this field, found that the risk of getting cancer from low levels of radiation appears to be four times as high as previously estimated. The permissible level is therefore likely to be reduced from 5 REM to 1—2 REM per year.....(5) Permissible limits have changed so much that the whole exercise has turned out to be arbitrary and meaningless.

HEALTH HAZARDS OF NUCLEAR FUEL CYCLE

Production of electricity by nuclear power plants involves a few steps of cycle nature—mining of uranium ore; its concentration; manufacture of fuel-rods; 'burning' of these nuclear-fuel-rods in the reactor to get heat; treatment and storage of 'spent, fuel rods after this burning; disposal of this nuclear-waste or reprocessing of these spent fuel rods to

recover adequate concentration of uranium for reuse; transport of radio-active material during these steps ot the cycle. All these steps together constitute the Nuclear Fuel Cycle and each step has its own radiation hazards.

Mining, milling, enrichment :

Uranium mining releases radio-active random gas which causes lung cancer. But hardly any effective protective measures are adopted even in developed countries.

The mined uranium is broken into small pieces (milling) and this also releases much radon. The concentration of uranium inthe ores is extremely low : 0.07%. This ore is therfeore processed to increase the concentration of uranium to 3%. This enriched uranium is then injected into fuel—rods. Nuclear reactors 'burn' these fuel rods to produce heat which is used to produce steam to rotate the turbines. At each of these steps, radio-active uranium has to be handled. If there is any laxity in the necessary precautions, dangerous uranium causes damage to the workers. This is especially true after the enrichment of uranium. There are numerous instances all over the world of this laxity. Potentially the most hazardous of all t hese steps is the 'burning' of the fuel-rods. This process is the controlled chain—reaction which produces intense heat. In case of the major accident or a 'electro-melt down' due to uncontrolled heat, the reactor can explode and intensely radio-active elements enter the surrounding area in large proportions. The Chernobyl accident was not a full blown melt down, yet lacs of people over hundreds of square-kilometers had to be evacuated and thousands of tonnes of soil had to be scraped and would have to be stored separately for hundreds of years till its radio-activity is exhausted,. The possibility of such a major accident happening was estimated in 1975 to be in ten thousand reactor-years. With one hundred reactors operating then, it meant one accident in one hundred years. But in reality, the experience shows that a major accident would occur one in two thousand reactor-years. There are many minor accident leaks, giving out radio-activity in small dosages. It is because of these leaks that higher rates of blood and other cancers have been found in clusters, in areas surrounding these plants in workers employed in them. But the nuclear industry has questioned these findings and the debate is continuing.

Once the fuel is burnt to a specified level, it is taken out of the reactor and kept in water tanks to cool down for about 3 to 4 months. After initial cooling, the spent fuel is reprocessed to separate unburnt uranium, and a valuable fuel material—plutonium from fission products. Reprocessing stage with high degree of remote handling is a chemical step, and the scale of this remote handling operation is that of a highly sophisticated chemical industry. The low level liquid waste from this industry has to be constantly monitored and activity levels kept under control. The high level liquid and soild waste is chemically treated, vitrified (converted in to glass like material), sealed and buried at specially designed grave yards, where it will remain for generations together. These need to be kept watch upon for a period of a few hundred of years, so that the space is not used for any other purposes. Leakage and seepage in the waste containments can pose problems any time for future generations if they fail to take proper precautions Reprocessing of spent fuel and waste disposal are the crucial problems faced by the nuclear industry world over.

Throughout the fuel cycle, transporation of radioactive material is involved, requiring tremendous care, shielding and safety precautions. Any mishap due to inadequate care can lead to spread of contamination or avoidable exposure to people.

The limits on personal exposures force the nuclear managers to employ people on temporory basis for some specific jobs involving radiation hazard. Civil workers or workers from forces are used for risky jobs. These persons remain inexperienced inspite of short training given, if at all. The problem of temporary workers becomes all the more acute in developing countries. due to compelling unemployment. Fake names, faulty records of doses, and total apathy towards the unskilled temporary workers multiply their health problems. These people being not in the regular service cannot be kept track of for further check—ups even if it is wished so. In such circumstances correlation of radiation and its effects is totally out of question.

The pronuclear lobby has maintained that the dose of radiation due to tho nuclear power

plants is too small;even less than natural background radiation. Thus in the U. S. the avarage natural background radiation is 99 milli REM per years per person, whereas that due to atmospheric weapons testing and nuclear industry is 4-5 and 1 milli Rem per year per person, respectively. (7) There is a statistical gimmick in there figures. Whereas every citizen does receive natural background radiation, only a miniscule proportion of the citizens are employed in the nuclear industry and hence receive radiation from this source. By dividing the total dose received by all these workers, by total population of the country (not by number of workers employed in the industry) a misleading averaging is done. The fact is that those employed in the nuclear industry receive a dose far far higher then natural background radiation. For example. table 1 gives the dose received by different category of workers.

Table—1 (8)

Radiation received by workers U. S. A.. 1975

Sr. No.	*Occupational Group*	*Mean whole body dose in Milli Rem*
1.	*Industry other than power plants*	*530*
2.	*Power reactors*	*760*
3.	*Fuel fabrication and reprocessing*	*560*
4.	*Nuclear waste disposal*	*700*
5.	*Uranium mills*	*60*
6.	*Uranium enrichment*	*70*

In India, the data are scare to come by. In the absence of crucial information, let us resort to table—2 which presents the overall view of the personal dose monitoring services throughout our country This service covers roughly 94%, 31%, 20% and 20% of the radiation workers from DAE, industry, medical and research units. It should be borne in mind that in the category 'medical', the patients are not included. The incidences of over-exposures in non—DAE are 200 per year. The incidences involving exposures more that 10 Rem are between 25—39 per year. Of these acute over exposures half the countribution is from the radiation workers from medical field. A similar breakup for DAE workers is not readily available to public.

TABLE—2 (9)

Number of Radiation workers monitored and average dose/ year (in India)

Year	*1985*		*1986*	
	Monitored Persons	*Annual Ave. (mRem)*	*Monitored Persons*	*Annual ave. (mRem)*
DAE.	*12683*	*429*	*12032*	*456*
Industry	*4898*	*227*	*5255*	*191*
Medical	*13480*	*79*	*14292*	*66*
Research	*1803*	*22*	*1992*	*26*

The above table gives average figures. The record of some of the plants is extremely bad. For example. the average dose per employee per year in the Tarapur plant has increased by 35 times, from 117 m. Rem in 1969 to 4069 m. Rems in 1982. Radiation received by Indian workers measured as human Rems per megawatt, per year has increased in India from 21.5 m. Rem in 1969 to 2125 m. rems in 1980, a level 27% more than that in the U. S. (10)The exposure to Indian workers is high because minor leaks due the 'unusual occurance' are more common.

Lastly, the problem of Nuclear waste disposal has not been solved at all. There is no foolproof mechanism yet discovered which will completely isolate the radio-active waste for thousands of years. What is more no solution seems to be in sight.

REFERENCES :—

1) No Immediate Danger, Rosalie Bartell, the Womens'. Press, 1985, pp. 27, 29, 30; 2) Rosalie Bartell, op. cit ps 30. 37; 3) Rosalie Bartell, op cit p. 43, 44; 4) Radiation and Health, Indian Situation, Background paper for MFC—meet, 1990, p. 5; 5) New York Times, 20-12-89; 6) Radiation and Health — Indian situation, op cit p.6-7; 7) Radiation and Health, op. cit. Table—2 8) Radiation and Health, op. cit. Table—7; 9) Radiation and Health, op. cit. p—11: 10) State of Indian Environment, Citizens report, 1987 p. 290.

II

HAZARDS OF COMMON RADIOGRAPHIC TECHNIQUES TO STAFF AND PATIENTS

Dr. Sham Ashtekar

Introduction :

Diagnostic radiographic techniques constitute an extremely important tool in the hands of the physican today all over world. {Exposure rates as 868 exposures per year per thousand population are prevalent in European countries (1). In developing countries the rate is quite less as compared to these. However it also constitutes major source of radiation to mankind only next to N weapons and Nuclear Energy processors. Precisely therefore it has to be used with a lot of discretion and energy since radiation has proved to be a major determinant of cancers and genetic mutations.

The X—ray Units In India are mainly operated at two levels. The first is the X—ray Units in hospitals and consultant Radiologists processing a good number of exposures-even 100 a day-required for a range of diagnostic needs. Such installations normally use high output, low time exposure machines with a resonable safety organisation. The second level is that of the taluka level nursing homes / clinics, some urban 'Bazar' X—ray clinics that operate low output, longer time exposure machines with poor safety organisation.

The general consensus among experts indicates that properly used, the usual diagnostic X-ray procedures do not cause much harm to the patients / staff considering the contribution they offer in patient management. But badly organised units can harm the population in the long run. This paper attempts to outline some isssues in this context.

2. Biologic effects of X-rays :

The biologic effects of X—ray can be summed up as follows :

i) There is no 'tolerance level' for exposure since even small doses are biologically not 'lost'. As far as biological effects are concerned there is no 'adjustment dose' for radiation.

ii) The probablility of occurrance of X-ray hazards shows a linear relationship with exposure. More the dose proportionately, more shall be the occurrence of hazardous effects.

iii) There is a {sigmoid relationship between the exposure dose and the severity of the effects. Thus after an initial threshhold and then steady rise of dose-severity curve, there is a steep rise for subsequent dosages till there Is a plateau of steady rise again. The last segment of steady rise is accounted for by selective elimination of affected persons due to deaths.

iv) There are some somatic 'certainty effects' like radiation erythema. bone marrow fibrosis, radiation ulcers, skin cancers etc. which almost certainly occur after a latency {period, provided the dose is more than 10 and 100 rads for whole body and partial body irradiation respectively. These show a sigmoid dose-effect relationship. In the early days of radiodiagnosis these were of frequent occurrences because of poor protection measures. In almost all cases of such effects, event can be traced back to some past exposure. These effects are more severe with time concentrated dose as compared to a time spreaded exposure.

v) There are some somatic stochastic effects like organ cancers and leukemias that show a linear relation as for dose effect. These effects occur at their respective age profiles, only much more commonly in the exposed population.

vi) The genetic effects are always stochastic and there are two modalities. First the effect is mostly lethal to gonadal cells so that there is a lower birth rate in the exposed population. Second—less frequently there are chromosome abnormalities and mutations. Mutations are recessive that show up in later generations if the other partner also carries recessive trait. Such chances increase with accumutation of abnormal genes in the total genetic pool of the child bearing (prospective or current) age groups. Older parents carrying such abnormlities do not alter the gene pool. The somatic expression of these abnormalities can be very severe and in this sense X—rays are a major threat to to genetic constitution of the population if effective gonad protection is not offered. Children/persons below 18 years are 10 times prone to such abnormalities as compared to the adults. (1)

vii) These biologic risks to patients have tobe weighed against the possible benefits of radiodiagnosis and those on the staff compared to level of occupational hazards in other professions to get a balanced picture of the risk profile.

3. The dose in Radiodiagnosis .

The dose of the exposure is a function of many factors. The output of the machine in milliampere, the time of exposure, the distance of the subject from the X—ray tube all decide the dose of the exposure.

Maximum Permissible Dose (MPD) is defined as : The Permissible dose for an individual is that dose, accumulated over a long period of time or resulting from a single exposure, which, in the light of the present knowledge, carries a negligible probability of severe somatic injuries; furthermore it is such a dose that any effects that ensue more frequently are of a minor nature that would not be considered unacceptable by the exposed individual and by the competent medical authorities (1).

It is estimated that in the last two decades in most countries 75—96% of the exposed staff did not receive more than one tenth of the MPD. It is also estimated that in no country the genetically significant dose from this source is more than 1% of the natural background radiation. However, the same MPD level can not be accepted for children since children are about 10 times susceptible as compared to adults. (1)

4. The Estimation of Cancer risk.

There can be no generalisation about cancer risk from X—rays. Much depends upon the dose, the organs receiving X—rays, the age of the subject, positioning of subjects and some other factors. When a subject is exposed whole body- all organs may get irradiation but the risk is not similar in all the organs. Generally extremities are not sensitive and so also skin, bones and thyroid. As for dose, every procedure involves different dosages. Chest radiographs, extremities and thinner parts need much less exposure than abdomen. Thick set individuals need more exposure than thin ones. An AP chest view harms the bone marrow much more than a PA view. A 'repeat' doubles the dose and the risk thereof. Exposure of abdomen in an 18 - year subject causes cancers with many-fold frequency as compared to the same procedure in a 60 year old subject. An elderly can take much more dose without cancer risk since there is relatively shorter survival period for cancers to develop. Therefore multiple radiographs for diagnosis of gastric ulcers, renal stones, barium shadows involve much less risk than a single exposure in a child. Risk changes to more than 10,000 times from one situation to another situation (2).

The variation in risk due to these factors is quite sizeable as will be evident from the risk in the appendix.

5. Gonadal Doee :

Almost every exposure, save dental or similarly skin close exposures and well limited (collimated), exposures, result in some irradiation of the gonads. Appendix II shows the Gonadal dose grouping and also bone marrow dose grouping (1). This will underline the need to lead-shield the gonads whenever possible.

6. The risk factors, the X-ray machine, design factors, shielding :

i) The useful beam size : The X—ray beam directed towards the target / film is known as the useful (Primary) beam. The useful beamsize depends upon the design of the X—ray tube head output and the distance of the subject from the tube head. Most often unless optical devices are used to show the field of the beam the useful beam irradiates regions that surround the target region. This can be avoided by optical devices and adjusting the distance factor.

ii) Back radiation / scattered radiation : Radiation other than the useful beam is known as the back / scattered radiation. This mainly affects the staff. Adequate distancing of the operators control panel, lead apron are all necassary to avoid the exposure to this radiation it can also affect the patient and suitable position is necessary to minimise this dose (1).

iii) Fluroscopy : The machine output In fluroscopy operation is very low but time factor offsets this advantage. Moreover. staff doing fluoroscopy is necessarily exposed to the useful beam in a routine manner. Proper darkroom facility,

timer—indicators; apring switch, lead flaps, lead gloves, proper dark adaptation and good training are all necessary to minimise dose.

iv) Calculated Vs actual dose exposure : It is possible to calculate individual exposure doses as per the readings of MA; Kv time in secs. But actual doses are found to vary between 0.1 to 0.4 times the calculated dose due to equipment doctors. This is known to happen even in best of units (2). The real way of estimating actual exposure dose is to use special instruments like Gigar counters, crystal dosimeters, ionisation chambers etc. which is usually not done in India though BARC can help do this on request. It is estimated that much smaller doses than are actually delivered are really necessary for most of the procedures.

v) Leakages from Tube head : There is no other way to detect leakages from tube head (that will give substantially more radiation than the week back radiation) than special detectors like the Geiger counters. Whenever new installa tions / changes are made it is mandatory to check for this with the help of special services. BARC can help in this.

vi) Film and screens : Insensitive films / screens entail a longer exposure of the subject and staff and also reduce machine life. It is neces sary to use suitable films/screen to minimise exposure.

vii) Design and shielding : X—rays can penetrate and have to be stopped from affecting surrounding people by special design and devices. As far as design is concerned, adequate spacing is the first important thing. Since rediation at a given point is inversely proportional to distance from the source, a unit housed in a 10 x 10 feet room is more hazardous to outside people than the same unit housed in a 15 x 15 feet room. Unfortunately this is a restraint in many X—ray clinics. Secondly the useful beam has to be primarily directed at exterior wall so that minimum exposure occurs to the surrounding life. Thus it should not be directed at the waiting room, wards, street, passages unless adequately shielded. The control panel should be outside the X—ray room in units operating more than 50 kv machines. As for shielding, lead and wall thickness are two principal considerations. For every 50 kv rating of the machine a 0.5mm lead thickness is necessary to the useful beam (eg the fluroscopy procedures) Stray radiation can be taken care of by putting a 0.25 mm lead barrier (the usual lead aprons) provided the staff is distanced at about 10 ft from the source.A 9 inch brick mortar wall is equivalent to 1mm lead thickness and so is a 6 inch concrete slab. All walls should be designed to stop the primary radiation of the useful beam. Since machine position, direction of beam, installation etc. can change subsequently and this should be kept in mind. Doors / windows should be shielded with a 1mm lead thickness with adequate overlap so that radiation does not escape the gaps. It is always better to seek help of radiation engineers while designing the unit.

viii) Staff Monitoring for radiation : X—ray unit staff and other staff routinely comming in contact of X—ray units (Nurses / ward-servants etc.) are expossd to radiation. Unless proper precautions are taken to restrict staff entry in 'switch-on' time, a great risk awaits the operating staff by way of cancers, leukemias and gonadal irradiation. Standing behind the X—ray tube. lead aprons, control panel, adequate distance are all necessary. The film badge monitoring is a routine method in upper strata X—ray clinics. In the lower category of taluka level units, bazar clinics and minor units operating in small nursing homes no such monitoring is ever done; perhaps with the idea that the dose involved is low. In this context, the conditions in the latter category are quite bad since most of the operators have little knowledge of the potential risk of this invisible menace. At pressnt there is no working mechanism of regulating the conditions at such clinics. Although the total work load is quite small in this category, the neglect of basic protective factors understandbly constitutes a very real threat to both patients end operators.

7. Conclusion :

X—ray are a great help in patient management. Generally speaking MPD is not exceeded

APPENDIX—I

CANCER RISK ESTIMATION USING VARIOUS FACTORS FOR CHEST VIEW. (2)

			PA VIEW		AP VIEW	
Age yrs	Entry dose	Beam AVL	Male Cancer Risk	Female Cancer Risk	Male Cancer Risk	Female Cancer Risk
New born	0.010 R	2.5 mm AL	37* per million	49 per million	90 per million	260 per million
One year	0.012 R	2.5 mm AL	37 —,,—	49 —,,—	95 —,,—	283 —,,—
Ten Yrs.	0.016 R	2.5 mm AL	31 —,,—	35 —,,—	105 —,,—	280 —,,—
15 Yrs.	0.021 R	2.5 mm AL	16 —,,—	16 —,,—	86 —,,—	242 —,,—
20 Yrs	0 026 R	2.5 mm A2	15 —,,—	13 —,,—	44 —,,—	124 —,,—

* A Value of male risk of 37 per million means one cancer case in about 27,000 exposures.

both in case of staff and patients since there is a relative paucity of facilities in developing countries. As for the well equipped clinics with adequate shielding and care little harm is done to staff and the risk is acceptable. As for the lower rung units conditions are apalling; with potential risk for both the patients and staff and much needs be done to regulate these units. Gonadal irradiation must be avoided in early and middle age group whenever not necessary. A long term projection of gonadal irradiations to a fair portion of population (that is going to bear progeny) indicates accumulation of abnormal elements in the genetic pool and this can be real cause of concerns cancer risks in the exposed populations is going to increase but no generalisation can be possible in this regard. Early age of exposure, no of exposures, procedures involving high dose to susceptible organs are all risk factors to be watched.

(*Ctd. Page 14*)

A BOMBAY journalist and the Medico Friends Circle, an organisation wedded to protecting medical ethics, have done well to challenge the legal validity of the stand taken by the Maharashtra Medical Council (MMC) that journalists and members of the public cannot attend inquiries conducted by it against doctors. What is more heartening is that the Bombay high court has granted permission to the petitioners to attend a specific inquiry in which they had evinced interest, even though the petition has yet to be admitted. It is difficult to understand how a statutory body can routinely hold in-camera inquiries in matters relating to medical ethics, which are of utmost importance to the people. The act establishing the MMC grants it powers of a civil court. which makes it all the more necessary that the proceedings be open to all except in extraordinary cases.

(Source : The Times of India, 8 March 90)

III

FOOD IRRADIATION – THE NEW TOY ?

A. T. Dudani

Although food irradiation has been in use in U. S. A. for almost 30 years it has not caught up largely on account of the now well known, small but crucial Delaney Amendment in 1958 to the Food, Drugs and cosmetic Act which described food irradiation as an "additive" instead of "Process". This puts the onus of proving safety of any additives squarely on the manufactures. The rationale being that irradiation resulted in new molecules in food that were not present before. To date some 30 countries have permitted commercial irradiation of 28 different food items. World–wide annual capacity of food irradiation is about 4 724 lakh tonnes - bulk of which is being used for wheat (4 lakh tonnes) and the balance for spices, fruits and vegetab'es and seafoods.

Canada has so far sold some 134 Food Irradiators world-wide, including 4 to India largely for use in sterilisation of medical products. However in 1979, India exported one Irradiator to Indonesia. This country is endeavouring to enter food irradiation in a big way and some 5 Food Irradiators are at present in the process of fabrication and installation in addition to 4 already in operation.

How Irradiation works ?

Whan radiation strikes other material it transfers energy. At a certain level this radiation knocks out elections from the atoms of the material exposed-which in turn breaks the molecular structure of the material yielding ions or free radicals-hence the term ionising radiation. The ions being chemically very active, easily re-combine with surrounding material. These give rise to potentially toxic material products (URPs for short). While many of the URPs are similar to those that occur in cooking of food, some are unique to irradiation and have been implicated in causation of cancer. Formation of URPs has been found to be relared to the dose of irradiation used. For example 10 KG. results in about 306 mg of URPs per kg of food. Thus, irradiation triggers chemical reactions causing gross disruption of the DNA in the cells, thereby inhibiting cell growth or division. Whereas USA permits at present 1 KGy (equivalent of ten million chest X–Rays) in India dose of upto 10 KGy has been permitted.

Irradiation Process :

This itself is not very complicated. Food is placed on a conveyer belt which takes it to a chamber and source of ionising irradiation. Protective casing is removed enabling rays to go through the food and its packing.

The dosage as also the amount of exposure ranging from several minutes to several hours is pre-determined.

Radiation doses are expressed in terms of Grays (Gy) or in rads (radiation absorbed dose); one Gy equalling 100 rads (1 Kgy equal to 100,000 rads).

Areas of concern :

There are essentially 4 main areas of concern regarding widespread use of ionising radiation to sterilise, disinfest or stabilse food.

Firstly the chemical impact of heavy doses on the food itself to ensure that mutagenic or carcinogenic compounds or URPs are not formed.

Secondly Whether the food is rendered safe from 3 poilage microbes and pathogens like botulinum and that irradiation does not give rise to mutants which produce increased amounts of highly undesirable products such as aflatoxins.

Thirdly that vitamins and amino acids, minerals are not destroyed. A new area of concern is the possible deleterious effect of irradiation on antioxidants and other additives in foods.

Fourthly that Irradiation plants do not create any threat either to environment or any undue occupational health hazards by way of accidents, disposal of waste or transport or radioactive material.

What is the record ?

There is irrefutable evidence that irradiated foods suffer a significant loss of vitamins A, B, C & E and some essential amino acids, Depending on doses, in apples 70% loss of Vit. C has been reported. in case of wheat flour, 67% of thiamine was lost on irradiation and 8 months storage as against 25% loss in the non-irradiated control. Likewise in rolled oats the corresponding loss of Vit. E was 85% and 26% respectively.

USDA has reported that thiamine content of bacon in raw cooked or freeze driad form degraded at significantly highter rate during cooking if the bacon had been irradiated.

Some dangers :

Studies have also shown that gamma irradiation was unable to inhibit botulinal toxin production in frankurters if normal salt content was reduced

Stimulation and rapid division of naturally occuring aflatoxin-producing moulds has also been observed in irradiated foods. Aflatoxins are 1000 times more carcinogenic than the banned pesticide Ethyl dibromide for which irradiation has been suggested as a possible substitute. That fact you cannot see it, taste it, smell it or even test for it, also poses problems of misuse.

Call for Ban :

It is not therefore surprising that British Medical Association. and more recently the European Parliament has called for a ban on food irradiation. Several scientists, including 2 Nobel Laureates, Linus Pauling and George Ward have also supported a ban on food irradiation specially in view of results of trials at National Institute of Nutrition (NIN) Hyderabad during 1973-75 which showed polyploiding in blood, which has been linked with cancer. Although this work was caught up in a fierce controversy, recent evidence notably from Canada, U. K. & Australia supports the results obtained at NIN. Studies from US and Japan Radiation Research Foundation, Tokyo also show that harmful effects of nuclear radiation from Atomic bomb 42 years ago had been grossly under-estimated due to faulty calculations and US reluctance to provide information.

Moratorium pending safety assurance :

A conference of delegates from 9 Asia—Pacific countries co-sponsored by International Organisation of Consumer Union, Penang which met at Cenberra 9-11 November, 88 has in a Declaration urged W. H. O. to re-open the issue and also called for a world-wide moratorium on further use and development of food irradiation until various issues were sorted out. This is considered feasible since safe alternatives already exist, which can be further developed. Agency has been created under the Secretary, Ministry of Health, as Chairman to deal with all matters relating to irradiation or foodstuffs.

It does seem surprising that while this country faces the imminent prospect of its irradiated food exports being banned in several countries and boycotted in others, it is going ahead with building 5 new commercial irradiators (hopefully not for exports).

(*Background Paper for XVI Annual Meet of MFC*)

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REPORT OF XVI ANNUAL GENERAL BODY MEETING OF MEDICO FRIEND CIRCLE

The XVI annual general body meeting of Medico Friend Circle held on 29th January 1990 at Gandhigram Rural Institute, Dindigul Dt.,Tamilnadu. Aronnd 35 members attended. The meeting started at 11.00 A. M. A brief report of the proceedings is given below.

Annual meet in 1991 :

Medico Friend Circle in its last meeting of the core group at Sevagram, Wardha critically looked at the relevance of one-theme annual meets so far organised by it. Many members felt that :

—the topics for meet are chosen one year in advance on the basis of their topical importance. However by the time of the annual meet many other important issues emerge, for which there is no time for discussion.

—one theme discussion in annual meet also does not let the expertise available even within MFC members on different health aspects to be shared with other participants and interested members.

—one theme meet has restrictied the discussion on a particular topic for one time. It does not allow follow-up discussions and not provide the interest and the expertise on the issue to grow. This has led to a very high incidence of change in membership and also the participation in the meet.

Hence, after discussion in this meeting, it was decided that annual meet in 1991 will be of

three days duration and shall have multiple themes for debate / discussion. Different topics on which discussions will be organised are :

—primary health care revisited

— alcoholism and health

—sexually transmitted diseases

—privatisation of health care

Persons within MFC have taken up responsibility to prepare on these themes. The dates and venue of the meet shall be decided latter.

Core Group /Mid-Annual Meet

This will be held from June 9 to 11, 1990 at Sevagram, Wardha. "Role of MFC like group in contemporary health movement and how it can become a more active and vibrant organisation of health activism" are some of the important issues nagging the members of MFC since quite sometime. In last few core groups, some discussion on these issues have taken place. Many members have felt that in order to work out a detailed strategy to revitalise MFC, there is need to have a lengthy discussion. Hence, it has been decided to devote all three days in mid annual meet for this purpose. The meeting will be an extended core group in which all the current members and other interested persons will be invited.

Involvement in the issues Related to Bhopal

During the non-theme discussion, Sathya and Nishith reported in detail about the current health problems of Bhopal victims, the secretive attitude of Government research institutes towards the data generated by them and new possibilities of work in Bhopal because of changed political scene. After discussion it was felt that the work among Bhopal victims is sensitive and demanding and so far experience of such a work has not been encouraging. In this context given MFC's loose and complex organisational structure today, MFC as a body will not be able to undertake any major or continuous responsibility in Bhopal in near future. MFC would however co-operate with other groups and individuals whenever possible. Nevertheless, MFC has decided to demand from Indian Council of Medical Research ond other research bodies involved in research studies among Bhopal victims to release the reports and conclusions of their studies for the knowledge of victims and to supplement the medical work and research undertaken by non-governmental organisations for the benefits of victims. It was also decided that MFC would request to those advisors of ICMR who are sympathetic, to suggest ICMR to release the reports of its studies conducted by it, If ICMR does not respond favourably, MFC will take recourse to legal action. MFC would also encourage members to cooperate and assist other groups and individuals in medical work in Bhopal, in their individual capacities.

MFC Bulletin

"The present circulation of the bulletin is around 350 and there is an urgent need to increase it". It was also discussed that members, especially core group members should take up responsibility to write articles for publications in the bulletin regularly.

Anthology : Medical Education–Reexamined

The manuscript of this book is ready and will be printed soon. An active search for cheaper press and necessary funds is on. March has been fixed as deadline for printing.

NET-EN Booklet

Initial big report on Net-En was prepared by Sathya and Nalini for writ petition filed in the Supreme Court to stop the pre-market trial, unless proper and long term studies have been done. Later on Anant condensed the report for publication as a booklet. All comments on the draft has been received and it is left on the editor of the booklet to decide which of the comments to publish alongwith the draft. Hopefully, it will be ready soon for sale.

Problem of Foreign Contribution Registration

Nimitta Bhatt of the Trust for Reaching the Unreached, Baroda through a letter informed about the problems of newly created organisation to get registration under the Foreign Contribution Regulation Act of the Govt. of India. She also sent a copy of the resolution passed by their organisation. The general body decided a resolution to be sent to relevent authorities to provide registration to newly created organisations as soon as possible and also to simplify the procedure of getting it.

All India Meet of Health Activists–

The third all India People's Science Congress to be held at Bangalore from 8th to 11th March 1990 is also organising First All India Meet of Health Activists. MFC has been invited and requested to send 5 delegates. Amar, Anant and Narendra volunteered to participate. Ravi and Thelma will be requested to participate on behalf of MFC.

ORGANISATIONAL MATTERS

Budget-

Audited accounts of the year 1981 and till 31st March 1989 were placed and passed by the general body. M/s. V. K. Bansal and Associates was once again appointed to audit the accounts of MFC for the year 1989—90. A new budget for the year 1990—91 was worked out and passed.

Selection of Executive Committee Members–

Ravi Narayan, Sathya and Dhruv retired by rotation after completing two years. Anil Pilgaonkar, S. Sirdhar, Unnikrishnan and Narendra Gupta continue to be the members in their second year.

Election of New Convenor

Narendra Gupta completed his two year term in February 1990 and wished to be relieved. Anil Pilgaonkar has been elected as the new Convenor of Medico Friend Circle and he will take over from April 1990 after the end of current financial year. From April 1990 the organisational office of Medico Friend Circle will shift to 34-B, Noshir Bharucha Road, Bombay 400 007.

Narendra Gupta
Convenor

PRESS RELEASE

HEALTH BODY SAYS NO TO NUCLEAR ENERGY

Medico Friend Circle (MFC) in its XVI th Annual meet on "Radiation and Health" held at Gandhigram Rural University from 26th to 28th January resolved to oppose the production and use of nuclear energy as being too hazardous for the health of human beings and to demand that existing nuclear facilities be de-commissioned and no new nuclear plants be built.

MFC held an indepth critical discussion primarily on the health hazards of nuclear power plants. During this discussion, it was pointed out that authorities all over the world have concluded that the quantum of radiation, how so ever small, invariably cause damage to human tissues and that there is no level of radiation that can be considered safe. Production of nuclear energy damages the health of the people through exposure to ionising radiation at all stages of operation. Mining and milling, transport of radioactive material, burning of nuclear fuel in the reactors, storage of spent nuclear fuel etc. cause radioactive contamination of the environment. There is enough scientific evidence to this end. Moreover what is of grave concern is the nature of the health hazards caused by ionising radiations which could range from cancers, damage to the foetus, genetic mutation after many generations and would be carried over to future generations as well.

The MFC meet underlines the special significance of these health hazards which would affect the very quality of human race in the future generations to come. Added to this is the predicted adverse effect on the power to resist infectious organisms and other stresses. These alarming health hazards are reasons enough to outright reject nuclear power.

The participants of MFC meet emphasised that apart from these major health hazards, there are many other important health problems like increased incidence of allergies, asthma, high blood pressure, hypothyroidism, reduced fertility, spontaneous abortion etc. Thus on health grounds alone, nuclear energy is to be rejected in absolute terms with little need to base our judgement on the comparative analysis of health hazards of different sources of energy. Any source of energy which threatens the very survival and quality of human species has to be rejected and human society must find a model of development compatible with safe energy sources. During the course of the discussion it became clear that the health hazards of

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nuclear energy cannot be minimized despite claims to the contrary. Above all, the problem of safe disposal of radioactive waste for thousands of years has yet to be solved.

Today, nuclear energy constitutes only 1% of total electricity produced in India, shutting down of nuclear power plants will thus not result in a crisis on the energy front. The 1% deficit for which the nuclear energy is being produced can easily be overcome by saving electricity losses in transmission.

The MFC meet has also drawn attention to the health hazards of repeated exposure of pregnant women for prolonged periods to visual Display Terminals (Screens) attached to Computers.

The MFC meet, while affirming the well established immense value of radiological investigations has drawn attention to the fact that additional cancers do in fact occur due to exposure to X—rays. The incidence of additional cancers is extremely low and depends upon the age, sex of the person exposed and the quality of radiological apparatus. It has been estimated that in case of adult male persons exposed to these X—rays, there would be 15 additional cancers per million X—rays. Compared to the number of lives saved, & diseases diagnosed this risk is extremely low. But nevertheless it follows that X—rays must be kept to as minimum as necessary and secondly all the precautions necessary to maintain the X—rays units properly have to be meticulously followed. On both these counts the situation in Indie especially in Taluka places etc., is much worse than in the developed countries. Screening machines are much more hazardous because their exposure is many times more and hence it should be restricted to the absolute minimum. Atomic Energy Regulatory Board must exercise its powers to regulate the quality of radiology units.

(Ctd Page 9)

8. References :

1) Manual on Radiation protection in hospital and General Practice : Volume 1 By C B Braestrup & K J Viktelof. WHO Publication. Geneva 1974 PP 28, 29, 31, 27.

2) X—RAY. HEALTH EEFECTS OF COMMON EXAMS ; By John W Gofman & Egan O 'Connor, Sierra Club books, San Fransisco 1985 PP 86, 87, 2. 349

(Background Paper for XVI Annual Meet of MFC)