DMAT調整本部におけるチームとしての活動の重要性

特にロジスティックの重要性

福島県立医科大学附属病院　救命救急センター
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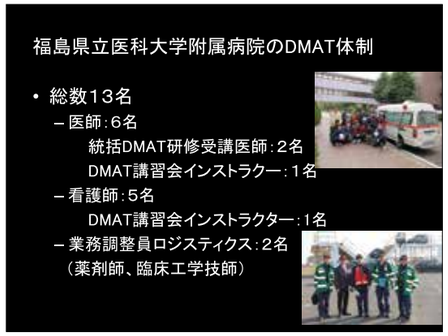
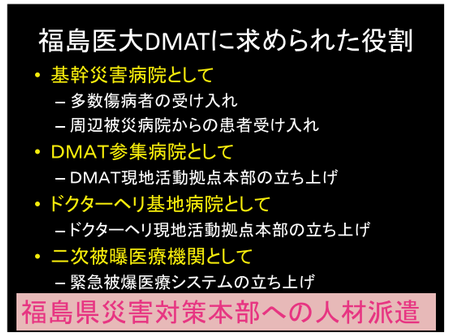
島田　二郎，田勢長一郎

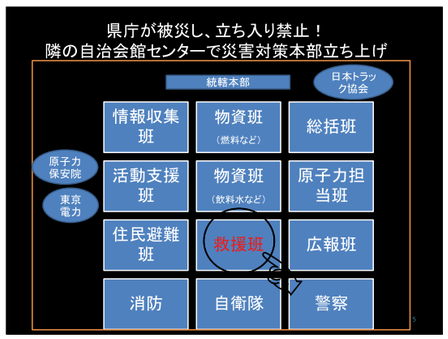
福島県における東日本大震災は、地震、津波、原発事故、そして風評被害が重なった複合災害である。この中でも原発事故が引き起こした災害は多くの医療問題を引き起こした。 今回、我々は、福島県災害対策本部において、これらの医療問題の対応にあたったＤＭＡＴの活動を検証したので報告する。



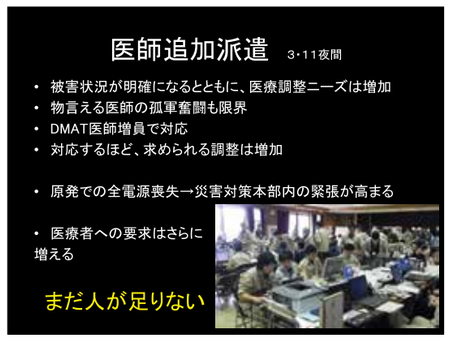
震災当時の当院のDMAT隊員は総数13名、その内訳は医師６名、看護師５名、業務調整員２名。うち、統括講習修了者は２名、DMAT講習会インストラクターは医師・看護師それぞれ１名であった。



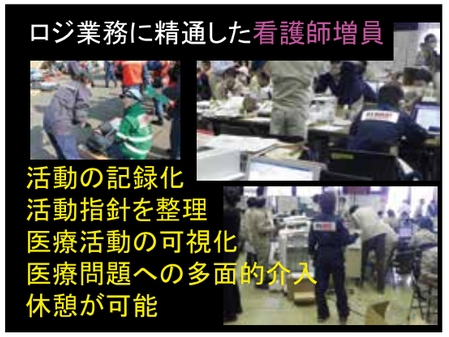
このような人材構成の中、当院DMATに求められた役割は、スライドに示すごとく多岐にわたり、さらには、県庁災害対策本部への統括DMAT派遣も重要な役割であった。しかし、統括DMAT医師の院内業務は多忙を極め、苦渋の選択として、統括研修は未受講であったが行政に対し物言える救急科教授を県庁に派遣した。



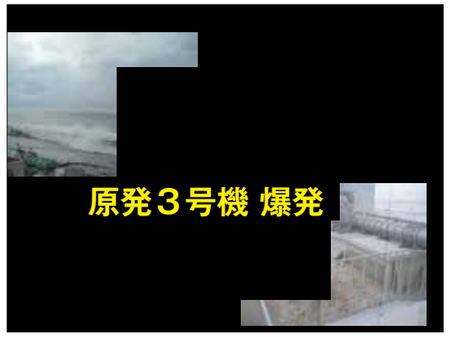
福島県災害対策マニュアルには、災害発生初動期のDMATによる医療活動支援がうたわれている。しかし、災害対策本部内にDMATの受け入れをする部署はなく、消防や警察、自衛隊などとともに救援班が設置され、そこで医療問題が検討されていることを掴み、半ば強引に救援班の中に席を確保し、DMATの調整というよりは、県内全体の医療調整を始めた。



医療調整業務は多岐にわたり、派遣医師の孤軍奮闘も限界であった。そこで医師の追加派遣を行った。
しかし、医療ニーズは増加の一途をたどり、調整をすればするほどさらに調整が増えるという悪循環に陥った。また、この時期に明らかになった原発の全電源喪失は、災害対策本部内の緊張を高め、医療者への要求は更にふえた。つまり、まだ人が足りなかった。



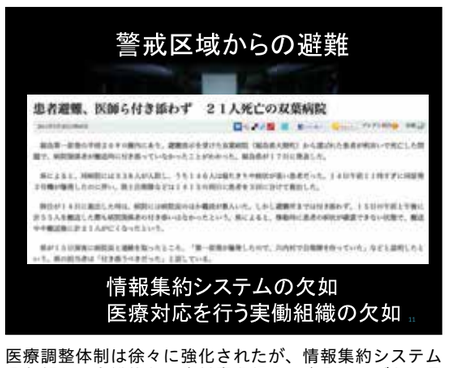
これに対し、発災翌日、さらに看護師１名を調整本部へ派遣した。派遣者はこれまでの災害訓練において、本部ロジ業務に精通していた。その結果、活動を記録し、活動指針を整理する事で、救援班における医療活動の可視化がすすむようになった。さらに、保健所などと連帯し多面的な医療調整を行った、また、医療者の休憩が可能になった。



そんな中、１号機に続き、３号機の爆発が起こった。

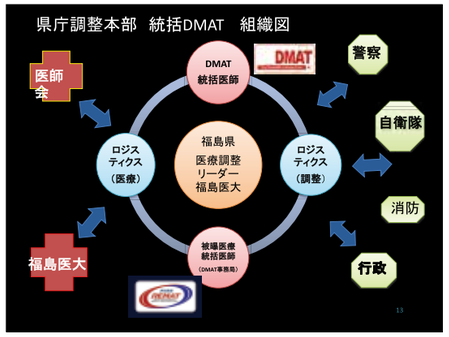
この爆発事故により、被曝に関する情報提供と放射線スクリーニング体制の構築が強く求められた。
しかし、我々医療班の被曝医療に関する知識は乏しく、チームはその機能を失いかけていた。

そこに、放射線被曝に精通する福井大学DMATが参入、さらに、放射線医学総合研修所（放医研）から、REMATが本部入りし、被曝対応は、無の状態から前進を始めた。



医療調整体制は徐々に強化されたが、情報集約システムの欠如と、実働的な医療対応を行う医療チームがないことで、原発20km圏内の病院避難では医療搬送が行えず、搬送中の死亡という悲劇の一因になった。

ここにＤＭＡＴ事務局チームが参入、カリスマ医師のリーダーシップにより、崩壊しかけた医療と行政の連携が再構築された。
事務局ロジの参入は事務処理能力を向上させ、医療情報集約システムを確立させた。さらに、医療実働部隊としてDMATを再招集した。
そして新たに災害医療と被曝医療の調整本部を立ち上げ、ここにDMATと放射線サーベイチームの融合が完成した。



このような過程を経て、強力な医療調整チームができあがり、この後に起こる30km圏内の病院避難では、様々なトラブルをチーム力で乗り切り、１人の死者を出すこともなく、避難を完了し得た。

この病院避難は、医療調整チームだけでは行えるミッションではなく、自衛隊など各機関の協力はなくてはならなかった。搬送計画を立案するリーダー医師は、院内調整を終え、遅れて参入したため、当初、災対本部内に人脈はなかった。各機関との交渉を支えたのは、災害当初から各機関と友好な関係構築を図っていたロジスティクスの功績があった。

そのほか、おのおののリーダー医師がその実力を発揮できたのは、さまざまな場面で、陰ながら交渉を行ったロジスティクスの努力があったことは否定できない。

ロジスティクス養成の重要性

- 統括研修は現在、医師のみが対象
- 県庁内、医療調整本部において、ロジスティクスの担う役割は重要
- 県庁内で、行うべきロジスティクスの役割は明確にされていない
- 統括チームとして活動するロジスティクスの養成研修の開催が望まれる

大規模災害では、予想されたとおり災害対策本部において医療班の果たす役割は重要なものであった。その対策として、現在、統括DMAT研修が行われているが、対象は医師に限られ、ロジの役割は明確にされていない。今回、我々が経験した活動から、自治体災害対策本部における医療調整活動では、統括医師ばかりでなく、それを支えるロジとともにチームとして機能することが重要であることが、改めて明らかになった。今回のロジの対応は、学びながら対応したと言える。この経験を生かし、今後、統括チームとして活動するロジの養成研修の開催が望まれる。

結　語

- 大災害では、種々の医療調整が求められ、行政内に構築されるべき医療班は、DMATの調整業務だけにとどまらない
- 統括医師だけでは業務の遂行は困難で、有能なロジスティクスを含めた、チームでの活動が必須である
- 災害時、行政内で統括チームとして機能できるロジスティクスの養成研修が必要である

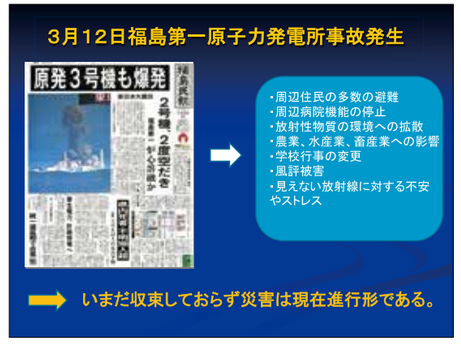
結語：大災害では、種々の医療調整が求められ、行政内に構築されるべき医療班は、ＤＭＡＴの調整業務だけにとどまらない。
統括医師だけでは業務の遂行は困難で、有能なロジを含めた、チームでの活動が必須である。
災害時、行政内で統括チームとして機能できるロジの養成研修が必要である。

（参考文献）日本集団災害医学会誌 vo.17 №.1

これからのフクシマの循環器看護を考える

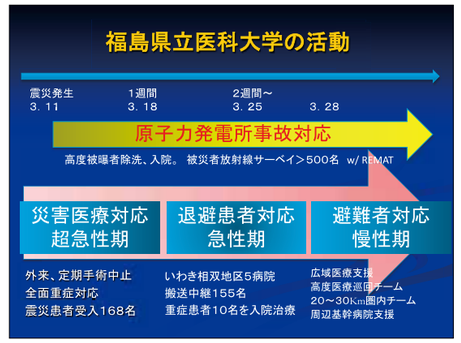
公立大学法人福島県立医科大学附属病院　救命救急センター
齋藤　紀子

東日本大震災では福島県でも最大震度６強を観測し、その後の津波により、太平洋沿岸部は甚大な被害を受けました。



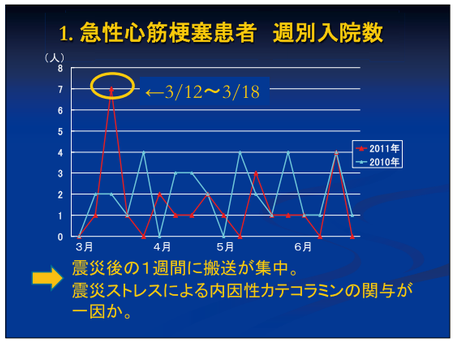
ほどなく東京電力福島第一原子力発電所の原発事故が発生しました。放射性物質の環境への拡散により、周辺住民はいまだ避難を余儀なくされ、農水、畜産業への影響など被害は多方面に及んでいます。福島は、地震、津波、原発事故という三重苦に見まわれました。いまだ事故は収束しておらず、福島県における災害は現在進行形であるといえます。

私の勤務している福島医大は原発から約60キロ離れた福島市にあります。

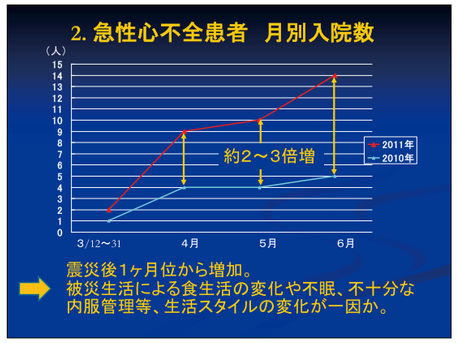


当院での震災後の活動についてですが、震災後は、即座に災害医療対応に切り替え、傷病者の受け入れを積極的に行いました。

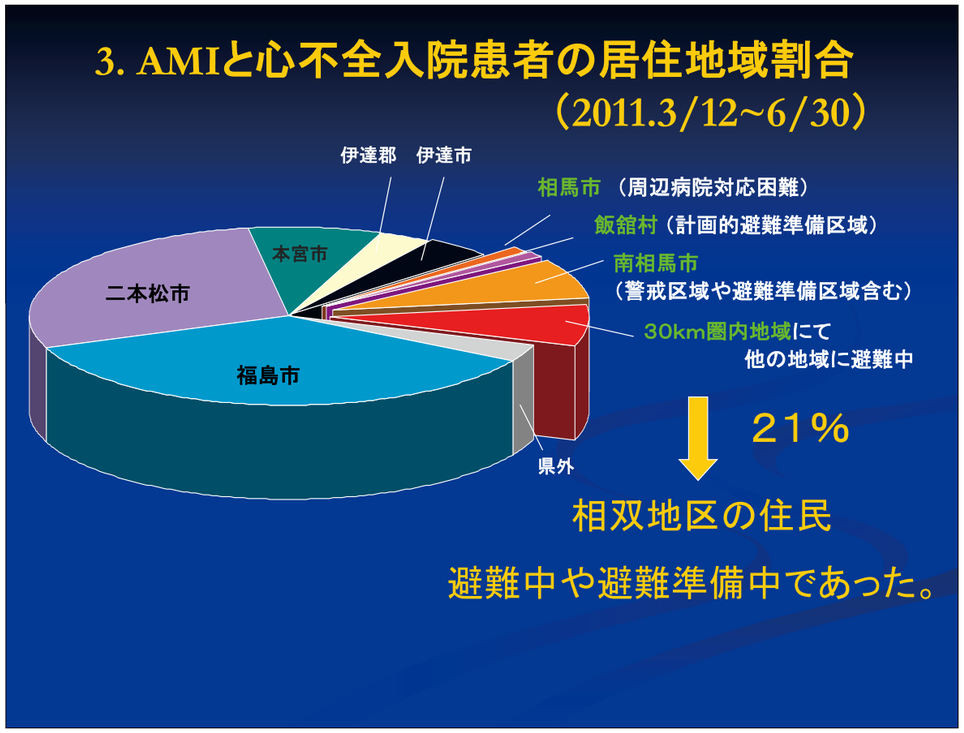
原発事故の発生により、原発周辺病院からは、陸路、空路で、のべ173名の搬送がありました。



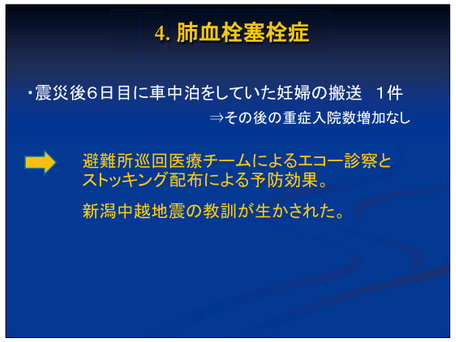
震災の心疾患への影響をみるために、救命センターCCUの入院患者数を検討しました。
急性心筋梗塞は、前年と比べ月ごとの入院数には大きな変化はなかったものの、震災後１週間に集中して搬送がありました。この一因として、震災ストレスによる内因性カテコラミンの関与を考えました。



急性心不全の入院は、４月に入り増加がみられ、震災後３ヶ月間では、前年と比べ２倍から３倍の増加がみられました。慢性心不全の急性増悪によるいわゆるリピーターの患者さんが多く入院してきました。
震災後は食料不足により、インスタント食品の摂取や野菜不足など私自身も経験しました。これら食生活の変化や、不眠による生活リズムの変調や通院が困難になり処方が一時的に切れてしまったりといった不十分な内服管理など、震災ストレスに加えこれらライフスタイルの変化が一因と考えられます。

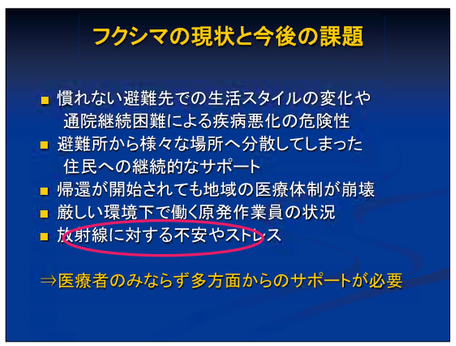


急性心筋梗塞と心不全入院患者の居住地域の割合ですが、近隣の市町村以外に約２割が、原発周辺の相双地区といわれる場所の住民であり、福島市や二本松市の避難所や、親戚の家に避難中であったり、避難の準備中であった方たちでした。また、地域の病院で収容困難との理由で搬送されてきた例も含まれています。

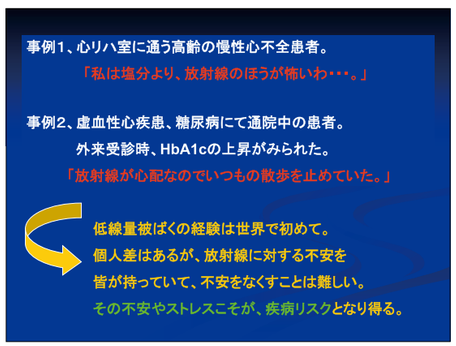


震災後、増加が心配されていた肺血栓塞栓症については、重症例１件の搬送がありましたが、その後の増加はみられませんでした。これは避難所巡回チームによるエコーを用いた診療とストッキング配布による予防効果を考えました。
新潟中越地震後に増加した肺血栓塞栓症ですが、今回はこの教訓が生かされたといえます。

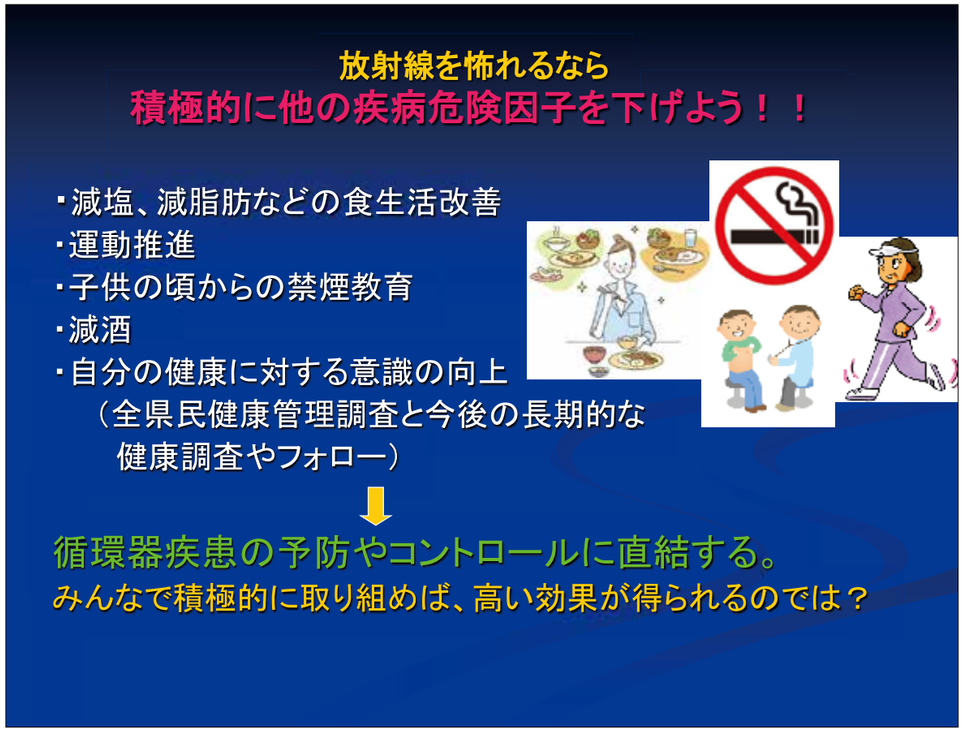
当院巡回チームの活動を紹介します。チームエコとして、心臓血管外科医、循環器内科医が中心となり、さらに、ヨルダンからの医療チームも加わり、DVT診断チャートでのスクリーニング後、ハイリスク群へのストッキング配布や生活指導が行われました。のべ、2,217名中、リスク所有者は945名にのぼりました。大きなDVTが見つかった11名に対しては、近医へ搬送し入院加療が行われました。基礎調査や運動、水分摂取指導、ストッキング装着指導、パンフレット配布には看護師も関わりました。



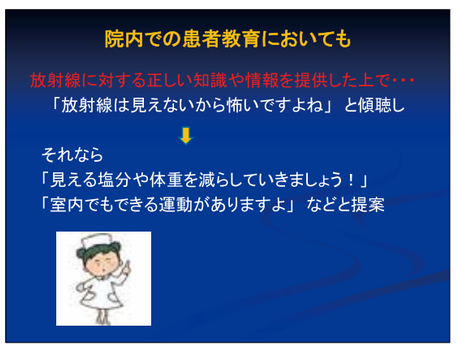
福島の循環器看護にも関わる現状と今後の課題ですが、まず、いまだ避難住民が多数であり、疾患を抱える方は、慣れない避難先でのライフスタイルの変化や通院継続困難による疾病悪化の危険性があります。また、一時避難所が閉鎖となり、県外も含め、様々な場所へ分散してしまっています。さきほどのチームエコが、DVTハイリスクと診断された多数の方たちも継続的調査や支援が必要であるにも関わらず、サポートできていないのも現状です。また、避難区域が解除となり、住民の帰還が始まる地域もありますが、医師や看護師不足など周辺地域の医療体制崩壊の問題もあります。さらに、現在も厳しい環境下で日本各地から集まった多数の作業員が従事しています。中高年男性作業員の中には、基礎疾患を抱えている方もいるとのことです。



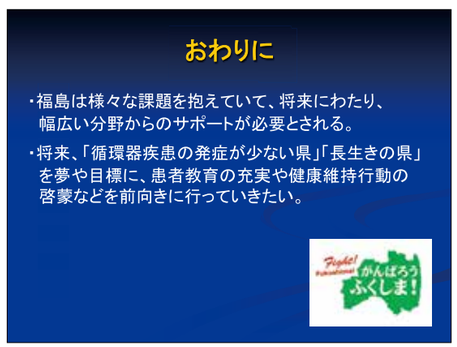
病院で実際にあった事例を紹介します。まず、心リハに通う、高齢の慢性心不全の患者さんです。看護師との会話中、塩分より放射線が怖いわとの発言がありました。次に虚血性心疾患と糖尿病で通院中の方です。受診時にHbA１Cの上昇があり、血糖コントロールが不良になっていました。主治医が話を聞くと、震災以来、日課にしていた散歩を止めていたそうです。今回の原発事故は、低線量被曝という世界で初めての経験になります。それゆえ個人差はありますが、私自身を含めて、放射線に対する不安は誰もが持っている現状です。そして、その不安をまったくゼロにすることは難しいと感じています。しかしその不安やストレスこそが疾病リスクになるのではないかと考えます。



そのように、放射線によるリスクをおそれるのであれば、逆の発想で、積極的に他の疾病リスクを下げればいいのではないかと考えました。食生活改善や運動推進、禁煙教育。それに加え、現在、全県民対象の健康管理調査や子供に対する甲状腺検査が開始されました。これにより、一人一人が自分の健康状態を意識しています。これら、日常生活習慣の改善や健康意識の向上は、いうまでもなく、循環器疾患の予防やコントロールに直結します。みんなで取り組めば、はるかに高い効果が得られるのではないでしょうか。



院内での患者教育においても、私たち医療者が放射線に対する正しい知識を得て、情報提供した上で、見えない放射線に対する不安の訴えを認めつつ、それなら、塩分や体重など見えるところからがんばりましょうなどと声かけしていくなどの工夫も、今後必要と考えられます。

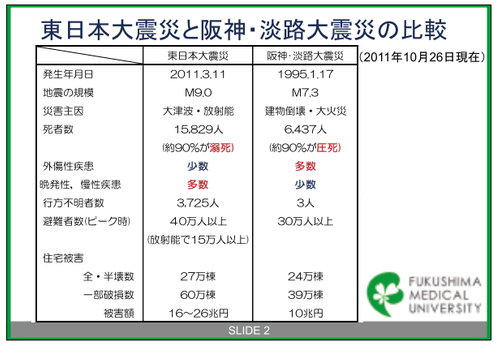


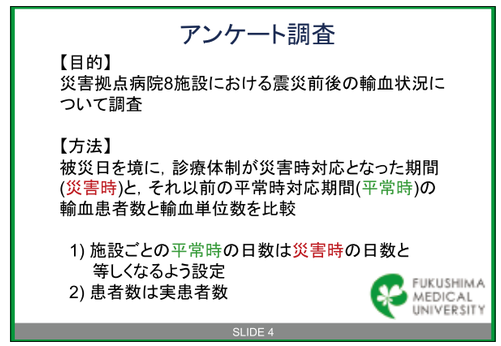
最後になりましたが、現在福島は様々な難しい課題を抱えていて、将来にわたり幅広いサポートが必要とされています。しかし、一人一人ががんばって疾病リスクを下げる努力をした結果、将来、循環器疾患の発症が少なく、長生きできる県と言ってもらえることを夢や目標にして、患者教育の充実や健康維持行動の啓蒙など、看護師としてできることを前向きに行っていきたいと考えます。

東日本大震災時の輸血 ～福島県災害拠点病院における対応～

福島県立医科大学附属病院 輸血･移植免疫部[1]，救命救急センター[2]，太田西ノ内病院 臨床検査科[3]，
白河厚生総合病院 検査科[4]，磐城共立病院 中央検査部[5]，福島赤十字病院 検査部[6]，
会津中央病院 臨床検査科[7]，南相馬市立病院 臨床検査科[8]，県立南会津病院 薬剤部[9]
○安田　広康[1]，渋谷　理絵[1]，塚田　泰彦[2]，渡辺　隆幸[3]，菊池　良子[4]，
鈴木久仁子[5]，菅野　和典[6]，大戸　高広[7]，嶋田　里子[8]，市橋　淳[9]，大戸　斉[1]

今年３月11日に発生した東日本大震災後の、福島県災害拠点病院における輸血状況と対応についてご報告いたします。





1) 福島県災害拠点病院の体制

震災翌日から一般外来診療や定期手術は一定期間休止，
救急患者や被災者への対応を優先

2) 各施設の災害時対応期間

	福島日赤	福島医大	南相馬	南会津	太田西ノ内	磐城共立	白河厚生	会津中央
期間	3/11-4/3	3/11-4/1	3/11-4/1	3/11-4/1	3/11-3/31	3/11-3/27	3/11-3/21	3/11-3/21
日数	24	22	22	22	21	17	11	11

災害時対応期間の中央値：21.5日

SLIDE 5

福島県災害拠点病院の赤血球製剤(RBC)在庫

地区	施設名	赤血球濃厚液の在庫(U) 平常時(目安) A	O	B	AB	災害時 A	O	B	AB
中通り	福島医大附属病院	10	10	5	3	10	10	5	3
	福島赤十字病院	0	0	0	0	0	0	0	0
	太田西ノ内病院	30	30	20	14	30	30	20	14
	白河厚生病院	6	6	6	4	26	18	10	8
浜通り	南相馬市立病院	0	0	0	0	6	6	4	4
	磐城共立病院	20	20	10	5	40	40	40	40
会津	会津中央病院	0	0	0	0	0	0	0	0
	県立南会津病院	0	0	0	0	0	0	0	0

3施設：災害時備蓄として在庫を増やした
5施設：通常体制

SLIDE 6

福島県災害拠点病院における被災日前後の輸血患者数

( )：変化率%

SLIDE 7

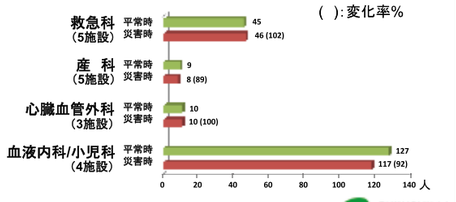
福島県災害拠点病院における被災日前後の輸血単位数

( )：変化率%

SLIDE 8

福島県災害拠点病院における被災日前後の診療科別輸血患者数

( )：変化率%



福島県災害拠点病院における震災前後の輸血製剤使用量を比較したグラフです。
輸血総患者数は、震災前635名に対し震災後457名と、72%に減少しました。
RBCは、2,685単位に対し1,938単位と、72%に減少しました。
FFPは、961単位に対し502単位と、52%に減少しました。
血小板製剤は、4,995単位に対し3,015単位と、60%に減少しました。

SLIDE 9

急性期における福島医大の役割

● **救命救急センターとして、傷病者の受け入れ・応急処置・域外搬送**

1）患者数168名（3/11～13の3日間）：大部分が浜通り地区からの搬送患者

トリアージ：
- 軽　症　93名(55%)　低体温症など
- 中等症　44名(26%)　嚥下性肺炎など
- 重　症　30名(18%)　多発外傷など
- 非治療　1名(1%)

2）傷病者の放射線量（γ線）スクリーニング：病院入り口で

SLIDE 10

急性期における福島医大の対応

● **基幹病院として、急性期医療チームの受け入れ**

1）院内に災害対策本部の立ち上げ
2）福島県災害対策本部への人員派遣
3）院内に福島県統括DMAT（災害時派遣医療チーム）の立ち上げ
4）DMAT参集拠点病院 ⇒ 約70チーム、350人
5）ドクターヘリ参集基地 ⇒ 9機

SLIDE 11

急性期の福島医大（輸血・移植免疫部）の対応

● **電子カルテや部門システムは正常作動**
業務は通常どおり実施可能と判断．

❖ 血液不足の可能性

1) 院内ドナー(15名)の確保
- ・ドナー検査
（問診，感染症マーカー，血液型）
- ・院内採血への準備
- ・採血器具の確認

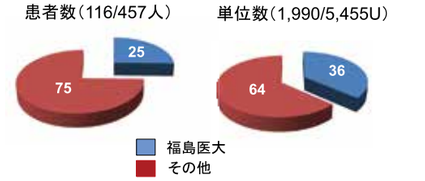
2) 血液センターへ在庫の確認
PCなど予約製剤を早めに発注

❖ 自己血採血予定者へ採血延期の連絡

SLIDE 12

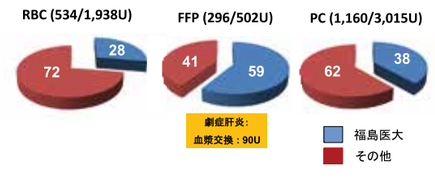
輸血部では、血液製剤が不足する可能性を考慮し、血小板製剤などの予約製剤は１週間前を目安にセンターへ発注するようにしました。
さらに、輸血部スタッフを中心とした院内ドナー15名を確保し、ドナー検査や採血器具の確認を行い、輸血製剤の不足に備えました。
また、自己血採血予定者には、採血延期の連絡を行いました。

災害拠点病院に占める福島医大の輸血患者数と輸血単位数の割合



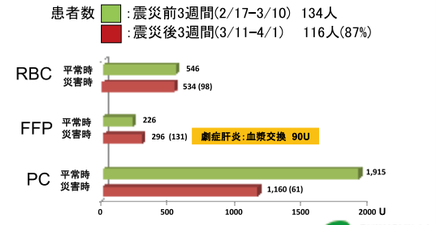
SLIDE 13

災害拠点病院に占める福島医大の各種輸血製剤単位数の割合



SLIDE 14

福島医大での震災前後の輸血製剤使用量



SLIDE 15

当院（基幹病院）における震災前後の輸血製剤使用量を比較したグラフです。
輸血実患者数は、震災前134名に対し震災後116名と、87%に減少しました。
RBCは、546単位に対し534単位と、ほぼ同等でした。
FFPは、226単位に対し296単位と、131%に増加しました。
これは、震災後に血漿交換が３回あり、使用単位数が増加したためと思われます。
血小板製剤は、1,915単位に対し1,160単位と、61%に減少しました。

福島医大の主な診療科における輸血患者数と各種製剤使用単位数

	震災前3週間(2/17-3/10) 患者数(人)	RBC(U)	FFP(U)	PC(U)	震災後3週間(3/11-4/1) 患者数(人)	RBC(U)	FFP(U)	PC(U)
血液疾患(血内/小児)	66	188	23	1,680	58	188	15	935
心臓血管外科	6	57	47	70	10*	78	61	115
産科	2	4	2	0	1**	46	30	50
救急科	6	30	16	55	3	12	4	0

* 緊急手術：解離性大動脈瘤，4例，たこつぼ心筋症，1例
** 肺塞栓症合併妊娠による大量輸血症例

SLIDE 16

産科の大量輸血症例

- 患者:40歳代　女性，妊娠32週

3.17　他の災害拠点病院より緊急搬送
　　急性肺塞栓症によるショック・心停止
　　産科にて誘発分娩にて児を摘出
　　肺動脈塞栓除去術

輸血量: RBC　46U　〔福島・東北管内センター製造〕
　　FFP　30U〔福島センター製造〕
　　PC　50U〔東北管外センター製造〕

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SLIDE 17

患者は40歳代妊娠34週の女性です。
３月17日に肺塞栓症合併での分娩のため、他施設より当院へ緊急搬送されました。
産科にて誘発分娩の後、肺動脈塞栓除去術を施行しました。
この症例に対して、RBC46単位、FFP30単位、血小板製剤50単位の輸血製剤の使用がありましたが、日赤製剤のみで対応可能であり、院内採血の必要はありませんでした。また、この症例で使用された製剤の製造場所に注目すると、RBC、FFPはすべて東北管内でしたが、血小板製剤はすべて東北管外で製造されたものでした。

日本赤十字血液センターの対応

1. 血液事業本部の主導のもと、北海道，東京，愛知，大阪，岡山，福岡のブロック血液センターから広域需給調整

2. 福島県へ搬送された輸血製剤量
〔2011年3月11日(金)～4月18日(月)の39日間〕

1) RBC　8,798 U*（平常時の26日分に相当）
2) PC　10,845 U*（平常時の29日分に相当）
3) FFP　0 U

*残余有効期限: RBC 10日前後
　　PC　2日

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SLIDE 18

福島県災害拠点病院での被災日から2ヶ月間の廃棄血量

（3.11～5.11，2ヶ月間）

	3.11-5.11(2ヶ月間)			2010.1.1-12.31(年間)		
	購入量	廃棄量	廃棄率(%)	購入量	廃棄量	廃棄率(%)
RBC	7,067	192	2.72	51,364	647	1.26
FFP	1,613	17	1.05	19,129	225	1.18
PC	9,230	100	1.08	87,405	235	0.27

・RBC：昨年の30%(192/647)に相当
・PC：昨年の43%(100/235)に相当

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SLIDE 19

まとめ

- 今震災では外傷患者は少なく，関連した緊急・大量輸血症例なし
- 福島県災害拠点病院における災害時の総輸血患者数と総輸血量は平常時のそれぞれ約7割，約6割．
- 基幹病院の福島医大では緊急手術（心臓血管外科：5例），大量輸血（産科：1例）だったが，広域需給調整により輸血製剤を確保．
- 福島県災害拠点病院のRBCやPCの廃棄血量の増加は，輸血患者数の減少や血液製剤の残余有効期限が短かったことに起因．

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SLIDE 20

今回の震災では１週間の断水はあったものの、停電はありませんでした。
また、震災による外傷患者は少なく、震災直後懸念されていた緊急・大量輸血症例はありませんでした。
血液疾患患者の減少により、震災後血小板製剤の使用量は大幅に減少しました。
産科で大量輸血が１例、心臓血管外科で５例の緊急手術がありましたが、血液製剤は東北管外の血液センターから福島血液センターを経由して供給されたため、不足することなく、院内採血の必要もありませんでした。
今回この大震災のなか、血液センターとの協力により輸血部門の機能を維持することができました。
しかし、検査、製造、供給を宮城血液センターへ集約・一元化することは、地震などの災害時にリスクを伴う可能性が示唆されました。

東日本大震災で明らかになった問題点

- 血液センターとの連絡体制
  1) 白河厚生病院の場合：血液センターへ電話が繋がりにくい
　　⇒ **災害時優先回線の整備**（or **公衆電話**が有効）
  2) 南相馬病院の場合：津波の影響で電話回線が遮断され，外部との連絡が取れない（4日間）　⇒ **衛星携帯電話の整備**
- 停電への対応（電子カルテ·システムが復旧するまでの間）
  1) 当日採血検体による輸血関連検査の実施　⇒　紙伝票
  2) 日常検査記録の活用⇒紙ベース（or HD(Excel CSV) ⇒ノートパソコン）
- 血液センターの集約化
  1) 交通網の寸断：仙台空港と東北新幹線が被災し，東北自動車道のみ
  2) 宮城基幹センターが被災した状況下で，多数の外傷患者にどのように対応するか？

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SLIDE 21

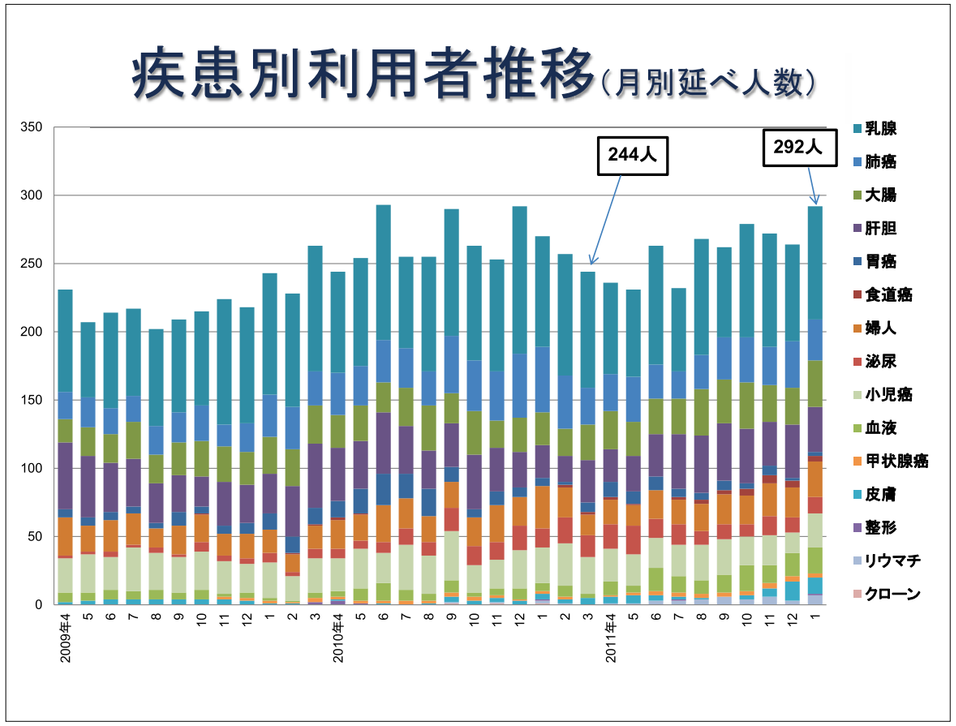
震災後のがん医療の現状

看護師の立場から　～通院治療の支援

公立大学法人福島県立医科大学附属病院　外来化学療法センター
がん化学療法認定看護師　氏家　由起子

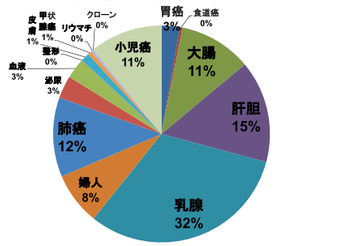
当院の紹介

- **都道府県がん診療連携拠点病院**
- **災害拠点病院**
- **二次被ばく医療機関**
- **救急指定病院（三次救急）・ドクターヘリ運航**
- **30診療科**
- **778床（一般713床、精神49床、結核14床、感染2床）**
- **医師468名　看護師710名　（平成21年4月）**
- **平均入院患者数　632名（平成21年度）**
- **1日平均外来患者数　1553名（平成21年度 入院中外来受診を除く）**



大震災の2011年３月は244件で５月までは、やや少ないようにみえるが、徐々に増えており2012年１月は、292件と過去最高の利用件数になっている。治療の場の選択も生活の場が落ち着いてきているため、混乱が無いと思われる。

疾患別利用率　2008年～2011年度まで



震災直後の外来対応

- 地震発生時･･･センター内に患者4名･家族1名
  治療中の患者は生食フラッシュ後に抜針し、
  玄関に誘導、担当医と主治医に確認し帰宅
- 外来看護体制
  救急外来支援の夜勤体制（黄･緑タッグ）
  玄関トリアージ、被ばくスクリーニング、
  除染担当
- 外来再開･･･内科系3月22日、外科系3月24日

看護師、助手が付き添った。PHSの連絡対応がすぐできた。
幸い、設備や職員も被害ない。

震災後の化学療法センター

- 被害･･･センター隣接の安全キャビネットの
  排気管のずれ　⇒地下からの搬送
  ＊福島市の断水、生化学検査できず
  ＊幹線道路が土砂崩れ、ガソリン不足
- 治療･･･3月14日から再開（1週間目は5名）
  22日より通常体制
  ＊主治医の判断と治療同意のある患者
- 治療体制･･･薬剤師（地下）、看護師1～2名
  事務1名（兼務）

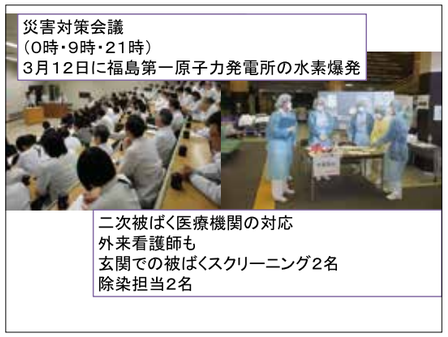
災害拠点病院、三次救急病院

被災した患者の来院を予測
院内のDMATを中心に
災害緊急医療体制の整備

外来看護師の担当
黄色タッグ･･･内科新患外来
緑タッグ･･･整形外科外来
外来看護師も急遽3交代勤務
（後に2交代）

看護学部の実習用ベッドを患者
受け入れ用に玄関ホールに

初めての体制、情報が錯綜



災害対策会議
（0時･9時･21時）
3月12日に福島第一原子力発電所の水素爆発

二次被ばく医療機関の対応
外来看護師も
玄関での被ばくスクリーニング2名
除染担当2名

緊急被ばく医療体制へ
移行

住所確認し、放射線量測定へ移動
（避難所でも除染対応可能になる）

除染棟わきに自衛隊車両やテント
テントで除染（シャワー･更衣）対応
高い線量は、千葉の放射能医学研
究所へ

REMAT：緊急被ばく医療支援チーム
DMAT：災害派遣医療チーム

震災後の看護支援

- 救急外来･･･初回治療後に発熱で受診
  初回FOLFOX後の患者来院
- 電話支援･･･救急医療体制中から看護師1名
  治療予定の患者、治療後2週間になる患者、
  相馬･双葉地区の患者など
- 安否確認と、医療体制や受診行動の説明
  看護相談
- 玄関のトリアージに外来治療予定者の連絡
  （化学療法･手術の入約患者が治療できない状況もあった）

震災後の救急体制時は、断水もあり生化学や血算の５分画はできず、初回入院でFEC施行後の退院時処方の抗生剤や解熱剤を流された。自宅は流されたが、本人・ご家族は無事であった。Day14に避難所で38度以上発熱して来院。初回のFOLFOX後で在宅抜針を70代夫婦で行った方。家族は早く治療をしたい。２クール目で来院するがday14で十分な検査ができず、AEを心配して治療せず。（後に、震災直後は入院化学療法が行えない状況で治療予定が変更になっている方がいた。）
その他：外来への問い合せが多いのは、インシュリンの方、ストーマ用品の不足の対応、麻薬処方に関すること（処方箋やお薬手帳で院外処方で対応可能）

看護師の電話支援

- 3月15日～19日が治療後2週間にあたる方
- 予約があるが、受診していない方。 **約30名**
- 原発避難地域の方

「連絡できてうれしい。」
「治療や予約ができないと思った。」
「避難先で治療をするにはどうしたらよいか？」

震災直後の外来支援内容

- 診療科の外来で予約調整して連絡
- 診療科外来から紹介状を希望する方へは郵送
- 看護電話相談を記録。主治医が患者に連絡し予約変更や安否確認をしていた。

- 臨床腫瘍センターでの相談支援
- ワンワールドプロジェクトの支援
  http://oneworldpro.jugem.jp
- 心の相談（リエゾン精神看護専門看護師）

相談支援センターの震災対応の相談件数　2011年3月

通院治療を避難先の病院で継続	16件
入院加療を避難先の病院で継続	1件
医大での外来通院受け入れ	2件
医大での入院受け入れ	2件

医療相談室の連携状況

- 震災前からの入院患者の退院支援
  31名（がん患者は48%）自宅崩壊、原発避難
- 震災後（4月30日まで）の被災者の入院
  81名（がん患者は29.6%）
  震災･原発関係で自宅退院困難者　24名
  行政連携で施設へ退院1名、転院支援2名
- 震災後（4月30日まで）の退院支援依頼票**224名（がん患者32%、自宅退院困難23．6%）**

医療相談室の連携状況

- 相双地区の医療・介護の提供体制の崩壊
  ↓
  紹介患者の増加
- 退院・転院支援の際も、
  相双地区の方の支援に難渋するケース

病診連携・地域行政連携・介護福祉連携など
多職種の連携で対応

ワンワールドの震災支援物資

＊支援物資（4月）
かつら260組（髪型の選別）
帽子（ソフト・タオル・外用）
全製品チェック
カタログ写真撮影
＊担当　がん看護専門看護師
医療ソーシャルワーカー
＊広報（病院内外）
病院内掲示、新聞・テレビ報道
＊試着
3個位選択
必要時美容院でフッティング
かつらの手入れ方法の説明
＊提供
無料提供
美容室－震災支援で無料
受領書の発行
写真撮影（無料提供）
情報公開の有無を聴取

21

事例：かつらの意義

かつら着用→日常性の復古

・before
沈んだ気持ち（顔の表情）
何も良いことがなかった
がん再発＋地震
退院後の不安
病気の進展に対する不安

・after
笑顔になる
以前の私に戻った
・効果（前向きになる）
・ショッピング感覚→満足感
・化学療法の学習意欲の啓発
副作用対策を知りたい
療養日誌記入してみたい
・夫への誕生日プレゼント

22

震災後の通院治療看護の変化

- 治療中の連絡先の確認を確実にする
- 避難経路の説明、災害時の対応の説明
- 対応の準備（フラッシュ、抜針、止血など）
- 患者の体験を傾聴する、悲嘆のケア
- 通院時の心得の説明（薬・水分・連絡先）
- がんと共に、福島で生きることを
  肯定的に支える

治療できて
うれしい！
安心した。

みんなが大変な
時なのにありがたい。
がんばるよ！

刻々と変化する状況の中で被災者に必要とされる医療および看護の専門知識を提供することであり、その能力を最大限に生かして被災地域：被災者の為に働くことである。したがって、被災直後の災害救急医療から精神看護、感染症対策・保健指導など広範囲にわたり、災害急性期における被災者、被災地域への援助だけでなく災害すべてが災害看護の対象となる。

震災後の対策

- 災害シミュレーション
- 日頃からの連絡体制の整備、信頼関係の構築
- 通院時の患者の心得
  自分の治療や薬剤を知る
  災害時の対応の指導
- ユビキタス看護に学ぶ
  http://www.coe-cnas.jp/index.html

兵庫県立大学大学院看護学研究科／地域ケア開発研究所
21世紀COEプログラム
＜がん看護ケア方法の開発プロジェクト＞

被ばく医療に関すること

- 見えない先のわからない不安
- 長期避難と生活の不安定による心身の疲労
- 子や孫への心配と生きがい・心の支えの変化

畑や田んぼがどうなるか？
作ってもあげられない
いつ戻れるかわからない
孫に遊びに来てと、言えない
近所の友達と離れてしまって
家族は避難して、自分は仕事と治療があるから

現在は、緊急被ばく医療から慢性被ばく医療にシフトした。低線量被ばく下における健康影響が課題（世界的にもデータがない）、「放射線被ばくコミュニケーション」から「放射線健康リスクコミュニケーション」にがんでも健康、低線量被ばくでも健康に「その人らしく生きる」を目指す、支援する。

がん医療の変化と課題

緊急被ばく医療から**低線量被ばくの健康管理**

1. リスクコミュニケーション　正しく怖がる
   （医師や看護師・地域住民・学校など）
2. 危機介入者の健康管理　心のケア
   （消防・警察・自衛隊など）
3. 県民の健康管理（小児甲状腺検診）
   10月　健康管理学講座開設
   県民健康管理センター　長期的支援

ずっと健康に過ごせる福島県に！！

- **がん医療・がん看護の充実**
- **不安な時に相談できる窓口の充実**

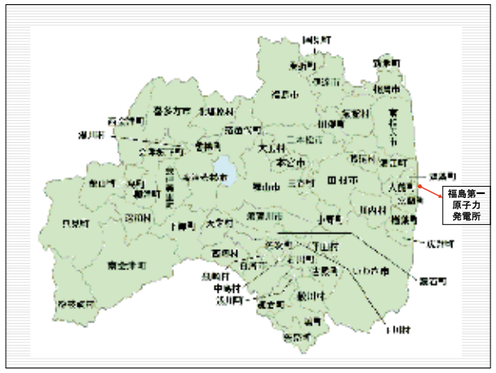
ご清聴ありがとうございました。

東日本大震災を経験して ～災害時の状況と対策について～

公立大学法人福島県立医科大学附属病院　栄養管理部　専門栄養技師（兼）係長　真田久美子

はじめに

平成23年3月11日は、後世に語り継がれる日となってしまいました。宮城県の牡鹿半島東南約130キロの三陸沖を震源とするマグニチュード9.0の巨大地震は、その後の津波による住宅の倒壊、福島県では東京電力福島第一原子力発電所の放射性物質漏れなど、未曽有の災害をもたらしています。この震災で亡くなられた方、全国各地に避難されておられる方々に心からのお見舞いを申しあげます。



東北地方太平洋沖地震

3月11日14：46分
福島県で最大震度6強
浜通りに大津波

東日本　大地震

震度７　沿岸に大津波

M8. 8国内最大　死者多数

2011年（平成23年）３月12日　朝日新聞

世界最大級Ｍ９．０に修正

速報値の45倍に

2011年（平成23年）３月14日　福島民友

福島県の被害状況

- □死者　1846人
- □行方不明者　120人
- □住宅全壊　18,113棟
- □避難の状況　49，805人

平成23年10月16日福島県災害対策本部

公立大学法人 福島県立医科大学の概要

当院は福島県中通りに位置、現在地に昭和62年6月に移転開業し、平成18年 大学の独立行政法人化に伴い公立大学法人福島県立医科大学となった。

現在30診療科・778床で診療を行っている。

- ・災害拠点病院選定（平成8年）
- ・特定機能病院承認（平成7年）
- ・エイズ拠点病院選定（平成6年）
- ・日本医療機能評価機構認定（平成18年）
- ・都道府県がん診療連携拠点病院指定（平成22年）
- ・救急病院認定（平成23年）

栄養管理部の概要

- 栄養管理部は中央診療施設に属し、大森孝一部長のもと職員数は55名（職員39名、委託16名）が担当している。
- 給食の提供は直営、食器洗浄・配膳・盛り付け補助等を一部委託している。
- 平成22年度の患者給食人員では、一般食、特別食を合わせて約57食種、1日平均1491人、内特別食593人（40%）、1食あたり497食を提供。
- 現在は保温トレイを使用して配膳しているが、今年度中に保温・保冷配膳車に移行の予定。

美味しい給食を目指して

当院の栄養管理は現在、食事が待ち遠しくなる美味しい給食の提供を目指して（業務改善アクションプラン）として、栄養士、調理師ともに様々な業務に取り組んでいる。

例として

① 調理師と栄養士の協同病棟訪問
② 嚥下訓練食ワーキングへの調理師参加
③ 先進施設の視察研修

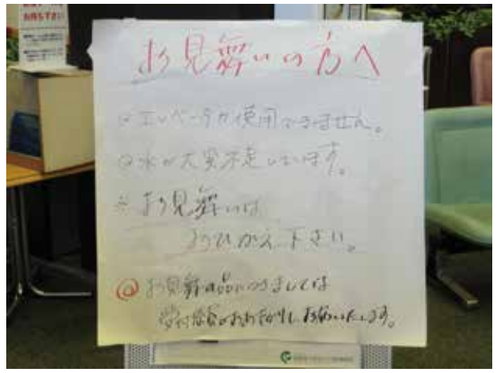
ベルトコンベアーによる盛り付け風景

地震当日の記録

穏やかな昼下がり、突然襲ってきた激しい揺れ。危険を感じてあわてて外に出たところ、ゴーといった不気味な地鳴り音とともに立っていられないほどの揺れが襲ってきた。揺れは何度も強くなったりして長い時間続き、その後は頻繁に本震と同規模と感じられる揺れが襲ってきた。揺れが最初に納まった直後には院内のすべてのエレベーターが、厨房内では蒸気が止まった。

病院機能

- 診療体制は重症救急患者に特化し、一般外来診療は中止とした。（3月11日～21日）
- 22日からは予約のみの外来を再開した。
  （3月28日から外来診療は通常どおり。）
- 入院患者は一部の重症患者の除き退院させた。
- 見舞い者の面会を制限した。
- 電子カルテシステムそのものには影響しなかった。



ライフライン

- 電気は止まらなかった。
- 直後はガスと水の確保はできた。その後ガスと上水道は止まる。
  都市ガス→12日午前1時復帰
  水→当日夕8時より使用制限
  （上水道の復旧は3月18日夕）
  蒸気→12日午前1時復帰
- エレベーターは配膳の10分前に非常用の一基のみ復旧。院内に夕食の配膳専用と放送し、配膳することができた。

地震当日夕食の献立

- 酢豚（粥食はマーボー豆腐）
- ひきないり
- 杏仁豆腐
- みそ汁

○食数519食

献立について

- 酢豚の豚肉はすでに揚げ終わっており、野菜と合わせて炒めるばかりになっていた。
- ひきないり、杏仁豆腐は盛り付けるばかりになっていた。
- フライヤーを使っていなかったことから油による火傷や引火は免れた。調理業務は行っていたが担当者は即座にガスを止めた。厨房内火災のないことを確認した。

献立の変更

- 余震が続いていたこと、エレベーターが動かない場合10階まで人海戦術で運ぶことを想定し、みそ汁はなしとする。
  （その後4月に発生した余震時は配膳時間と重なったため、院内にいた職員を集めて、10階まで人海戦術で配膳を行った。）
- 酢豚の豚肉は揚げ終わっていたことから、蒸気（ライスボイラー）で作る予定であった酢豚、マーボー豆腐、おかゆは急遽ガスを利用して大鍋で作る。

破損状況

- 厨房用エレベーター2基のうち一基は12日午前1時に復帰したが、残り一基は24日の夕食時まで復帰しなかった。
- 御茶を作るための給湯器は4、6、8、10階に設置していたが、10階は転倒し、8階はコンセントが焦げた。（転倒防止策講じる）
- 事務室脇廊下の壁、厨房内床はひび割れ多数。厨房内天井、外ダクトの天井一部はがれ落ちた。

東北地方太平洋沖地震

3月12日
地震発生2日目の記録

人員体制

- 地震当夜は国道4号線に土砂崩れがあり、道路は車が渋滞した。
  余震が続き、市内は停電となったことから、責任者3名（医事課主幹、係長、主任栄養技師）と明朝早出勤務者3名は院内に宿泊し、翌日朝食の準備に備えた。翌12日は、出勤できる人は自主的に来てもらうこととし、調理師10名、栄養士5名体制で朝4時から朝食の準備をした。

朝食の献立

- 主食（アルファ化米）粥食も同じ
- 納豆　・牛乳

（粥食はラジウム卵をビニールパックに入れて）

- ゆかりふりかけ
- 味つけのり　　〇食数531食

★アルファ化米にはパック容器、輪ゴム、ゆかりふりかけ、しゃもじ、割りばしが人数分入っている。

昼食の献立

- アルファ化米
- ハンバーグ
- ポイムのお浸し
- 八朔

〇食数506食

★下膳後に1回目の食器洗浄を実施
（使用水量11㌧）

夕食の献立

- アルファ化米
- まぐろの照り焼き
- グリーンレタス
- グレープフルーツ
- 炒り鶏煮
- 生姜和え　　〇食数446食

★下膳後に2回目の食器洗浄を実施
（使用水量11㌧）

東北地方太平洋沖地震

3月13日
地震発生3日目の記録

水節約のため食器の洗浄ができなくなった

- 主食は流動食を除きご飯のみとし、アルファ化米使用を継続。
- おかずは水を使わない調理法（お浸しは煮浸し）に変える。
- 献立の品数を減らし、皿にラップを敷き、2重にして盛り付ける。
- 保温トレイは蓋をせず、お膳はアルコールを噴霧してタオルで拭いて使用。
- 使い捨て食器を使用。

水道復旧までの院内の対応

- 13日（3日目）朝9時現在の院内の水
- 上水600㌧　中水300㌧（トイレ用）
- 水道復旧予定3月18日（7日目）
- 患者用に配る水は500mlを1本かお茶350mlを1缶にした。
- 院内トイレの水は流さない。
- 駐車場に仮設トイレを設置して、職員、面会者はそちらを使用するようにした。

食材の納入

- 生鮮食料品→市場の混乱があったが納品はできた。
- 水不足→牛乳、豆腐、納豆
  牛乳は原発の放射線の関係から原材料が入荷しないため製造できない。（3月28日まで続いた）
- ガソリン不足→米、卵、冷凍食品業者が納品できない。（米は業者を替えて納入。その他は職員が取りに行った。）

実際に提供した非常用献立

- 主食はご飯を150g程度とした。
- 重湯・三分粥は献立どおり（牛乳の替わり果汁）
- 鮮魚、納豆、豆腐の替わりのたんぱく源は魚の缶詰で代用。
- 牛乳に代わる栄養補給には経管栄養剤を小分けにした。
- 1日一人当たり1400～1500kcalを目安とした。
- これら非常用献立は3月25日まで対応した。

大地震発生時の危機管理

- 入院患者3日分の備蓄では不十分である。しかし、大量に購入すると保管の場所の確保ができない。→5日分の備蓄とする。
- 配膳用エレベーターが使えなくなった場合の対応について、休日や早朝は人海戦術の対応が困難。→震度5弱、5強時の教職員の配備体制をつくり、緊急連絡及び応急対策実施。

震災前に備蓄していた食品（一人3日分）

- ミネラルウォーター500ml×3本×3日分
- さんま味噌煮缶105g×1缶×3日分
- 白桃缶250g×2缶
- アルファ米白米100g×3食×3日分

<一人1日当たりの栄養価>
エネルギー1586kcal，たんぱく質42g，
脂質31g，炭水化物284g，水分1687ml

震災後の備蓄品（一人5日分）

- ミネラルウォーター500ml×3本×5日分
- 魚の缶詰　小缶×3缶×5日分
- 白桃缶250g×1缶×5日分
- アルファ化米100g×3食×5日分
- 粥（レトルト）200g×3食×5日分

<一人1日当たりの栄養価>
エネルギー1888kcal，たんぱく質69g，
脂質35g，炭水化物313g，水分2477ml

震災後の備蓄品（その他）

<電気・ガス・水道が使えないことを想定>

- 調理用水　20L×150本、飯用パック、デスポ哺乳瓶、割りばし、スプーン、デスポ手袋、アルコール、輪ゴム、ラップ
- ガス　1日当たり300Lのお湯を沸かす条件で5日分

〇都市ガス→ガス会社と協定書を締結した
〇プロパンガス→ボンベの保管場所を検討中

支援物資の活用

全国各地から支援物資をいただきましたこと、この場をお借りして厚く御礼申し上げます。

現在でもアルファ化米はお粥に、ミネラルウォーターは調乳用に利用させていただいております。

筍やきのこの水煮は献立に入れて有効に利用させていただき、水、魚の缶詰、粉ミルク、経管栄養剤も残さず活用させていただきました。

良かった点

- アルファ化米の備蓄があったことから、直後から温かいご飯を提供することができた。
- ミネラルウオーター等の備蓄品は病棟各階のパントリー（食堂の前室）に保管し、鍵は各階共通にして病棟の管理下にしておいたことから、患者さんへの配布が看護師さんの協力のもと比較的スムーズにできた。
- 野菜、果物は入荷できたことから献立を一部変えるだけで提供できた。

改善を要する点

- 学校給食用のアルファ化米は炊き方をマニュアル化しておく必要がある。また、ガスを使用するため、ガスが止まった場合炊くことができない。
- 牛乳に替わる栄養補助食品の備蓄が必要。
- かさばらないデスポ用食器、スプーン、はしは必要量を確保しておくか、即手配できる算段をしておく必要がある。

今後の教訓としたいこと（1）

- 断水が続いた場合を想定して、最低限の調理用水と熱源（プロパンガス）の確保は必要。
- 配膳時間にエレベーターが止まった場合を想定し、人海戦術で配膳を行うための人員の確保の方法を決めておく。
- エレベーターが使えないことを想定して、厨房で最低限必要な水とアルファ化米は厨房内に保管しておく。

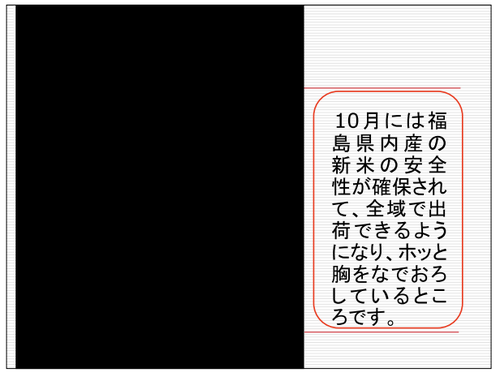
今後の教訓としたいこと（2）

- 道路が寸断されることを想定し、納入業者はなるべく近隣に確保しておく必要がある。
- 院内の貯水量と食器洗浄で使用する水量について把握しておく。
- ガソリンが不足して職員、業者が病院に来れなくなった場合について、予め対応を検討しておく。
- 常日頃使わないドアの開閉、鍵の所在など設備面を点検しておく。

おわりに

震災から7か月が過ぎ、現在では病院内も通常の業務に戻っています。今回の震災を経験して、改めて食事は患者さんの生命の源であり、携わっている栄養士、調理師のもつ使命感が困難を乗り越える一番の力となったことを実感しました。

今回、このような機会を与えていただきました山下部会長に、この場をお借りして厚く御礼申し上げます。



10月には福島県内産の新米の安全性が確保されて、全域で出荷できるようになり、ホッと胸をなでおろしているところです。

福島県の野菜・果物

Fukushima J. Med. Sci.,Vol. 57, No. 2, 2011 [Editorial]

FUKUSHIMA SYMPOSIUM：A BRIEF NOTE

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Snow rarely falls in March here in Fukushima. Though, on the particular evening that the Fukushima Daiichi nuclear plant spilled enormous amounts of radioactive materials into the environment, it was snowing.

Fukushima city recorded nearly 20 μSv per hour of radiation that night despite being about 60 km away from the plant. The radioactive materials contained in the snow seeped into the ground. This was the same ground that had given the people of Fukushima Prefecture a fruitful life.

From that day on, the accident has been nothing but torture to the people even though radiation levels have dropped to one tenth of the initial levels. The passing of several months has failed to heal the suffering caused by extreme anxiety and the mental crisis of which the people are faced with.

The Fukushima Society of Medical Science, an affiliate of Fukushima Medical University, has been struggling to protect people's health. In July, the society asked a wide variety of experts evaluating the current situation of Fukushima to hold a symposium with the theme of protecting citizens. Because of the size limit of the hall, the audience was restricted to schoolteachers, hospital doctors, journalists, the police and the Self-Defense Forces. The latter mentioned Self-Defense Forces are in direct contact with citizens and are involved in the rescue services. A local radio station later broadcasted the symposium.

An Dr. Naoki Matsuda at Nagasaki University addressed the opening lecture on basics of radiation and general health effects at the symposium. Fukushima Medical University's Dr. Tsuneo Kobayashi, a radiology physicist, gave precious and precise information on environmental radiation observed at Fukushima Medical University before and after the accident. Also, Dr. Katsuhiko Yamaguchi reported their surveillance of radiation in Fukushima Prefecture by dosimeters laid on a car. Dr. Noboru Takamura, who has been studying the health effects of the Chernobyl nuclear power plant accident in 1986, summarized his research. As another example of radioactive spillage, Dr. Kenneth Nollet gave a brief talk on his personal experience in the U.S. while growing up.

Concluding the second half of the session, Dr. Tomotaka Sofue, from the National Cancer Institute, explained his approach of evaluating radiation health effects in comparison to various health risks such as smoking, improper food intake or lack of exercise. From a sociology point of view, Dr. Naoya Sekiya analyzed how fear spreads among people often causing otherwise-unnecessary panic. Finally, we heard Dr. Kenji Kamiya, a professor of Hiroshima University and now also vice-president of Fukushima Medical University, talk about the challenges faced in Fukushima

和田郁夫，大戸　斉
http://www.jstage.jst.go.jp/browse/fms　http://www.fmu.ac.jp/home/lib/F-igaku/

during the period of emergency. Professor Kamiya also talked about his studies and other studies concerning the cellular DNA recovery system after radiation injury.

This symposium was our attempt to seek the way to properly estimate the health risk of radiation. As effects of low level radiation has been under debate, we did not seek a clear answer. Rather, we wished citizens to know what was certain and what wasn't. We hope that the symposium provided people in Fukushima Prefecture with an opportunity to consider their health risk based on trustworthy data, and that our experience can be of help to people around the world.

震災後の診療体制及び実績について

病院経営課

（1）診療体制の変更（震災直後は外来診療を重症患者に特化→その後、段階的に診療機能回復）

- 平成23年３月11日（金）～
  １次（緑）…整形外科外来
  ２次（黄）…内科新患外来
  ３次（赤）…救急外来
  （３月12日に「重症患者に特化し、一般外来は閉鎖」する旨報道機関へテロップ依頼）
  緑：93名、黄：44名、赤：30名、黒：１名　計168名
- 平成23年３月14日（月）～
  １次・２次　外科系…整形外科外来
  内科系…内科新患外来
  ３次……救急外来
  特殊外来…耳鼻咽喉科、眼科、小児科、心身医療科、皮膚科、泌尿器科の各科外来　計400名
- 平成23年３月17日（木）～
  １次・２次（外科系・内科系）
  ……内科新患外来
  ３次……救急外来
  特殊外来を一つにまとめる（心身医療科のみ単独）　計364名
- 平成23年３月22日（火）～
  内科系外来再開（予約患者のみ）…循環器内科、血液内科、消化器内科、リウマチ・膠原病内科、腎臓・高血圧内科、糖尿病・内分泌代謝内科、神経内科、呼吸器内科、小児科、心身医療科、放射線科、産科
  外科系……急患等は整形外科外来で対応
  外科系は手術（３台）（＋緊急用１台）を再開
  緊急外来…３次対応
- 平成23年３月24日（木）～
  外科系外来も再開し、全診療科で再開（予約患者のみ）
  （平成23年３月25日（金）18：30で院内の患者振り分け、サーベイ終了）
- 平成23年３月28日（月）～
  外来診療が通常どおりとなる。
- 平成23年４月４日（月）～
  手術室フル稼働

（2）診療体制制限の経緯

- 水の供給停止、薬品、診療材料等の物資不足、ガソリン不足による職員の通勤手段の確保困難等により診療機能が著しく低下し、診療制限をせざるを得なかった。特に透析、生化学検査及び滅菌消毒面で困難な状況に陥った。３月18日（金）に水道水の供給再開、文部科学省はじめ各方面からの物資の支援等により、３月22日（火）から内科系外来を再開することができた。

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RADIATION MEASUREMENTS AT THE CAMPUS OF FUKUSHIMA MEDICAL UNIVERSITY THROUGH THE 2011 OFF THE PACIFIC COAST OF TOHOKU EARTHQUAKE AND SUBSEQUENT NUCLEAR POWER PLANT CRISIS

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Abstract : An earthquake, Tohoku region Pacific Coast earthquake, occurred on the 11th of March, 2011, and subsequent Fukushima nuclear power plant accidents have been stirring natural radiation around the author's office in Fukushima Medical University (FMU). FMU is located in Fukushima city, and is 57 km (35 miles) away from northwest of the Fukushima Daiichi nuclear power plant. This paper presents three types of radiation survey undertaken through the unprecedented accidents at the campus and the hospital of FMU. First, a group of interested people immediately began radiation surveillance ; the group members were assembled from the faculty members of "Life Sciences and Social Medicine" and "Human and Natural Sciences." Second, the present author, regardless of the earthquake, had serially observed natural radiations such as gamma radiation in air with NaI scintillation counter, atmospheric radon with Lucas cell, and second cosmic rays with NaI scintillation. Gamma radiation indicated most drastic change, i.e., peak value (9.3 times usual level) appeared on March 16, and decreased to 1.7 times usual level after two months. A nonlinear least squares regression to this decreasing data gave short half-life of 3.6 days and long half-life of 181 days. These two apparent half-lives are attributed to two groups of radioisotopes, i.e., short half-life one of I-131 and long half-life ones of Cs-134, Cs-137 and Sr-90. Also, atmospheric radon concentration became high since a stop of ventilation, while second cosmic rays did not show any response. Third, late April, 2011, a team of radiation dosimetry under the direct control of Dean, School of Medicine, was established for the continuation of radiation survey in the campus and the hospital of Fukushima Medical University.

Key words : Fukushima 1 nuclear accidents, earthquake and tsunami, radiation surveillance, natural radiation

INTRODUCTION

Fukushima Medical university (later often referred to as FMU) is located in the northeastern region of Japan (37°45'N, 140°28'E, 67.4 m above sea level), and is 57 km (35 miles) away from northwest of the Fukushima Daiichi nuclear power plant. The Tohoku region Pacific Coast earthquake occurred on 11 March, 2011, and Fukushima nuclear power plant accidents broke out subsequently.

The present paper reports three groups of radiation measurement performed through the unexampled accidents. First, immediately after the earthquake, in order to investigate the levels of radiations outside and inside the

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campus, Associate Dean, School of Medicine, Professor Hiroyuki Yaginuma assembled a group of interested people from the faculty members of "Life Sciences and Social Medicine (basic medical sciences)" and "Human and Natural Sciences (liberal arts course)." Their hard-working efforts gave valuable information about radiation safety for many staff and patients in the hospital of FMU and the staff and students of FMU campus.

Second, the present author had been measuring several natural radiations[1)] around his office from September in 2010. The natural radiations under the serial measurement were : gamma radiation in air with NaI scintillation counter, atmospheric radon with Lucas cell, and second cosmic rays with another NaI scintillation counter. Amongst the results of serial observation, gamma radiation showed the most drastic change, i.e., peak value of 9.3 times as usual level occurred on March 16, and exponentially decreased to 1.5 times of usual level after five months. A nonlinear least squares regression to these data indicated short half-life of 3.6 days and long half-life of 181 days. The first apparently short half-life (later referred as HL) is attributed to the existence of I-131 (HL : 8 days), while the second long HL may be contributions from nuclides of Cs-134 (HL : 2 years), Cs-137(HL : 30 years) and Sr-90 (HL : 28.1 years). Also, the atmospheric radon concentration at the other place became high because of a stop of ventilation. Atmospheric radon at other places and second cosmic rays did not show any distinct response.

Third, several weeks after the accidents, a team of radiation dosimetry under the direct control of Dean, School of Medicine, Prof. Hitoshi Ohto, was established for the continuation of radiation survey in FMU.

MATERIAL AND METHODS

1. Radiation surveillance right after the magnitude 9.0 earthquake

Associate Dean, School of Medicine, Professor H. Yaginuma supervised radiation surveillance groups of interested people mentioned above. An NaI(Tl) scintillation counter surveyed radiation in several places in Fukushima Medical University hospital, i.e, ICU, NICU and pediatric ward. In the early stage, Japanese Self-Defense Force officials conducted patients screening with Geiger counters at the entrance of hospital with the help of this surveillance team.

2. Serial natural-radiation measurements from Septermber 2010

NaI scintillation counter

A3 ″×3 ″ NaI(Tl) scintillation detector (Teledyne S-1212-T, 7% resolution for Cs-137) was observing gamma radiation in air at the author's office since October 2010. Every four hour counting data was stored in a personal computer. The present report discusses only gross dose rate expressed as a unit of cps. The office room was on the fourth floor of the five storied concrete building built in 1988.

Radon detector

Passive type detectors (Pylon, AB-5) had been measuring atmospheric radon concentration at three places, i.e., the author's office room, students' lab and the Radioisotope Center. Another active type radon detector (Durridge, RAD7) had been detecting atmospheric radon in the author's room. Both types of detector were acquiring every one-hour data and stored in memories and/or printed out to papers. All these detectors safely continued measurements in spite of the magnitude 9.0 earthquake.

Second cosmic rays

For the observation of cosmic rays, a 1″×1″ NaI(Tl) scintillation detector (Harshaw 905-3, 7% resolution for Cs-137) had been counting radiation whose energy is over 3 MeV. These data were also stored in a personal computer.

3. The team of radiation dosimetry under the direct control of Dean, School of Medicine

The team of radiation measurement under the direct control of Dean, School of Medicine, used mainly NaI(Tl) scintillation counter for hospital and campus surveillance, and again Geiger counters checked mats in entrance hall and shoes-soles of students after exercise of sports in the ground of the campus.

RESULTS

1. Radiation surveillance right after the magnitude 9.0 earthquake

From the beginning stage of the power plant crisis, Associate Dean, School of Medicine, Professor H. Yaginuma emitted the information of radiation surveillance, acquired from his teams, to FMU staff. In particular, outdoor gamma radiation results were reported on a bulletin board up to the present. Maximum of the observed value was 11.9 μSv/h at 11 : 30 on the 16th of March, 2011. The outdoor gamma values are around 0.4 μSV/h nowadays.

Ward surveys were not announced officially, however ward members were able to have no worries about indoor radiation.

Patients screening services at the entrance of the hospital continued until the 25th of March, 2011. People whose cps exceeded 10,000 cpm were required decontamination at the

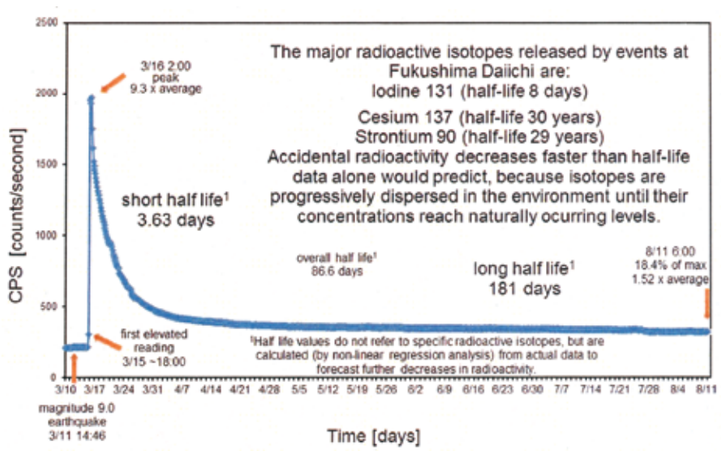

Fig. 1. Serial gamma radiation measurements in air with sodium iodide (NaI) scintillation counter before and after the magnitude 9.0 earthquake, tsunami, and subsequent nuclear power plant crisis. Results were stored every 4 hours as the average cps from the accumulated counts. Measured place was Fukushima Medical University Department of Natural Sciences (Physics) professor's office. Radiation surveillance is a routine activity of this department.

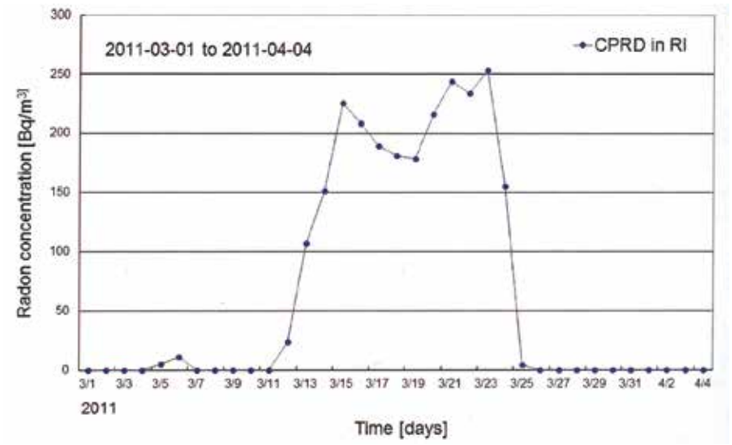

Fig. 2. Change of atmospheric radon concentration after the magnitude 9.0 earthquake in a room of the Radioisotope Center. CPRD means continuous passive radon detector (Pylon, AB-5).

separate 'decontamination tent.' The maximum value found was 100, 000 cpm. All members of FMU appreciate the aid of the staff of Japanese Self-Defense Force officials.

2. Serial natural-radiation measurements from September 2010

Gamma radiation in air

Figure 1 shows gamma radiations with the NaI(Tl) scintillation detector. Just when the magnitude 9.0 earthquake happened, there was no change for the counts. As indicated in the figure, radiation dose reading began to elevate about 18 : 00 on the 15th of April and reached the maximum value of 9.3 times as usual values. This sudden increase was attributed to the hydrogen explosion at the nuclear power plant. Thereafter, the counts seemed to attenuate exponentially. This early exponential attenuation was expressed roughly 3 days of HL that was attributed to the existence of I-131 (HL : 8.06 days). This early environmental HL of 3 days was reasonably shorter than the physical HL of I-131.

After one month has passed, semi-log plot of the cps versus time did not fit to a single line and the apparent HL became longer and longer, indicating the appearance of the second long HL. Thus, the author tried a model equation of $CPS=a2^{-t/Ta}+b2^{-t/Tb}$, where Ta is the short HL and Tb is the longer HL. Nonlinear least squares regression, using a command, nls, of S-PLUS[2] or R[3], obtained the value of Ta=3.63 ±0.02 days and Tb=181±5 days. This second longer HL increased longer and longer afterwards and reached 181 days after about five months (144 days after the peak value was observed). This long HL might be contributions of newly supplied radioisotopes from nuclear reactor or environmentally accumulated long HL isotopes such as Cs-134, Cs-137 and Sr-90. The value of b/(a+b) was 0.13 that means long HL radioisotopes in FMU were 13% at the first attack of the explosion of the reactor to Fukushima.

Atmospheric radon

Figure 2 shows the change of atmospheric radon in one room of the Radioisotope Center. This Center is normally ventilated extremely because of the prevention of non-sealed radioisotopes. This extreme ventilation stopped when the earthquake broke out and RI users were immediately prohibited to enter. The stop of ventilation naturally raised atmospheric radon concentration as indicated in the Figure 2.

Usual radon level was quite low and less than the lower detection limit of the device (5 Bq/m^3), while after the ventilation stopped, it raised as high as 250 Bq/m^3 that exceeds intervention level of the U.S.A.(150 Bq/m^3) or Europe (200 Bq/m^3). The origin of the elevated radon might be the thick concrete wall of the room that was devised to handle sealed radiation sources. Although the level became high, there was no problem of radiation protection because people were inhibited to enter during the accident.

Radon level at other places also became slightly high after the earthquake, and again the ventilation stopped for about 10 days. However, the level did not exceed usually observed maximum level since these rooms have not so thick concrete as RI center's room.

Second cosmic rays

Second cosmic rays showed a little decrease and growth through the earthquake. However, these changes were explained with the contrary change of the atmospheric pressure ; second cosmic rays decrease when the atmospheric pressure increases (thicker air disturbs cosmic rays to reach the ground). Atmospheric pressure at the time was later checked with the data from automated meteorological data acquisition system (AMeDAS) of Japan Meteorological Agency.

3. The team of radiation dosimetry under the direct control of Dean, School of Medicine

The results of surveillance by the team of radiation dosimetry under the direct control of Dean, School of Medicine, are informed to FMU staff twice a month nowadays. Indoor levels are now no problem, while outdoor values are a little high, especially on some 'hotspots.' However, times for students' club activities outside are not so long, and they can be careful not to stay too long near those hotspots.

DISCUSSION

From the early stage of the increase of gamma-ray background caused by the crisis in Fukushima Daiichi nuclear power plant, the author distributed the data as Figure 1 to the relevant people within the campus almost every day, to confirm that there was no further accident in the nuclear power plant. Frequency of the data distribution became roughly once a month nowadays. The audience of this information asked the author several questions.

"How could we translate the unit cps in Figure 1 to more familiar unit of μSv/h?" This was a serious but quite difficult problem. The author had no high precision dosimeters for environmental level. Only a pocket dosimeter (Panasonic, ZP-145) was placed in the author's office from the 18th of March, and comparing cps of NaI with this tiny dosimeter, a conversion factor of 9.4×10^{-4} (μSv/h)/cps was temporarily obtained. The author intends to get more precise dosimeter.

"The reason of the increase of long half-life is the influence of supplies from nuclear reactor?" Concerning this question, there is an interesting report by Meteorologica1 Research Institute[4]. This report says that the fallout of Cs-137 away from the Chernobyl nuclear disaster faded environmentally with the half-life of 25 days. Thus, the present author guessed that the newly supplied radioisotopes from Fukushima Daiichi Nuclear Power Station might be the origin of the half-life longer than 25 days. Nowadays, however, environmentally accumulated long HL radioisotopes such as Cs-137 might be the main origin of the apparent half-life longer than 100 days.

"ls the expression with half-life really appropriate for the change of cps?" The answer is not so clear either. However, radioisotopes from nuclear power plant are divided into two groups, i.e., with short half-life one (I-131) and with long half-life ones (Cs-134, Cs-137 and Sr-90). Therefore, the idea of the sum of two groups of RI with different half-life may be one of the simplest models, at the present time of three months or 100 days after the accident.

CONCLUSIONS

Three groups of radiation survey through Tohoku Region Pacific Coast Earthquake and the subsequent Fukushima Daiichi nuclear disaster were reported. First, at the head of Associate Dean, School of Medicine, the group of interested people assembled from the faculty members of "Life Sciences and Social Medicine" and "Human and Natural Sciences" began radiation surveillance immediately after the earthquake, and gave precious information and confirmation of a sense of security for the staff of Fukushima Medical University. Second, serial measurements of natural radiation revealed various responses from the nuclear power plant accidents. For the gamma radiation data, non-linear least squares fit indicated short and long half-life decrease of the radiation. Shorter half-life is clearly recognized as the contribution of iodine 131, while longer half-life is attributed to the radiation from cesium-134, cesium 137 and strontium 90. Third, the team of radiation dosimetry under the direct control of Dean, School of Medicine, started late April and continues the surveillance and will continue for all the people in Fukushima Medical University.

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Fukushima J. Med. Sci., Vol. 57, No. 2, 2011

LESSONS FROM CHERNOBYL

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Abstract : The Chernobyl disaster on April 26th, 1986, led to the emission of radioactive substances such as iodine-131 and radioactive cesium. As the Soviet Union did not control food distribution and intake, residents were exposed to high levels of internal radiation, leading to the internal radiation exposure of the thyroid gland by iodine131. As a result, the number of people who had thyroid cancer increased drastically among those who had been under 15 years old at the time of the accident. The age predilection is about to move to 25 or older. However, there has been no scientific evidence of impacts for solid tumor other than thyroid cancer, leukemia, benign diseases, or inheritance including unborn babies. On the other hand, the accident was thought to have caused social unrest and mental damage which had far more impact than that caused by radiation exposure.

In this paper, we would like to summarize the impacts on the health of the people in Chernobyl compared to those caused by the accident at the Fukushima Daiichi Nuclear Power Plant.

Key words : Chernobyl Nuclear Power Plant, internal exposure, thyroid cancer, iodine131

INTRODUCTION

The accident took place on Apri1 26 in 1986 at the Chernobyl Nuclear Power Plant located 130 km north from Kiev, the capital of Ukraine. The reactor 4 exploded and caught fire. This was to be the worst radiation disaster in history. At the time no specific information was publicized due to the cold war. Lack of information and fear of invisible radiation caused panic around the world. Substantial international support began only after 1990 when the Soviet Union stepped towards disorganization along with perestroika (economy reform) and glasnost (publicity).

The scientific knowledge we learned from health impacts on inhabitants around the Chernobyl Nuclear Power Plant and workers in the plant provides us with critical information when considering countermeasures for health impacts on the people and workers involved in the accident at the Fukushima Daiichi Nuclear Power Plant.

In this study, we would like to briefly explain health impacts caused by the accident in Chernobyl and study similarities and differences in the accident in the Fukushima Daiichi Nuclear Power Plant. We would like to consider the lessons which must be learnt from the accident in Chernobyl.

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EMITTED RADIOACTIVE NUCLIDES AND COUNTERMEASURES FOR INTERNAL EXPOSURE

For the Fukushima Daiichi Nuclear Power plant, we have to wait until inspections reveal details of radioactive nuclides emitted in the accident. In Chernobyl, one of the dominantly emitted radioactive nuclides was assumed to be harmless xenon 131. Some of the other nuclides have short half-life such as that of iodine-131 of which is eight days and tellurium-132, which turns into iodine-132 within a very short period of time. Radioactive cesium which has a relatively long half-life was also thought to be included[1] (Table 1).

Since iodine 131 and radioactive cesium were the dominantly emitted substances in Chernobyl, it is thought that this is the similar case in Fukushima. However, whereas only trace quantities of radioactive strontium and plutonium, which led to safety concerns regarding MOX fuel, were found outside the Fukushima nuclear plants, a significant amount of those radioactive materials was released in Chernobyl. The emitted amount (approx. 520 TBq) in Chernobyl was approximately seven times more than that in Fukushima as of today even though these two accidents are in the level 7 of INES.

Among the substances mentioned, radioiodine, especially iodine-131 is thought to be the one which most affected people's health around Chernobyl. Iodine 131 accumulated in thyroid glands particularly through food intake and resulted in internal exposure. Infants in Chernobyl also suffered internal exposure due to the intake of milk containing high density of iodine-131. Because the Soviet Union then did not control either food distribution or intake, people were unaware of ingesting contaminated milk, vegetables, water, etc. This was considered to be the main reason of internal exposure[2].

The most dominant nuclide emitted during the accident at the Fukushima Nuclear Power Plant was iodine-131. Another major component of the emissions was radioactive

Table 1. Radionuclide emitted in the accident at the Chernobyl Nuclear Power Plant (Modified the data in Reference 1)

Radionuclide	Half-life	Radiation	Emission amount (PBq)*
Neptunium 239	58 hrs	β-rays, γ-rays	95
molybdenum 99	67 hrs	β-rays, γ-rays	>168
tellurium 132	78 hrs	β-rays, y-nys	1,150
xenon 133	5 days	β-rays, γ-rays	6,500
iodine 131	8 days	β-rays, γ-rays	1,760
barium 140	13 days	β-nys, γ-rays	240
cerium 141	33 days	β-ays, γ-rays	196
ruthenium 103	40 days	β-rays, γ-rays	>168
strontium 89	52 days	β-rays	
zirconium 95	65 days	β-nys, γ-rays	196
curium242	163 days	α-rays	
cerium 144	285 days	β-rays, γ-rays	116
ruthenium 106	1 year	β-rays, γ-rays	>73
cesium 134	2 years	β-rays	
plutonium 241	13 years	β-rays	
strontium 90	28 years	β-rays	
cesium 137	30 years	β-rays, γ-rays	85
plutonium 238	86 years	α-rays	
plutonium 240	6, 850 years	α-rays, γ-rays	0.042
plutonium 239	24,400 years	α-rays, γ-rays	0.030

*PBq is equivalent to 10^{15} becquerel.

cesium (cesium-134 and cesium-137) , which has long half-life. Iodine-131 was detected in various produce including food, drink, and beef cattle immediately after the accident. Panic was caused not only through the reality of the accident but also by the widespread of groundless rumors through media and the Internet. As a countermeasure, the Japanese government specified values of radioiodine and cesium contained in food and drink as the provisional standard. They regulated shipping produce with higher content of radioiodine and cesium in order to prevent people from ingesting contaminated foods and drinks. We must remember the tough decision taken by the people working in the primary sector of industry in Fukushima Prefecture. Without this sacrifice, the chance of internal exposure to contaminated food could not be decreased. This countermeasure was taken based on the experiences of internal exposure in Chernobyl described above. Careful health evaluation is still required from now on , however, we assume the impact on people's health that we will see in the future will be far different from those in Chernobyl even though the accident was categorized in the same level seven.

IMPACTS ON HEALTH OF PEOPLE IN CHERNOBYL

In 2006, 20 years after the Chernobyl accident, the World Health Organization (WHO) evaluated impacts on health of people in Chernobyl dealing with International Atomic Energy Agency (IAEA). The materials the group of experts examined were mainly internationally-reviewed manuscripts. They also used publications in countries around Chernobyl (The Republic of Belarus, Russian Federation and Ukraine). Those experts primarily evaluated two health-related issues[3]. One of the issues was health impacts which were directly related to radiation exposure, and the other was diseases that were not thought to be directly related to radiation exposure, however, the relation with the accident could be in doubt. After the evaluation, they submitted a report to the relevant governments.

The results showed the drastic increase of thyroid-gland cancer among children who had been younger than 15 years at the time of the accident. According to the report, nearly 5,000 operations of thyroid-gland cancer have been implemented for children in this age group in Russian regions around Chernobyl, Ukraine, and The Republic of Belarus by 2002 (the number of operations increased to 6,000 by 2006). The age predilection is about to move to 25 or older to middle aged. As described above, the increase in thyroid cancer in infants attributed to excess internal exposure to thyroid gland via ingestion of radioiodine immediately after the accident. It is possible to assume that the chronic iodine deficiency at that time further increased the number of sufferers[4]. Additionally, the occurrence frequency of thyroid cancer in infants and the dose of internal exposure to the thyroid gland had positive correlation[4]. It was very fortunate that 99% of patients had good prognosis and survived after the operations. Radioiodine therapy after the total extirpation of the thyroid gland against lung metastasis showed significant effects and metastasis treatment had a high cure rate[6]. However, the problems of long prognosis, recurrence, and other complications still remain and further tracing and appropriate treatment are essential.

On the other hand, no increase in leukemia has been seen among citizens including infants and adults though that was primarily concerned from the experiences of atomic-bomb survivors in Hiroshima and Nagasaki. This is probably because people in Hiroshima and Nagasaki suffered mainly from external exposure while it was internal exposure to radioiodine immediately after the accident in Chernobyl. Despite the fact that enormous efforts were expended to analyze genetic abnormality of radiation-induced thyroid cancer, the analyses have not been able to distinguish between induction by radiation and spontaneity at the molecular level[7].

Apart from thyroid cancer, increase in solid cancers, benign diseases, genetic effects, or effects on unborn babies among residents living around the Chernobyl Nuclear Power Plant has not been scientifically demonstrated. However, social unrest and mental damage caused by the accident is thought to be more serious than the physical damage due to direct radiation exposure. Especially those who were forced to evacuate immediately after the accident and those who were forced to move have issues related to social and economic unstableness. In addition, problems of current health fears and strong anxiety over health impacts on future generations have come up. A paucity of scientific research is available on psychological effects and many psychological effects are not determined as health disorder. The WHO report mentioned above states that what the residents are suffering from is at a potential subclinical level which is not clinically identified as abnormal. The report also requires future resolution.

When we look at the current situation in Fukushima, we should see the radiophobia brought by mass media. Rumors have widely spread among the residents due to lack of accurate information. The same fear has been found in other areas including Tokyo metropolitan area even though they are far from Fukushima. This panic like phenomena can be attributed to the internet societies which magnified irresponsible groundless information or rumors. To provide accurate information and thorough mental care is critically required in order not to let people in Fukushima, especially mothers and their children, have the similar fear of potential health problems that people had in Chernobyl. Farmers and workers engaged in the primary industries are under another threat. Primary industries have been thriving in Fukushima, however, their products are vulnerable to harmful rumors or misinformation. The people are anticipating financial damages and some have even committed suicide because of the fear of the future. Immediate action must be taken to prevent such tragedy. A correct information source and the proper passing of information by the media are required in health risk communication with regards to radiation. However, preceding those, the health risk communication requires individual awareness of risk to understand and judge risk. To develop such risk awareness, mutual trust must be built between the information source, media, and recipients of information.

IMPACT ON WORKERS' HEALTH IN CHERNOBYL

Radioactive fallout caused internal exposure among residents in Chernobyl. However, workers who were in the nuclear plant when the accident happened and those who did the recovery operation after the accident had a potential risk of high-level external exposure. The same is true in the Fukushima Daiichi Nuclear Plant. In Chernobyl, 134 people were diagnosed with acute radiation syndrom (ARS). ARS killed 28 of them immediately and 19 of them died due to various reasons between 1987 and 2004. According to the follow-up survey for the workers who registered in the emergency work in the Russian Federation, 116 people died because of solid cancers and 110 people died due to cardiovascular diseases. However, causality with radiation exposure is unknown. The survey also identified that 24 death cases were attributed to acute leukemia, however, the cause was difficult to prove since the average radiation was 115 mSv[5]. Another follow-up survey conducted for the decontamination workers in the Ukraine reported that 18 workers died due to acute leukemia and their radiation exposure was between 120 and 500 mSv[6]. The impacts on cardiovascular and immune systems of the decontamination workers have been argued in Chernobyl, however, until today, nothing explicit has suggested the relation between radiation exposure and the impacts. Analysis of other confounders and long-term accurate investigation and examination are essential.

Currently, the uppermost radiation exposure is specified as 250 mSv for the workers

in the Fukushima Daiichi Nuclear Power Plant. Although this value is recommended by International Commission on Radiologica1 Protection (ICRP), long-term follow-up is needed for the workers as well as monitoring their potential cancer risk. Establishing a system to protect the well-being of citizens in Fukushima Prefecture and the decontamination workers is urgently required.

CONCLUSION

Despite the fact that almost half year has passed since the disaster, we are still recovering from the nuclear accident. Those who were forced to evacuate have been suffering from unbearable agony. It is crucially important to learn lessons from the accident at the Chernobyl Nuclear Power Plant, which happened 25 years ago, in order to revive Fukushima and to provide the citizens with a sense of security.

In this paper, we wrote evidences which were approved by United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), IAEA, WHO, and other autholized organizations because we believe that scientists are required to be sensitive to the accuracy of information when they send it to the society. Unfortunately, some professionals have presented health impacts in Chernobyl through mass media when that fact was not internationally agreed with and we think that is beneath one's dignity.

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AN AMERICAN HIBAKUSHA IN FUKUSHIMA

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Abstract : A magnitude 9.0 earthquake and tsunami originating off the east coast of Japan triggered the explosive release of radioactive isotopes from one of four nuclear power plants in the affected area. This event has been compared with the 1986 nuclear accident at Chernobyl, the 1945 atomic bombing of Hiroshima and Nagasaki, and the intervening era of atmospheric nuclear weapons testing. The credibility of any comparison depends on the source, for which reason various specialists were invited to address an audience of media, healthcare, and disaster response professionals on July 18, 2011 in Fukushima City, Fukushima Prefecture. This article is based on a presentation given July 18, and interprets the Fukushima nuclear crisis from the perspective of an American doctor who grew up downwind of an atomic bomb test site, and who now works at Fukushima Medical University.

Key words : hibakusha, radiation exposure

WORDS ON WORDS

1. Hibakusha

Hibakusha has entered the English lexicon, particularly in reference to survivors of the 1945 atomic bombing of Hiroshima and Nagasaki[1]. It may surprise English speakers to hear the same word applied to people exposed to radiation from the Fukushima Daiichi nuclear power plant. An important distinction is lost when *hi-baku-sha* is rendered in Roman letters rather than the ideographic kanji characters that Japan adopted, and adapted, from Chinese. 被爆者 (subjected to - explode - person)[2] refers specifically to victims of an A-bomb or H-bomb blast[3]. 被曝者 (subjected to - expose - person) can be anyone exposed to radiation[2,3]. Nuclear plant accidents are typically cited in this definition, but laboratory mishaps and medical radiation can also make people 被曝者. The middle kanji of each word can be understood as a composite of two simpler elements : either 火 (fire) or 日 (sun, day) on the left, and 暴 (violent) on the right[2]. Thus, A- or H-bomb exposure to radiation is connoted by violent fire, and other exposures to radiation are connoted by violent light. More rigorous analyses are available, but inordinate attention to linguistics can interfere with practical understanding of language. In everyday Japanese, the distinction between 被爆者 and 被曝者 is often blurred by rendering the baku of *hi-baku-sha* with two *hiragana* characters that represent the syllables *ba* (ば) and *ku* (く) without imposing a specific meaning : 被ばく者. Early language learners, Japanese or foreign, might render the entire word in *hiragana* : ひばくしゃ.

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2. Fukushima

Fukushima, too, has entered the general English lexicon as a name associated with detrimental effects of ionizing radiation. In a specialized English lexicon, Fukushima had previously been associated with a beneficial effect. In 1988, Fukushima Medical University was the first institution worldwide to treat all allogeneic donor blood cell products with ionizing radiation to prevent transfusion-associated graft-versus-host disease[4]. Modern authors continue to cite pioneering articles on graft-versus-host disease from Fukushima Medical University[5,6].

General public knowledge about Fukushima is another matter. The prefecture was renowned as a tourist destination and agricultural center, but most people did not know that two nuclear plants on Fukushima's Pacific coast were dedicated exclusively to Tokyo's massive demand for electricity. These are the Fukushima 1 and 2 Nuclear Power Plants, now known around the world by their Japanese designations, *Fukushima Daiichi* and *Fukushima Daini*.

THE PRICE OF POWER

Per kilowatt-hour, nuclear plants have been promoted as being less expensive than other sources of electricity, but indirect, human costs are once again earning some attention. Recent investigations have suggested that from 2003 through 2008, on the basis of workplace radiation exposure, Fukushima Daiichi was among the world's five highest-risk nuclear plants, the other four being in the United States, Spain, lndia, and Mexico[7]. Through various safety initiatives by TEPCO, the Tokyo Electric Power Company, working conditions seemed to be improving at Fukushima Daiichi in the years just prior to March 11, 2011[7].

THE GREAT EAST JAPAN EARTHQUAKE "3. 11"

On March 11, 2011, a magnitude 9. 0 earthquake originated off the Pacific coast of Japan's Tohoku district. Nuclear power stations Onagawa (Miyagi Prefecture, est. 1984), Fukushima Daiichi and Daini (Fukushima Prefecture, est. 1971 and 1982), and Tokai Daini (Ibaraki Prefecture, est. 1978) went into automatic shutdown[8]. The earthquake and related tsunami have been implicated in subsequent failures, radiation release, and core meltdowns at the oldest of these power stations, Fukushima Daiichi. Remote video images of gas-releasing explosions at Fukushima Daiichi were promptly and repeatedly aired on commercial and public television.

At Fukushima Medical University, 57 kilometers from Fukushima Daiichi, the leading edge of a spike in background radiation was observed on the evening of March 15. In a physics professor's office, a peak value of 9.3 times average was recorded in the early hours of March 16. As of October 11, 2011, the decay curve of this increased background radiation could be resolved into a short harf-life of 3.74 days and a long half-life of 242 days. These half-lives do not refer to specific radioactive isotopes, but are calculated by non-linear regression analysis from actual data to forecast further decreases in radioactivity. As of October 11, background radiation at the office where the March 15-16 spike was detected was down to 1.50 times the average background observed prior to the spike. Although radioactive isotopes of cesium and strontium have half-lives around 30 years, background radiation decreases faster as isotopes are progressively dispersed into the environment. For example, the aforementioned decay curve includes a noticeable dip in background radiation on July 28, corresponding to a day of heavy rain.

AMERICAN PERSPECTIVES

1. Americans in Japan

On March 17, the US Department of State announced online and by email that US citizens within 50 miles (80 km) of Fukushima Daiichi should evacuate the area or take shelter

indoors if safe evacuation is not possible. This recommendation was attributed to the US Nuclear Regulatory Commission, and said to be in accord with directives that would be issued for a comparable event in the United States. Other governments issued similar advice.

This author, an American citizen employed by Fukushima Medical University since January 2008, subscribes to an advisory service of the United States Embassy in Tokyo. The embassy made a health and welfare inquiry by telephone on March 16, and sent an email with evacuation advice on March 17. Subsequent emails in March included information about travel assistance available to US citizens and their dependents. Through September 18, 2011, the United States Embassy in Tokyo continued to advise, “out of an abundance of caution," that citizens living within 80 km of Fukushima Daiichi “evacuate or shelter in place." The March 17 recommendation was modified on May 16 to say that the risk of travel through the area by bullet train or expressway was low. A July 19 travel alert added that it was deemed a low risk to travel to, from, and through Sendai Airport.

Fully aware of official US recommendations, this author continued working at Fukushima Medical University and living about 2 km away. No coercion was involved; in fact, neighbors and colleagues were rather surprised by what seemed to be an act of defiance against the US government by one of its citizens. However, my advice to others, including an American journalist and a Congolese graduate student, was for them to heed the advice of their respective governments, both of which recommended being outside of Japan's post-3.11 risk areas.

It is the opinion of this author that one motivation for the US Embassy's evacuation advice and assistance was to prevent American citizens from burdening Japan, and cordial Japanese hosts, where infrastructure was damaged and resources were limited. Americans with emergency response, medical, and/or nuclear safety expertise have, along with other nationals, freely traveled and worked in Japan's disaster-affected areas.

2. American Hibakusha

In the early 1970s, a guest speaker visited Hibbing High School in the City of Hibbing, capital of St. Louis County in the State of Minnesota. Students assembled in the Hibbing High School Auditorium to learn about nuclear power and radiation. The guest speaker sought a volunteer. From those in the audience who raised their hands, he invited a high school girl onto the stage and asked her to assist with some task. After the task, the speaker offered her a drink of cola as a small reward. The student politely accepted. A conversation along the following lines ensued :

Speaker : “Refreshing?"
Student : “Yes."
Speaker : “Suppose I said your cola was radioactive?"
Student : [Surprised silence.]
Speaker : “Watch."

The speaker turned on a Geiger counter and started to wand our volunteer. As the detector approached her throat, the occasional clicks became much more frequent. This got everyone's attention.

Speaker : “No, I did not give you radioactive cola. Radioactive substances are tightly regulated, and I am not a medical doctor. Your thyroid gland, at the front of your throat, naturally attracts iodine, some of which is radioactive."

To the best of my recollection, the speaker gave no particular details about the extent to which radioactive iodine might be found in nature. However, St. Louis County was downwind of an unnatural source of radioactive iodine: the Nevada Test Site, where 100 of America's 210 atmospheric tests of

nuclear weapons were conducted between January 1951 and July 1962[9].

The exposure of Americans to radioactive iodine from the Nevada Test Site was not comprehensively investigated until Public Law 97-414 was enacted in 1993, although smaller investigations had been previously reported[10]. As directed by Public Law 97-414, the US National Cancer Institute published results in 1997[11]. In the 1950s, about 150 million curies — in modern terms 5.6×10^{18} becquerels — of I-131 entered the atmosphere from atomic bombs detonated at the Nevada Test Site. The average thyroid dose to 160 million Americans during the 1950s was 20 millisieverts. St. Louis County residents, 2,200 km from the Nevada Test Site, received an average thyroid dose of 60-90 millisieverts. Not only location, but also milk consumption and thyroid size were significant factors in an individual's exposure. Children 3 months to 5 years old exceeded the average thyroid dose by 3-7 times[11].

What were citizens told about radiation in the era of atmospheric testing of nuclear weapons? A woman who grew up in southern Utah, just east of Nevada, recalled that when visitors with Geiger counters came to her primary school, she was told that dental X-rays were the cause of elevated readings when a Geiger counter was aimed at her face[12]. A transfusion medicine colleague who grew up in North Dakota, just west of northern Minnesota, said that as a child she was told not to chew on grass outdoors, because it was tainted with strontium (Anne Kaldun, personal communication). Cows are more frequent consumers of grass than well-fed children, but American literature (e.g., *The Adventures of Huckleberry Finn* by Mark Twain) and art (e.g., illustrations by Norman Rockwell) conjure up images of rural children chewing on straws of hay as they work or play outdoors. In the same decade that Anne Kaldun was admonished not to chew on strontium-tainted grass in North Dakota, Japanese investigators were systematically measuring and reporting strontium-90, cesium-137, and plutonium-239 fallout in the atmosphere, rainwater, soil, and food supply in Japan.[13]

DISCUSSION

This author, born in 1958, and Americans of similar age were hibakusha as a result of growing up in the era of atmospheric nuclear weapons testing. What we were told about this was limited, perhaps misleading, or at least inconsistent with what is now in the public domain. Retrospectively, the spread of radioactive iodine across the continental United States was the main health consequence of atom bomb detonations at the Nevada Test Site, although other isotopes, such as radioactive cesium, were released as well. Hydrogen bomb detonations around the world fueled a global spread of radioactive strontium[10], so people of every nationality can be counted as hibakusha[9,10]. Saying so should never diminish the significance of this word as it applies to people of Hiroshima and Nagasaki. Rather, this statement of fact should be a touchstone, through which citizens of the world might empathize with the unique history of Japan: a World War II target of two atomic bombs, a Cold War recipient of radioactive fallout that contaminated the food supply, and the most recent nation to deal with a nuclear power plant meltdown.

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Fukushima Daiichi Nuclear Power Plant Accident and Emergency Medical Response at Fukushima Medical University Hospital

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Summary. Fukushima Medical University Hospital has unexpectedly experienced the most difficult situation during the Fukushima Nuclear Disaster just after the combined disaster of the biggest earthquake and tsunami in Japan. Through our own activities at the unit of radiation emergency medicine, we have learnt that there is much room for improvement. However, even under such unpredicted conditions, we also gained a valuable experience thanks to our wonderful colleagues who were dispatched to our area from all over Japan. We have the responsibility to provide the radiation emergency medical service, the physical-mental-radiological health care, and risk communication with considerable information, to plant workers, emergency responders, and residents in Fukushima in turn.

Key words : Fukushima NPP accident; combined disaster; radiation emergency medicine; risk communication

1 .Introduction

The Fukushima nuclear power plant (NPP) accident on March 11th, 2011 followed the magnitude 9 great earthquake and the up to 38.9 meters tsunami, and resulted in the massive release into the atmosphere of radionuclides, put at Level 7 in International Nuclear Event Scale (INES). The deposition of artificial radionuclides in a particular area occurred due to the rain and snow mainly on March 15th and it has dramatically changed our conventional safe life in Fukushima from the beginning with unpredictable fear and anxiety [1,2]. Reviewing our experience, we are trying to understand what we should have done, what we have learned, and what we should do from now on.

2 .Results and Discussion

Fukushima Medical University Hospital is located 56 km north east from Fukushima Daiichi NPP. We have an Emergency and Critical Care Center with a Level 1 trauma center; also, we have an emergency medical helicopter system.

Fortunately, we did not suffer a building collapse, but did lose both our water and petrol supply. In the initial phase of the disaster, we did our best to examine the patients of trauma and submersion due to the tsunami and earthquake. Because of the lack of water we could not perform enough medical procedures including major operations and renal replacement therapy. The combined disaster taxed us to the limits.

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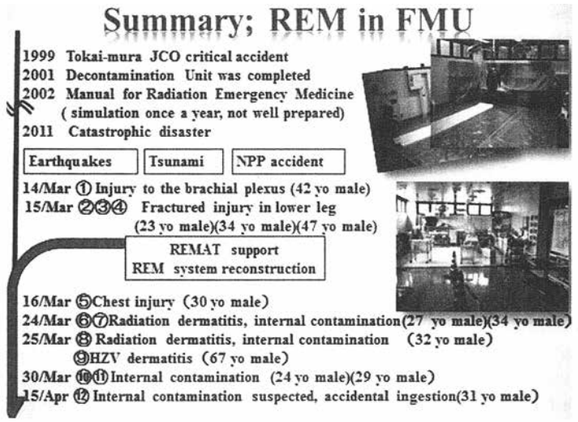

Figure 1. Summary of the radiation emergency medical service in Fukushima Medical University Hospital.
We have examined twelve radiation-exposed and contaminated patients. REM; Radiation Emergency Medicine, FMU; Fukushima Medical University, yo; years old, REMAT; Radiation Emergency Medical Assistance Team.

To our regret, we had not had enough engagement in Radiation Emergency Medicine(REM)nor had we had any communication with the NPP Company previous to that. Therefore, leading up to the NPP accident, we ER physicians did not have enough preparation for a nuclear accident, nor had enough information for the plant accident. Also, the only information we could get was from television reports, not from the disaster site or the government. At first immediately after the accident, we had to resort to making our way by looking at a textbook as we examined a contaminated patient. At first, the situation overwhelmed us, and our mood became dark and depressed, like a patient who has been told they have cancer for the first time. However, soon, Radiological Emergency Medical Assistance Team (REMAT) in Japan, came to help our hospital. They let us know the severity of the plant's status despite the scarcity of accurate information and the prevailing confusion.

During this time, REMAT was always in our side. Finally, they resuscitated us; they braced us up to take on facing the accident.

When setting up our own REMAT against the nuclear disaster at our hospital, we had to share the recognition and role of our jobs, such as risky crisis intervention, focusing on the assistance of people who had been evacuated from the disaster site. We tried to share the scanty information to calm our anxiety, and to focus on the health problems of the plant workers. To prepare for some kind of adequate treatment of the radiation-exposed patients, we set up the daily morning conferences, web meetings, night lectures and simulations to brush up our skills and knowledge with the volunteer doctors, and also together with the Japan Self-defense Force NBC protective unit. We treated twelve patients in our unit from the 14th of March to the 15th of April. Six of them were whole body contaminated, four were locally contaminated, and two only locally externally exposed (Figure 1).

Fortunately, there were no radiation-exposed and contaminated patients in the NPP, in those days. At that point, we did not have an adequate Radiation Emergency Medical hospital, nor had enough local community medical hospitals, especially near the NPP because of the evacuation direction and hospital damage there. We had to reconstruct the Radiation Emergency Medical System nearly from the beginning and in short possible time (Figure 2).

Very quickly, we became aware of another important problem of the emergency responders such as firefighters and ambulance

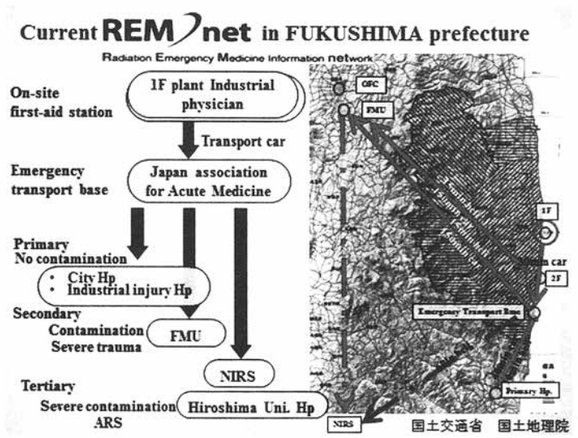

Figure 2. Current Radiation Emergency Medicine Network in Fukushima Prefecture.
Off-site center manages the patient information and controls the transport. Patients with radiation contamination cannot be accepted in the Primary Radiation Emergency Hospital at this point. Emergency medical helicopter can approach to 20 km radius to contact the non-contaminated patients at this point. Doctors can enter into the 20 km radius at their own risk. 1F; Fukushima Daiichi Nuclear Power Plant, FMU; Fukushima Medical University Hospital, NIRS; National Institute of Radiological Sciences.

crew in the disaster site. They were not only crisis responders but also disaster-associated victims as they began to suffer from post-disaster stress-induced psycho-somatic illness. They had not only exhausted themselves but also felt uncertain feelings about their own radiation consequences during the crisis. We, therefore, introduced them to the mental health care psychologist, and also set up a consultation clinic by ourselves for treating them.

Simultaneously, we calculated the internal and external exposure dose by the data from whole-body counter and personal dosimeter in turn. Using the dose date evaluated, we were able to counsel them to relieve their mental stress over radiation related anxieties and their future. Two hundred and seventy-five persons were examined by the 11th of September as an acute internal exposure cohort. After 9.11, we are planning to examine them again to either deny or estimate the chronic internal exposure which may be from food consumption.

Based on our own experience just after the accident, the established support system from the network related with radiation emergency medicine in Japan worked relatively effectively and efficiently. However, still the general citizens residing in the contaminated area of Fukushima have more unexplained fears about low dose radiation exposure, such as food contamination and 20 mSv topics. These fears may be exaggerated by misinformation; unreliable comments and rumors about radiation and its effects on human health. The lack of coordination of specialist's comments does nothing to help the situation. All this creates a new wrinkle in risk management: the management of information. We need to cooperate with domestic and international experts in one platform, and speak about the situation with one voice as much as reasonably possible. To begin with, we have had dialogues with public office workers and public health nurses who are also risk communicators with residents. Also, the Prefectural People's Health Management Survey is now beginning from this September, primarily to address health care needs not only for medical research. It will continue for at least 30 years [3].

The recent outstanding issues are listed up as Table 1.

In summary, we very much regret our insufficient preparation. We at the disaster site capital hospital recognize our three main responsibilities. First, we have to provide the Radiation Emergency Medical Service for NPP workers over the course of several decades. Secondly, we must continue to examine the total health for emergency responders in the long term. Third, we should continue dialogues with citizens about the risk they may and may not face. After all, we, too are citizens living in Fukushima. We wish to share the above with all the staff in Fukushima Medical University.

Table 1 . Outstanding issue and solution for NPP accident

1. Radiation Emergency Medicine for Plant workers
◆Reconstruction of Radiation Emergency Medical network
⇒Devastation of the local community medicine prevent the reconstruction of the Radiation Emergency Medical network
◆Deficient of the information transport system about plant status
⇒Web meeting, FAX, base on trust relationship with NPP company.
2. Health care management for emergency responder
◆Lack of the legal safeguard
⇒Development of legal system both economically and medically
◆Needs for long span follow up
⇒Denying the chronic internal contamination using whole body counter
3. Intervention for resident in Fukushima
1) Emergency situation procedure
◆No review for the thyroid protection yet
◆When and how to take the stable iodine if disaster would relapse
◆Lack of information transmission tool about nucleotide release, evacuation direction
2) Decrease the chronic external exposure
⇒Increase the dosimetory measurement points
⇒Draw the local deposition map
⇒Organize the way of decontamination in the soil
3) Decrease the chronic internal exposure
⇒Information provision about the food contamination to the community resident
⇒Careful analysis and restriction for local food shipment (Example. Wild mushroom open-field vegetable)
⇒Adjust the compartmentalized public administration (Example. Ministry of Health, Labor and Welfare: meat dosimetory. Ministry of Agriculture, Forestry and Fisheries : fodder risk management, meat shipment)
⇒Decrease the anxiety about the low dose exposure and contamination
4) Dose assessment and explanation
⇒Unify the way of dose assessment and explanation
⇒Prefectural People's Health Management Survey
⇒External exposure; film badge for students
⇒Internal dose management; how to apply the whole body counter
5) Risk communication
⇒Notably with public office workers, public health nurses and physicians
⇒Public announcement with one voice as much as reasonably achievable
⇒Awareness-raising to the specialist who does not know the impact of their comment to the resident
⇒Put press reporting into resident's shoes

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BMJ Group blogs [http://blogs.bmj.com/]

The first seven days of the disaster

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21 Mar, 11 by BMJ Group

First of all, I want to express my deep sympathy for those who lost their loved ones, their houses, their work, their home towns, and their hope by this terrible disaster.

Who, in later times, will be able to understand that we had to fall again into the darkness after we had once known the light?

Sebastien Castilian: De arte dubitandi (1562)
Quoted in Kenzaburo Oe: Hiroshima Note (1965)

It is now seven days since the first earthquake and tsunami hit us in the Pacific Coast areas of the Tohoku region (the northernmost region of the main island of Japan made up of the 6 prefectures – Aomori, Iwate, Akita, Miyagi, Yamagata, and Fukushima). The disaster that we now call the "Tohoku-Kanto Earthquake" was caused by the strongest earthquake ever recorded in Japan (magnitude 9.0) followed by a 15 metre tsunami and hundreds of aftershocks which are still hitting us every day and night. According to a National Police Agency tally as of at 7 p.m. on Friday 18th March, at least 6,911 people were killed and 10,316 were missing. In Fukushima prefecture where I am (the southernmost prefecture of the Tohoku region; population 2,026,826, area 13,782.75 km^2), at least 602 people were killed, 3,844 are missing, and 45,826 people were compelled to live in 426 evacuation shelters in the prefecture. We still do not know the exact numbers of casualties, because the damage is too enormous.

The first 2 days were hectic. Essential services such as water, gas, electricity, and phone networks were not working. Normally I move between 5 teaching practices in the communities (20 to 230 km apart one another) to teach 17 GP registrars in the prefecture, but I had to cancel these visits because the transportation systems and the roads were badly damaged. I tried hard to make sure all my trainees and colleagues were safe and sound. However, I was not able to contact them all until five days after the first earthquake hit. Five of them had been working in Soma and Iwaki, some of the towns that had been directly affected by the tsunami. Fortunately, they are all safe and we have been able to talk to each other using our internet network. I have also been part of the anti disaster team at Fukushima Medical University (FMU) in Fukushima city. Major trauma patients and patients with medical and surgical emergencies were brought by helicopters to the FMU Hospital, the largest teaching hospital in the prefecture. The hospital itself has been functioning well, collaborating with the prefectural government headquarters and the Disaster Medical Assistance Teams (DMATs) who came from several other prefectures in Japan that had not been hit by the disaster, but it was difficult for us to get a picture of what was going on in the prefecture overall. A major lesson from this period was the need to resume information networks as quickly as possible after the disaster, collaborating with the local/national governments, police, paramedics, telecommunication companies, and the internet services.

In the following 2-3 days, hundreds of patients came to the FMU hospital, either by themselves or in chartered buses from community hospitals and nursing homes in the severely damaged tsunami hit areas. Our hospital was even busier, treating the emergency patients, and triaging the other patients who had a wide range of problems needing primary to secondary, even tertiary care. Many of the patients were frail, demented, bedridden elderly, often without a clinical history and context. Some patients needed oxygen, IV fluid, tube feeding, or dialysis. Others were suffering from hypothermia, aspiration, or pneumonia. A major lesson from this second period was the need for a good collaboration between specialists in the hospitals and primary care physicians even in the acute disaster period. If many patients with primary care problems had not rushed into secondary/tertiary care hospitals after the disaster, the function of the hospitals would not have been affected so much. On the other hand, care of the weak (frail elderly, children, pregnant/nursing mothers, people with chronic illnesses, mental illnesses, or multiple co-morbidities) can easily fall behind in an acute disaster period without well functioning primary care providers.

Along with these "normal" disaster recovery activities, we had to face the third disaster after the earthquakes and tsunami, namely, the series of hazardous accidents at the nuclear power plants located on the Pacific Coast in Fukushima prefecture. Even though the FMU hospital has well trained dedicated nuclear medicine specialists who had prepared for potential nuclear accidents and who could provide us with information, there was a high level of anxiety amongst the care teams, as well as patients and their families, that had increased like a cascade after rain.

Sometimes it became difficult to keep our strong Fukushima tradition of endurance (*gaman*) and non blaming culture. The mental well being of the caregivers who were under constant demanding pressure is an ongoing issue. A video clip on YouTube entitled Pray for Japan: be strong deeply moved us into tears. That was a good example how music and narrative can heal us. I wish people in the evacuation shelters could personally listen to their favourite music anytime they want without bothering others. Watching a TV repetitiously reporting the disaster news all through days and nights must be harmful for their mental well being.

I believe that the prevention of thyroid cancer of children should be a top priority. But we still do not have high quality standardised evidence based information to assist us. We experienced the disasters in Hiroshima and Nagasaki, but despite this there are many misunderstandings regarding radiation. We are now busy sourcing potassium iodide for the children in the Fukushima prefecture and constructing systems to deliver the medicine and to provide parents with pertinent information on timing, duration, doses, and adverse effects of its administration. We need information on immediate, short, and long term effects of radiation, and interventions and strategies to alleviate the effects. Also, we want to know how better we can give that information to the parents, to support them emotionally, and to follow up beyond the acute disaster period. As we have many farmers and fishermen in Fukushima, we are very much concerned about risk of potentially contaminated foods (milk, meat, fish, vegetable, rice, buckwheat, sake, etc.).

I cannot predict what will happen next. I cannot estimate how long the recovery from the disaster will take us, either. *"After all, tomorrow is another day,"* might be true, but I want to humbly add to say that tomorrow is another day we could make a difference.

・Listen to Ryuki Kassai talk about the situation in Fukushima in a BMJ podcast

The second seven days of the disaster

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29 Mar, 11 by BMJ Group

First of all, I want to express my sincere gratitude to those who provided us with useful information, who kindly donated to us, who warmly encouraged us, who thoughtfully conveyed our messages abroad, and who continue to pray for Japan after the disaster.

"(…) what he had been thinking about was the earthquake. Images of it had come to him one after another, as if in a slide show, flashing on the screen and fading away. Highways, flames, smoke, piles of rubble, cracks in streets. He couldn't break the chain of silent images."

Haruki Murakami: After the Quake (2001)
(Translated from the Japanese by Jay Robin)

In the second week of the disaster, we have had freezing weather in Fukushima and the Tohoku region as a whole, which has made our life even harder, especially without much fuel and petrol. The daily minimum temperature in Fukushima City has been below freezing point three days out of the seven. We normally begin to expect the cherry blossoms at this time of the year, but that is not the case this year. Ironically a view of the snowy white chain of mountains including Mt. Azuma (2,035 meters) and Mt. Adatara (1,700 meters) is very beautiful.

The number of casualties hasn't stopped rising. According to a National Police Agency tally, as of 9 p.m. on Friday 25th March, at least 10,102 (6,911 – the figures in the brackets are the ones reported one week before) people were killed and 17,053 (10,316) were missing. In Fukushima Prefecture, at least 855 (602) people were killed, 5,934 (3,844) are missing, and 61,998 (45,826) people have been forced to live in 356 (426) evacuation shelters in the prefecture. The full extent of loss of life is still unclear, as search efforts in Fukushima Prefecture have been hampered by the accidents at the Fukushima No. 1 nuclear power plant.

The acute disaster period has been followed by a period of uncertainty, especially in Fukushima Prefecture. Our largest concern for now is the unstable condition of the nuclear power plant. Despite several trial operations, bravely carried out by dedicated squads of the self defense forces, the fire and disaster management agency, and the riot police, to cool down the crippled reactors, they still seem active and uncontrollable with radioactive leakage. In the last day of the second week, three workers were exposed to radioactive water on the basement floor of the reactor's turbine building, two of whom were brought to the Fukushima Medical University (FMU) Hospital and then transferred to the National Institute of Radiological Sciences (NIRS) Hospital. It was reported that they had external contamination of their feet, not direct exposure. However, the implication of this accident was immense. A numbers of rumors about possible detonation spread by telephone, e-mail, TV, radio, the internet, etc. Many foreign officials, company employees, and international students were urged, through their diplomatic channels or by their families and friends, to get out of Japan immediately.

We need to understand that the information/knowledge gap about nuclear medicine, especially in terms of crisis management, is so big between specialists and lay people. Many health care workers are not aware of the distinctions in terminology about radioactivity e.g. the Becquerel(Bq), absorbed dose (the Gray, Gy), equivalent dose (the Sievert, Sv), and effective dose; and the one between direct exposure to ionising radiation and contamination with radioactive materials. The media, politicians, and the public at large are also uncertain about what these terms mean. Sometimes they have confused these terms, including mistaking millisievert for microsievert, in national government announcements, and the media have confused these in news stories.

Moreover, the general public in Japan may not be good at explaining or thinking about risks relatively or in depth. At a press conference the government said, "We urge people not to drink milk, not to give tap water to infants, or not to eat vegetables such as spinach, broccoli, (…) in Fukushima and neighboring prefectures, because their radioactivity has exceeded the state's recommended safety standards." This was confusing and the Japanese people don't understand well what the risks really are, what they should or should not do, or for how long.

The academic and financial year starts in April in Japan, which is increasing the uncertainty. Most graduation ceremonies in March, including FMU's, were cancelled. FMU has decided to postpone our entrance ceremony in April by one month. We have heard that a few freshmen and registrars may decline their offers and not come to FMU or its hospital, because they and their families are so anxious about the uncertain conditions here in Fukushima. I understand them, but there is something very important for doctors of the future that can only be learnt under these circumstances. Luckily I expect all three new GP registrars and one trainer will come and join my department in April. The first lesson that they have to learn in Fukushima may well be "how to deal with uncertainty."

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Fukushima one month on

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27 Apr, 11 by BMJ Group

Ironically, the annual *sakura* (cherry flowers) season has just come to Fukushima when one month has passed since the first earthquake and tsunami hit us. Fukushima is famous for its *sakura*; we have the 1000-year-old *Takizakura* (cascade *sakura*), one of the three best cherry trees of Japan, and the *Hanamiyama* (cherry-blossom viewing hills) wholly covered by the blossoms. Cherry trees are in full bloom everywhere in mid and east Fukushima. Beautiful, yet not many people seem to drink sake, sing songs, or dance under the blossoms this year. It is difficult for us to decide between the two options this year – to celebrate the season, or not. Sakura is the most spiritual flower for the Japanese. A few of you may recall that a *sakura* tree with drifting blossoms on the wind was used as the background of the last battle scene in the movie *The Last Samurai*, which implies the crowning glory, that is the "perfect (*migoto-na*)" death as the samurai.

We continue to be hit by large aftershocks day after day, night after night. According to the Japan Meteorological Agency, as of 3 pm on 22 April, there have been 429 aftershocks with a magnitude of 5.0 and above, 74 registering 6.0 and higher and five at the 7.0 level or higher since the first one. We still do not have any positive reports that the Fukushima Daiichi (No. 1) nuclear power plant is settled.

One month is long enough that people despair when the situation does not seem to improve as they had expected. Let me take one of the most tragic examples. After being destroyed by the first earthquake on 11 March, the waterworks department had worked hard to restore 97% of the water supply in Iwaki City. However, the aftershock of magnitude 7.0 smashed most of it again on 11 April, exactly one month later. Not only the workers in the waterworks department of the city but also many citizens of Iwaki City felt as if they had worked in vain, like Sisyphus.

On 4 April I was standing in the ruins of the tsunami-hit community in Minami-Soma City looking out at the horizon of the Pacific. A nursing home was in front of me. Broken chairs, tables, beds, cabinets, wheelchairs, bookshelves, and many other things were scattered with tons of mud and debris everywhere. Badly damaged cars were rolled over in the yard and were even inside the building, which had no intact doors or windows. There was no evidence of life, but a local policeman said that more than 1,000 people were still missing from that city alone.

According to a National Police Agency tally at 3 pm on 22 April, 14,172 people were killed and 12,392 were missing by the Tohoku-Kanto Earthquake. In Fukushima Prefecture, 1,432 people were killed, and 1,835 are missing. According to the Anti-Disaster Headquarters of the Fukushima Prefecture government, 25,936 people from Fukushima are living in evacuation shelters within the prefecture, and 29,833, outside the prefecture.

Since 4 April, I have been working as a leader of the teams whose mission is to find, visit and take care of the people who cannot move by themselves and still live at home in the zone between 20 and 30 km from the nuclear power plant, just next to the exclusion zone. The teams of the first week of the operation consisted of about 50 people from the Self Defense Forces (SDF), rescue squads, public health nurses from the local city/town governments, and doctors and nurses from Nagasaki University and Fukushima Medical University (FMU) Hospitals, co-organised by FMU and the Fukushima Prefecture government. In the first week of the operation, we took care of 299 persons at home in 3 cities, 2 towns and one village, with 223 persons being in Minami-Soma City.

Identifying who we needed to visit was difficult. We had to make a database of the target people by collecting information from several sources – from registers of several different health services, from making many phone calls and by going from house to house. Some had already been evacuated outside, while others had made the long journey back to Minami-Soma because staying in the evacuation centres was too difficult and their families were too exhausted to take care of them in the shelters. Some town governments had moved their whole town to other prefectures.

One of the weaknesses of Japanese primary care is that we do not have health register systems for the whole population. We cannot have an accurate grasp of the health status and needs of people in the communities without such health register systems. Although some hospitals in Japan are now making databases to show what kinds of diseases they treat in their hospitals, Japanese primary care doctors tend to be reluctant to share information on what kinds of patients they have seen.

A demented old couple whose nursing services had abruptly ceased since 11 March were taking care of each other. A family of three generations with a sick grandfather did not want to move because they cannot leave their beef cattle. An old man in wheelchair who used to be an engine driver transporting thousands of soldiers between Manchuria and Siberia after the Second World War said that life after this disaster was much better. A blind couple whose neighbours had all left for the shelters were having difficulty getting food and news to support their life. A son who was taking care of his old father with a colostomy has brought his father back from the shelters because people around them complained of odour from the pouch. These are only a few examples of the people I visited in the past 3 weeks. Rather than critical medical care in hospitals, what they need is to resume basic community-based services to support their lives at home, such as home helpers, balanced meals, bathing, rehabilitation, and oral hygiene.

The Japanese Government has just announced that it will widen the evacuation zone; people who live in the designated areas outside the 20-km no-go zone around the crippled nuclear plant must evacuate the area in one month. We need to minimise the negative impact of this evacuation, especially on those who are heavily dependent on basic community-based services. I hope that the memories of Sakura of their home towns will help them to survive the evacuation.

The country is smashed, hills and rivers remain.

The city turns to Spring, plants and trees grow deep.

Moved by the moment, flowers splash tears.

Resentful of parting, birds startle the heart.

Du Fu: View in Springtime (757)
(Translated from the Chinese by Paul Rouzer)

・Listen to Ryuki Kassai talk about the situation in Fukushima in a BMJ podcast

Health Exchange [http://healthexchangenews.com]

Beyond the day after tomorrow : community health in Japan

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Posted on July 6, 2011 by Admin01

When the earthquake, tsunami and subsequent aftershocks hit Japan in early 2011, health systems and staff were tested to the extreme in trying to meet people's health needs. Ryuki Kassai, from the Department of Community and Family Medicine, Fukushima Medical University, tells the story of what happened and the lessons that he and other medical professionals learned from their experiences.

On Friday afternoon, 11 March 2011 the first earthquake and tsunami hit us in the Pacific Coast areas of the Tohoku region (the northernmost region of the main island of Japan). The disaster that we now call the 'Great Eastern Japan Earthquake' was caused by the strongest earthquake ever recorded in Japan (magnitude 9.0) followed by a 15-metre tsunami and hundreds of aftershocks.

Ryuki Kassai with a team next to the exclusion zone, Minami-Soma City. Credit: Member of Self Defense Forces (SDF)

According to the Japan Meteorological Agency, as of 8:00 am on 21 May there have been 459 aftershocks with a magnitude of 5.0 and above, with 76 registering 6.0 and higher and five at the 7.0 level or higher. According to a National Police Agency tally as of 20 May, 15,148 people are dead and 8,881 are missing with 91,484 houses/buildings completely destroyed and 40,454 partially destroyed.

A major lesson from the first few days of the disaster was the need to resume information networks as quickly as possible. The telephone circuits were immediately shut down, due to the overload in the affected areas. Although the Internet was alive, its use was limited by the availability of computers and electricity. It was difficult for us to get a whole picture of what was going on in the prefecture and the region overall.

Hundreds of patients were evacuated from community hospitals and nursing homes in the severely damaged tsunami-hit areas, especially in the towns very close to the Fukushima Daiichi (No. 1) nuclear power plant, and were transferred in chartered buses to facilities in safer places. Those evacuations had to be operated without notice to the receiving facilities. Damage to the electronic medical record systems of the sending facilities resulted in referral/transfer without necessary patient information about their medical condition. We need to invent some innovative telecommunication systems that can survive the acute initial period of grave disasters, by collaborating with the local/national governments, police, paramedics, telecommunication companies, the Internet services, academics in technology etc.

People in Fukushima, especially those who have young children, nursing or pregnant mothers in their families, are very worried about potential risk of thyroid cancer to children after the nuclear accidents. They sometimes complain that they do not know what to do, or what not to do, and that they are not given essential information for their decision-making.

Unfortunately, we still do not have high quality standardised evidence-based information to assist us. By collaborating with people around the world, we need to construct a database of evidence-based information/references on immediate, short- and long-term effects of ionizing radiation, as well as of several kinds of disasters, and interventions and strategies to alleviate the effects. On the other hand, we know that scientific evidence cannot be generated without bias. A gap always exists between scientific evidence and daily practices in reality. In order to apply evidence into our practice/decision-making, we have to take several contextual factors into account.

Another lesson I have learned is the need for good collaboration between specialists in the hospitals and primary care physicians, after the disaster, even in the acute disaster period. If many patients with primary care problems had not been rushed into secondary/tertiary care hospitals after the disaster, the function of the hospitals would not have been affected so much. I found that care of the weak (frail elderly, children, pregnant or nursing mothers, people with chronic illness, mental illness, or multiple co-morbidity) was easily left behind in the acute disaster period without well-functioning primary care providers.

Japan has weak systems of primary care, which have become much more conspicuous since we were affected by the disaster. Many primary care doctors in the communities stopped seeing patients and they did not work within networks to serve communities. Several primary care assistance teams visited the affected areas, but it was often difficult for the local governments and people to coordinate such sporadic aid from several different prefectures in Japan.

During the past two months I have been working as a leader of the teams to help people who cannot move by themselves and still live at home in the zone between 20 and 30 km from the nuclear power plant, next to the exclusion zone. In the first week of the operation, we took care of 299 people at home in three cities, two towns and one village. Identifying who we needed to visit was difficult. We had to make a database of the target people by collecting information from several sources: from registers of several different health services, making many phone calls and by going from house to house. This is another weakness of Japanese primary care; we do not have health register systems for the whole population. We cannot have an accurate grasp of the health status and needs of people in the communities without such health register systems.

It is hard for us to resolve all the difficulties in the aftermath of the disaster. However, it is my hope that we can make good use of what we have experienced and learn to reconstruct at least some systems in better ways.

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BMJ Group blogs [http://blogs.bmj.com/]

The first anniversary of the Japanese tsunami

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28 Mar, 12 by BMJ Group

According to the plan, we should be well along the path to rebirth, but in reality, foolishness has continued, and nihilism and despair have only spread.

Hayao Miyazaki: Nausicaä of the Valley of the Wind (1994)
(Translated from the Japanese by Matt Thorn)

In the afternoon on the 11 March 2012, I was standing on the tsunami-hit coast in Iwaki, Fukushima prefecture, gazing alternately at the Pacific Ocean and the ruins of the town. The Pacific looked beautiful. On the opposite side, however, there spread a vast expanse of bare land, where, on the first anniversary of the disaster, several people came to pray for those who were killed by the Great East Japan Earthquake, and in particular the victims of the ferocious tsunami which hit there on the 11 March 2011. It seemed to me that several of them were still looking for some shred of evidence that would make them believe their loved ones were not dead after all. One year on, how far — if at all — have we progressed towards full recovery? How much have we accomplished in terms of the reconstruction of our society?

According to a national police agency tally as of the 21 March 2012, in the three most affected prefectures in the Tohoku region: 4,671 people were killed in Iwate, 9,512 in Miyagi, and 1,605 in Fukushima. 1,237 people were missing in Iwate, 1,688 in Miyagi, and 214 in Fukushima. 20,185 houses were totally destroyed in Iwate, 84,749 in Miyagi, and 20,194 in Fukushima; and 4,562 houses were more than half destroyed in Iwate, 147,165 in Miyagi, and 65,733 in Fukushima. The reconstruction headquarters reported on the 26 January 2012 that there were still 341,411 people living in evacuation shelters, in the houses of relatives or friends, or in temporary accommodation far away from their home towns.

Although Fukushima has fewer victims compared with Iwate and Miyagi, we probably have the largest number of evacuees, who now live in and outside the prefecture but who used to live along the coastal areas of Fukushima. A series of accidents at the Fukushima Daiichi nuclear power plant have rendered homeless the people from 7 towns and 2 cities. It seems too difficult for most people in Fukushima, as perhaps in the rest of Japan, to get a balanced understanding of the long term risk from low dose radiation. Even many doctors, nurses, and their families have left Fukushima, afraid of the possible fatal effects of radiation. Emotion beats scientific evidence.

Let me share an episode that happened last summer to illustrate people's irresistible fear of the invisible threat. *Obon* is one of the Japanese folk customs to honour the departed spirits of one's ancestors, who are believed to revisit their home towns during *Obon*. It has both Buddhist and Shinto influences. *Obon* was originally celebrated on the fifteenth day of the seventh month of the lunar calendar, but in modern Japan it has been varied among the regions of Japan. It is now most commonly around the 15th August. During the *Obon* holiday, people return to their ancestral home towns and, together with family/and friends, hold reunions with their ancestors' spirits. At the end of *Obon*, we light *Okuribi* (send-off fire) on the ground to send off the spirits of deceased family members, who are believed to return to the spirit world. The most famous *Okuribi* must be the *Daimonji*, or the *Okuribi* at Gozan (the Five Mountains) in Kyoto on the 16 August. Last summer, however, many people in the Tohoku region had watched the *Daimonji* on TV with mixed feelings. Pine trees from Rikuzentakata, in the Iwate prefecture, where 1,487 were killed by the disaster, were supposed to be sent and burnt as firewood for the *Okuribi* fire at Gozan in Kyoto by invitation. However, the local people in Kyoto got so anxious about possible nuclear contamination of the firewood, its smoke and ashes, that they refused to use the wood from Rikuzentakata, even though the city is located some 200 km from the Fukushima Daiich reactor. Complaints, criticism, and controversy continued for months.

Several plans for reconstruction following the disaster have been proposed in vain due to poorly-collaborating stakeholders in our society. A large number of medical professionals, researchers, politicians, musicians, and even restaurant chefs came to the affected communities and tried to help us, encourage us, entertain us, and heal us. But sadly, the hidden agenda of some of them seemed just to become famous for the sake of their own interest. Their visits and thoughtless behaviour threw the communities into confusion. Their priority seemed to be to undertake highly visible projects no matter how little they met people's needs in the affected communities. I myself would like to rebuild a community-based primary care system, a more sustainable one than before, along the affected coast of Fukushima through programmes of capacity building and social networking. However, it has been difficult for long-term human resources projects like this to attract the support of policy makers and academics.

The quotation at the beginning of this blog is from the popular cartoon by the acclaimed animation director Hayao Miyazaki entitled *"Nausicaä of the Valley of the Wind."* It is a story of reconstruction over 1000 years after a foolish series of wars devastated much of our planet. Humanity clings to existence at the fringes of a vast, polluted forest inhabited by monstrous insects. The struggle for existence escalates into another series of wars between humanity and the insects, as well as among the humans. Only Nausicaä, the princess of the tiny kingdom of the Valley of the Wind, knows the environmental significance of the forest. She turns her caring gaze towards all the creatures in harmony with the healing power of the forest. In Nausicaä, Miyazaki seems to explore how we have to pay for our mistakes after we have destroyed our environment.

As early as two weeks after the disaster we had found ourselves somehow insensitive to what was happening around us. Daily tragic news and reports came and went, passing in front of us like a silent slide show. After several months of an active reconstruction phase, it seems to me that we are now experiencing a second apathetic phase around the first anniversary of the disaster. It seems easy for the media and journalists to tell anniversary stories, and they eventually broadcast and published a lot of them worldwide. But for most of us people in the affected areas, the scenery remains rather the same; nothing much has changed.

After becoming a disaster victim myself, I now understand that it was not hard to care about the events in Fukushima. They just happened in front of us. What is more difficult, however, is for us now to feel a doctor's compassion toward people's sufferings in other parts of the world. Tragedy can happen anywhere and at any time: the big earthquake in China, the flooding in Thailand, the cyclone in the Philippines, and the riots in several areas of the world. The information comes to us continuously through the internet, emails, Facebook, Twitter and so on. If we are not sensitive enough, they too appear just as a series of silent slide shows. We need to survive the apathetic phase again by keeping our medical caring gaze turned towards what is happening to people elsewhere in the world, as well as in Fukushima.

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Disaster in Japan : a new medical gaze

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On the 11 March 2011 disaster struck Japan. A magnitude 9 earthquake followed by a tsunami hit the east coast of Tohoku and Kanto. Thousands of people have been killed, more people have been left homeless, and the headlines around the world now give their attention to the damaged nuclear reactors in Fukushima. This disaster poses particular challenges for Japan and symbolises a more general dilemma for health professionals observing around the world.

In Japan, relief efforts have focused on rescuing trapped or stranded people, evacuating those in unsafe areas, and providing basic shelter, water, food, and medicines. Despite establishing the emergency management committee and activating 120 field units,[1] the government has faced some criticism for not acting more swiftly following the disaster.[2] The evolving figures are shocking. On 12 April 2011 Reuters reported that 13,843 people were confirmed dead by Japan's National Police Agency, while 14,030 were missing.[3] It was reported that 136,481 people remained in shelters, with the majority of the 70,000 people previously living in the 20 kilometre nuclear exclusion zone thought to have left their homes. A request for international aid has been issued. The challenge faced by rescue workers includes poor access to affected areas, flooded hospitals, an older population, and growing fears about the safety of food and water supplies.[3] Potassium iodine tablets are being distributed to limit the impact of radiation exposure.[4]

That such a nuclear problem should befall Japan, considered one of the exemplars of 'safe' nuclear power, has prompted many other countries to take note.[5] In the coming months more details will inevitably emerge regarding the details that led to the nuclear accident. However, despite the understandable concern about the Fukushima nuclear reactors, some have argued that a disproportionate amount of media time has been spent covering the explosion, as opposed to the human tragedy of those killed, injured, and displaced by the earthquake.[6]

STRENGTH OF FAMILY MEDICINE IN FUKUSHIMA

For many involved in general practice, it is particularly sad that Fukushima has overnight become known for a disaster when it had been slowly fostering a reputation for very different reasons. Fukushima, a rural and industrial area that has traditionally struggled to attract enough doctors to serve its aging population, now boasts one of the first structured family medicine training programmes in Japan.[7] As such, it has received a number of international visitors interested to see how a generalist approach fares in one of the most high-tech hospital dominant countries in the world.[6,8]

Figure 1 Registrars and medical students at the Family Medicine Resident Forum, Fukushima Medical University, 23 April 2011. The Forum provided the first opportunity to listen to what each attendee had experienced in person (not by teleconference) since 11 March.

In the subsequent days after the first earthquake, trainees in family medicine at Fukushima Medical University, spread around the small communities of the prefecture, were communicating again by teleconference. They have been working hard in the forefront of care at community-based hospitals and clinics. At their regular teleconference sessions, the forum in which they normally meet for teaching sessions, family medicine trainees shared the common challenges faced in the aftermath of the earthquake. These included the difficulties of providing communities and local government with pertinent advice about ionising radiation, triaging frail older people in order to evacuate them to institutions inland, and maintaining their clinical facilities without enough information, water, electricity, and petrol.

TRAGEDIES IN MODERN CONSCIOUSNESS

For observers around the world, the tragedy left many people who have friends and family in the affected areas desperate for information and keen to help however they can. For those with a less tangible connection to Japan the news of the earthquake perhaps poses a more general dilemma. The distance from Fukushima to the UK is over 9000 kilometres yet the images of the earthquake, the tsunami, and the failed nuclear reactors for the wider international audience are only centimetres away. Within minutes to hours video footage was freely available on YouTube, blogs, Twitter, and rolling news stations. Tragedies around the world are now part of the modern consciousness, such as the recent mud-slides in Brazil, the earthquake in New Zealand, and the upsurge in conflicts in the Middle East. How does one — from a distance and proximity — make sense of such events ?

When Michel Foucault coined the term the 'medical gaze' in the 1960s, it related to the way in which doctors in the 18th century learned in hospitals to see beyond the surface of bodies, to see organs and pathophysiology, and to distance themselves from human suffering.[9] Now the 'medical gaze', increasingly cultivated in general practice, has a holistic focus[10] with a greater emphasis on patient experience and community orientation in contrast to the 18th century teaching at the Hotel-Dieu; the factors influencing the 'medical gaze' change with time.

As the default exposure to world events increases, it is important that the 'medical gaze' is mindfully international, so that it can better harness this exposure, even if at times solutions and meaningful words will be hard to find. For example, it would be helpful for the international community to construct a database of evidence-based information/references on immediate, short-, and long-term effects of ionising radiation, as well as the impact of other kinds of disasters, looking at interventions and strategies to alleviate their effects, especially from the viewpoint of primary care. Appropriate teaching tools would also be useful. In the UK, it is encouraging that GP trainees are now invited to spend more time overseas with Out of Programme experience.[11] A more global view of health may be further facilitated as arguments for an international curriculum gather momentum.[12]

RELIEF EFFORTS AND MEDICAL CARE

Japan will require help in the months and years to come. In practical terms, international aid agencies are best placed to respond initially in the aftermath of natural disasters, but require the support of those who are able to donate time and/or money. As relief efforts continue it is welcome that governments, international agencies, and professional organisations have expressed their solidarity with the people of Japan. Nuclear power deserves to be debated globally and safer sustainable power sources sought. In particular, lessons can be learned for the UK with regards to the role of primary care if confronted with a similar nuclear tragedy. It is important that political differences about the future direction of Japan's medical system are put to one side as it unites against the challenge posed by the disaster.

Medicine is now a truly global profession,[13] whose connections and potential are continually emerging. This may mean exposure to news of more disasters, but more importantly it is an opportunity for greater understanding, hope, and solidarity. Around the world, colleagues in general practice face challenges that can inspire acts of great human endeavour despite adversity.

Notes

Provenance

Commissioned; not externally peer reviewed.

Competing interests

Patrick Hutt visited the Fukushima family medicine training programme in 2008, staying as a guest of Professor Kassai and his colleagues. Ryuki Kassai established the vocational training scheme in general practice in Fukushima and is a citizen of Fukushima.

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