POLICY ISSUE
NOTATION VOTE

January 25, 2012 SECY-12-0011

FOR: The Commissioners

FROM: R. W. Borchardt
Executive Director for Operations

SUBJECT: DATA COLLECTION REGARDING PATIENT RELEASE

PURPOSE:

The purpose of this paper is to provide to the Commission recommendations on whether data gaps exist, and whether and how such data could be collected and used regarding patient release. This paper does not address any new commitments.

SUMMARY:

The staff has concluded that there are gaps in the available empirical data regarding doses being received by members of the public as a result of the release of patients treated with medical isotopes. These gaps in the available empirical data relate to: 1) internal doses to members of the public from close physical contact with patients or radioactive contamination from bodily fluids, and 2) internal and external doses to members of the public from patients released to locations other than their primary residences (e.g., houses, apartments). In most cases where empirical data is lacking, analytical estimates may be used. This paper discusses possible methods that the NRC might use to collect additional data and the feasibility of collection of such data. This paper also discusses the effect of the identified gaps on the underlying assumptions and calculations used in NRC guidance to support patient release. The staff has provided four options for Commission consideration regarding both the collection of data to address the gaps and the need for revisiting the methods and assumptions involved in the dose calculations used to support patient release.

CONTACT: Said Daibes, FSME/MSSA
(301) 415-6863

The staff recommends that the Commission approve Option 3, whereby an evaluation would be conducted to determine if improvements are warranted in the methods and assumptions in the NRC guidance currently used to make patient release decisions. The staff anticipates that an optimum approach to undertaking this study would be via semi-empirical modeling, i.e., using models to calculate doses supported by available empirical data that may be useful in selecting the most realistic assumptions and parameters.

BACKGROUND:

The current requirements in 10 CFR 35.75, often referred to as the "Patient Release Rule," were promulgated in 1997 and establish the regulatory framework for the release of patients from licensee control who have been administered unsealed byproduct material or implants containing byproduct material. These regulations allow a licensee to authorize the release of an individual from its control if the total effective dose equivalent to any other individual, from exposure to the released individual, is not likely to exceed 5 mSv (0.5 rem). The guidance for dose calculations and calculation methods is set forth in NUREG-1492, "Regulatory Analysis on Criteria for the Release of Patients Administered Radioactive Material," and NUREG -1556, Volume 9, "Consolidated Guidance about Materials Licenses: Program-Specific Guidance About Medical Licenses," Appendix U, "Model Procedures for Release of Patients or Human Research Subjects Administered Radioactive Materials" (hereafter NUREGs-1492 and 1556).

In Staff Requirements Memorandum (SRM) - COMGBJ-11-0003, dated June 23, 2011, the Commission directed the staff to evaluate whether there are gaps in the available data on doses received by members of the public from release of patients treated with medical isotopes (hereafter Task 1). The SRM also directed the staff to consider how the agency could collect additional data, if needed, to fill these gaps. In undertaking this task, the staff was directed to consider the practicality, usefulness, and methodology of collecting this data and how it would inform and add value to regulatory decision-making. Also, the staff was directed to coordinate with the Office of Nuclear Regulatory Research (RES) in order to determine whether this type of study is feasible and, if so, the proper scope of the study and estimated resources (hereafter Task 2). With regard to this task, the Commission advised that the staff should weigh the utility of such additional data-gathering against the potential for intruding upon patient privacy protections, and assume that existing guidance provided to patients is being followed appropriately, including the additional guidance provided recently to licensees strongly discouraging the use of hotels by released patients. Finally, the SRM directed staff to include, as an alternative or additional option, a recommendation on the feasibility of revisiting the dose assessment used to support the patient release rulemaking and address the staff's recommended approach on the use of expert elicitation (hereafter Task 3).

DISCUSSION:

Staff efforts to address each of the three tasks are described in detail in Enclosures 1, 2, and 3. A summary of the staff's efforts regarding each task is provided below.

Task 1

As directed by COMGBJ-11-0003, the staff searched available technical literature on doses received by members of the public from released patients treated with medical isotopes. As described in Enclosure 1, the staff collected and reviewed literature that focused primarily on empirical (i.e., based on observation and experiments such as field studies) dose findings from exposure to patients administered medical isotopes. Almost all of the published literature addressed doses from Iodine-131 (I-131) hyperthyroid and thyroid cancer patients and focused on releases to primary residences. Analytical data (i.e., based on theoretical studies) was reviewed as well.

As a result of its review, the staff concluded that there are gaps in the empirical data on the release of patients to locations other than their primary residences, mainly with regard to exposures to other individuals at nursing homes and hotels. There are also gaps in the evaluation of internal doses delivered to members of the public from inhalation and/or ingestion of radioiodine contaminants discharged from the patient's body (i.e., perspiration, saliva, vomit, other body fluids, etc.), due to the increased activities administered in today's patient release practices.

Specifically, with regard to release of patients administered I-131, no empirical studies have been published regarding internal doses to members of the public, or for internal and external doses to members of the public for patients released to locations other than their primary residences. Where empirical data is lacking, analytical estimates are used when needed to support that radiation doses to other individuals from radioactivity in released patients can be safely controlled.

The analysis also indicated that there is a lack of available data (i.e., gaps) on the release of patients administered medical isotopes other than I-131 for hyperthyroid and thyroid cancer. However, the staff concluded that this data gap does not significantly impact patient release practices because of the lower volatility, smaller administered doses, and considerably lower external radiation dose for these other medical isotopes, as compared to I-131. In addition, these other medical isotope uses involve considerably smaller patient populations.

Task 2

For Task 2, the staff addressed: (1) how the agency could collect additional data to resolve the gaps identified during Task 1 reviews, (2) the feasibility of collecting such data and the scope of the study, and (3) the estimated resources and timeline required to conduct the study or studies. The staff also provided a discussion on the methods that NRC might use to collect additional data on doses received by members of the public due to the release of patients treated with medical isotopes to hotels and nursing homes.

The staff determined it may be beneficial to re-examine one of the assumptions in NUREGs-1492 and 1556 guidance which underlies current patient release practices, specifically that internal dose to members of the public is negligible compared with external dose. This re-examination may be warranted because current release practices permit patients to be released with much higher activity than was the case when this assumption was made in promulgating

the patient release rule. Accounting for internal dose is particularly important in the case of children and pregnant women. However, it may be difficult to collect data on internal doses to members of the public, as well as on internal and external doses at nursing homes and hotels. Additionally, there may be privacy considerations that would first have to be addressed.

As described in Enclosure 2, the staff explored the feasibility of a study to collect data related to internal dose and patients released to locations, such as nursing homes and hotels. It is anticipated that such efforts may be difficult and the number of cases examined may be too small to provide an adequate sample. If that is found to be the case, simulations using realistic dose calculations coupled with time-and-motion studies could be used to obtain reasonable dose estimates. Such a simulation would adequately fill the current data gap in this area. As explained in Enclosure 2, this proposed study/analysis would both validate and reinforce existing U.S. Nuclear Regulatory Commission (NRC) guidance and/or requirements or may demonstrate the need for further guidance and re-evaluation of existing practices.

The staff's estimated resources and timeline for completion of Task 2 are addressed in the resource section under Option 2.

Task 3

The Commission also directed that the staff include a recommendation regarding the feasibility of revisiting the dose assessment used to support the patient release rulemaking and address the staff's recommended approach on the use of expert elicitation. However, the patient release rule is not based upon dose assessments; rather, the rule provides a dose threshold for patient release. A patient may be released from licensee control if the total effective dose equivalent to any other individual from exposure to the released individual is not likely to exceed that threshold (i.e., 5 mSv (0.5 rem)).

NUREGs-1492 and 1556 provide the calculations and assumptions used to determine whether a patient should be released. The staff considered the feasibility of whether the calculations and assumptions underlying these calculations should be re-examined. The staff determined that re-examination of the methods and assumptions involved in the dose calculations described in the NUREGs could be accomplished by the staff with contractual support. The estimated resources and timeline for revisiting the calculations and assumptions in the NUREGs are addressed in the resource section under Option 3.

The SRM directed that the staff consider the feasibility of expert elicitation. The staff's assessment concludes that the use of expert elicitation would not be cost effective and would not be necessary because most of the methods and parameters involved in the calculations are reasonably well established and non-controversial. Once the review has started, the staff will initiate expert elicitation if it is necessary.

The staff's estimated resources and timeline for task 3 with expert elicitation are addressed in the resource section under Option 4.

Options:

In developing its recommendation regarding both the feasibility of collecting data for the identified gaps and whether the calculations and assumptions involved in determining whether a patient may be released should be re-evaluated, the staff considered the following four options:

Option 1 - Do not pursue any further research/data collection and do not revisit calculations and methods described in the NUREGs.

This option is based on the assumption that the analytical assessments performed in NUREGs-1492 and 1556 are reliable and provide reasonable assurance that the dose criterion used to release patients is in fact being met, and affirms that safety concerns are being adequately addressed. This position is supported by the few published field studies on this subject. In addition, the Advisory Committee on the Medical Uses of Isotopes (ACMUI) has affirmed in its 2010 report that radiation doses to other individuals from radioactivity in released patients can be safely controlled by the current 10 CFR 35.75 patient release criteria (Ref. 22 in Enclosure 1). Under this option, there would be no need to expend additional agency resources. However, because existing gaps in empirical data have been identified, not pursuing additional research in this area and relying solely on analytical estimates may be viewed critically by some stakeholders.

Option 2 - Perform research/empirical data collection to fill identified gaps in available data.

Since the staff concluded that there are gaps in the data on the release of patients to locations other than their primary residences, and also in the evaluation of internal doses delivered to members of the public, this option involves collection of empirical data on external and internal doses to members of the public exposed to released patients. External dose to potentially exposed individuals could be monitored by providing the individuals most likely to come in contact with specific patients with personal dosimeters for the duration of the exposure.

It would be much more difficult to estimate internal dose. The logistics of monitoring for intake is likely to present additional problems. It would require monitoring potentially exposed people, including children, for possible intakes of I-131 using special radiation detection equipment, and the monitoring would have to be repeated several times during the exposure period to ensure that sufficient data is collected to enable calculation of the resulting internal doses.

Furthermore, the staff sees difficulties with the logistical aspects of empirical data collection in a hotel or nursing home environment due to the need for patient and hotel or nursing home staff consent, corresponding approvals from the related authorities/facilities, public perception of the facilities, and possible inaccuracies in the study's results, due to behavioral changes of participants knowing that they are being monitored. Should it be found feasible to conduct the above measurements, it is unlikely that the sample size would be large enough (due to difficulties in getting adequate numbers of participants) to make any definitive conclusions regarding the adequacy of current practices.

An alternative to monitoring exposed members of the public may be to perform semi-empirical modeling, using models to calculate doses and model parameters based on field data. Data could be obtained on levels of radiation fields around hospitalized patients, and levels of contamination measured on surfaces, walls, sheets, air, etc., in the patient's room. Using this

data, together with reasonable assumptions to allow for differences between hospital and nursing home or hotel settings, staff could obtain at least an order of magnitude estimate of the doses to members of the public. However, this approach would involve making certain assumptions, and the results would therefore have greater uncertainty than an approach based exclusively on measurements, but it would be more feasible to implement. It is anticipated that any data collection would be performed employing peer-reviewed standards by an independent entity.

Option 3 – As an alternative to collecting empirical data, revisit calculations and methods described in the NUREGs' guidance for patient release.

This option would involve a review of the methods and assumptions used in NUREGs-1492 and 1556 to determine if improvements are warranted. This evaluation would include a review of the assumptions associated with internal dose and location of release. This could result in repeating the calculations, and the generation of a new set of tables that may be used by licensees as an operational basis to release patients that the NRC would consider adequate to show compliance with the primary criterion of 5 mSv (0.5 rem) in 10 CFR Part 35. Guidance would then be updated to reflect current release practices. Any empirical data used for the revision would be obtained from published technical literature and not NRC sponsored studies.

The advantage of this option is that the NRC guidance could be enhanced by using semi-empirical data. This involves using new analytical techniques, as well as computer codes for sophisticated dose assessments, which have become available since NUREG-1492 was developed. The revised guidance would also incorporate information obtained from experience that has been gained about patient release, patient behavior after release, and issues associated with patients taking precautions to minimize dose to others. It is expected that factors will be identified that impact dose to members of the public and suggest improvements in release practices or patient instructions that could improve as low as reasonably achievable (ALARA) efforts.

Option 4 - Perform analytical and limited empirical research/data collection, and revisit calculations and methods described in the NUREGs' guidance for patient release.

This option is the same as Option 3, but supplements the formal dose assessments of Option 3 by including a limited amount of empirical data collected from field measurements. The assessments performed under Option 3 would make use of available empirical data, which would be obtained from published technical literature but would not involve staff in actual collection of data from subjects as would be undertaken under Option 2. Option 4, however, would entail supplementing the published data, which may be limited in scope and quantity, with limited analytical and empirical data collection and measurements initiated by NRC (e.g., simulations including software and tissue equivalent phantoms, using realistic dose calculations coupled with time and motion studies). This approach may reduce the uncertainty of the results considering the great variability of behaviors of released patients. However, substantial improvement would not be expected. In implementing this option, expert elicitation would be considered, although the staff's assessment indicates that this would likely not be necessary because most of the methods and parameters involved in the calculations are reasonably well established and non-controversial. Informal discussion with experts in the field, as well as with ACMUI, would be used as appropriate.

Staff's Recommendation:

The staff recommends Option 3. As discussed in Option 2, there are significant logistical problems with conducting empirical studies. New analytical techniques, as well as computer codes for sophisticated dose assessments, have become available since NUREG-1492 was developed and can be used in lieu of collecting empirical data to enhance the guidance for patient release.

Considerable experience has also been gained about patient release, the behavior of patients after release, and the difficulties encountered in getting patients to take precautions to minimize dose to others. Some studies have also been conducted and published that describe the radiation doses received by members of the public from released patients, and this data would also be very helpful in the re-assessments. All of these factors could be used to refine the NUREG-1492 calculations and to develop improved operational tools for licensees to use in releasing patients to meet regulatory requirements. This approach may also permit identification of the factors that have the greatest impact on dose to members of the public, and may therefore suggest improvements in release practices or patient instructions that could enhance ALARA efforts.

In addition, a frequent criticism of the guidance for patient release in NUREGs-1492 and 1556 has been that the guidance is overly conservative; i.e., if the provided calculations are strictly followed this will result in few patients being able to be released from licensee control. However, the staff considers this criticism reflects a misunderstanding of the guidance. Specifically, the provided calculations, and tables that are based upon these calculations, are intended to serve as screening tools that may be used by licensees who do not wish to perform their own calculations. As such, they must be conservative and a limiting, but plausible, scenario must be assumed. However, licensees who have specific information about an individual patient may, and in fact do, factor that information into their calculations. The staff is including in its proposed approach to revising the guidance, a more detailed discussion on the utility of this guidance which may help to correct this misunderstanding. Additionally, as part of its effort, the staff will re-evaluate the calculations and in so doing determine whether the assumptions and parameters used are overly conservative.

RESOURCES:

There is no cost to implement Option 1. Option 2 would require approximately 2 years to complete and would require 0.75 Full Time Equivalent (FTE) with an associated cost of $1.2 M in contract support. If Option 3 were implemented, the staff estimates that the work would require approximately 2 years to complete and would expend 1.0 FTE and $500K in contract support. Option 4, with expert elicitation and with limited data collection, would require 2.5 years, 1.5 FTE, and $900K in contract support. Should the Commission select Options 2, 3, or 4, the staff would need to address the resource needs through the agency Planning, Budgeting, and Performance Management process, including potential reprogramming of resources in the current fiscal year.

COORDINATION:

The Office of the General Counsel has reviewed this paper and has no legal objection. The Office of the Chief Financial Officer has reviewed this paper for resource implications and has no objections. This paper includes the views of the ACMUI Subcommittee on Patient Release (Enclosure 4) and the staff's review of those comments (Enclosure 5). The ACMUI Patient Release Subcommittee report reaffirms that radiation doses to other individuals from radioactivity in released patients can be safely controlled by the current 10 CFR 35.75 release criteria, licensees' use of release criteria and instructions based on individual patient circumstances, and patients' and caregivers' understanding of and adherence to the patient release instructions (Ref. 22 in Enclosure 1). The Organization of Agreement States has provided their views and comments to the proposed options in this paper (see Enclosure 6).

/RA Michael F. Weber for/

R. W. Borchardt
Executive Director
for Operations

Enclosures:
1. Summary of Staff Gap Analysis (Task 1)
2. Feasibility Analysis of Closing Gaps in Existing Data (Task 2)
3. Feasibility of Revisiting Dose Assessment Used for 1997 Patient Release Rulemaking (Task 3)
4. ACMUI Patient Release Subcommittee Comments on the Draft Commission Paper on Data Collection for Patient Release
5. NRC staff review of ACMUI Patient Release Subcommittee comments
6. Organization of Agreement States Comments on the Draft SECY Paper on Data Collection for Patient Release

Summary of Staff Gap Analysis (Task 1)

As instructed in SRM-COMGBJ-11-0003, "Data Collection Regarding Patient Release," a gap analysis was performed by reviewing available articles in scientific and medical journals, as well as national and international radiation protection documents (see list of references). The available literature reviewed revealed that while there are a number of different isotopes used for medical purposes today, only a few were studied. Although this may appear to be a gap in the data this is not the case, because the isotopes studied are the ones that result in the delivery of the highest radiation doses to members of the public. Almost all of the published literature reviewed addressed doses from Iodine-131 (I-131) hyperthyroid and thyroid cancer patients and focused on releases to primary residences (e.g., houses, apartments).

The staff searched for articles on doses (internal and external) from exposure to patients that were administered medical isotopes either on an outpatient or inpatient basis (Ref. 1-22). Many articles focused on the diagnostic/therapeutic quantities of medical isotopes administered and how it impacted patient release (Ref. 1-15). In addition to the United States, patient release studies were performed in India, Pakistan, Japan, England, Belgium, and the Middle East. (Ref. 4, 5, 9-14). Patient release protocols in these countries were analyzed based on release criteria, including radiopharmaceutical limits and quantity allowed for release. Generally, in most of these foreign countries, the limits established for the total activity of radiopharmaceuticals administered to patients are lower than the limits for activity of radiopharmaceuticals administered to patients in the United States. Therefore, when considering doses from released patients to members of the public in these countries, it follows that all of these doses were below the regulatory dose limit set by the U.S. Nuclear Regulatory Commission (NRC) for release of patients, with the exception of doses to some members of the public who willingly chose to care for a patient at close proximity, and others who didn't follow provided guidance. This demonstrates the importance of socioeconomic and cultural considerations when making patient release decisions (Ref. 4, 5, 9-14).

There were articles addressing doses and potential doses from patients while traveling by different means of transportation (e.g., air, bus, train, private vehicle or other public transport) after their release, addressing the patient's proximity to others (including family, small children, radiation workers, hospital staff, etc.), and doses to accompanying individuals that might be present at any given moment and exposed to the released patient. No gap was identified with regard to this issue. One article assessed the dose from the care of the indigent and/or incontinent radioactive patients (Ref. 1).

The available published data was closely scrutinized for information on doses imparted to others after release of the patient to a primary residence and alternative locations (such as a hotel, motel, nursing homes, dormitory, etc.), and the release instructions provided to the patient. A number of studies concluded that I-131 outpatient therapy, with the patient released to a primary residence can be performed safely (Ref. 3, 5, 7-11). No articles reviewed included information on measured or calculated doses from patients released to alternative locations such as a hotel, motel, nursing homes, dormitory, etc. This was identified as a gap in the data.

Existing data supports that radiation doses delivered to other individuals can be safely controlled by current patient release regulations (10 CFR 35.75) (Ref. 20). Studies that monitored released patients administered < 30 mCi I-131 have reported that the delivered radiation doses to other individuals are below 5 mSv, even in cases where the released patient has used public transport (train and bus) as a means of returning to his primary residence (Ref. 13). This activity amount (< 30 mCi of I-131) is significantly lower than the activity in released patients in the United States.

National and International scientific radiation protection documents summarized findings from other studies. These findings were incorporated into their recommendations on patient release that appear to be consistent, in principle and practice, with NRC patient release regulations and guidance (Ref. 23). They focused on whether families of outpatients receiving radioiodine could comply with statutory dose limits and constraints (Ref. 11) and indicate that with proper instructions and recommendations, this could be achieved. Further studies indicate that nurses caring for an indigent patient and medical personnel that may handle a radioactive corpse, with appropriate radiation protection guidelines and recommendations, can be reassured that their doses in these specific circumstances are very low (Ref. 1).

Clinical data suggest that hyperthyroid and thyroid cancer patients can continue to be treated with radioiodine on an out-patient basis, if given appropriate radiation protection advice (Ref. 7). However, particular consideration needs to be given to children aged 3 years or younger, if they may be exposed to the released patient or patient fluids (Ref. 23). While various studies highlighted that the internal radiation doses delivered primarily from radioiodine contamination were very low after release to a residence, the amount of I-131 administered in these cases was significantly lower than that generally administered in most I-131 clinical administrations in the United States (Ref. 15-17).

No articles reviewed included information on the measurement of internal doses delivered to members of the public primarily from inhalation and/or ingestion of radioactive contamination (perspiration, body fluids [saliva, blood, sweat, urine, etc.]) when considering the increased activities administered in today's patient release practices. This was identified as a gap in the data.

The NRC staff is in agreement with the Advisory Committee on the Medical Uses of Isotopes' (ACMUI's) "Draft Patient Release Subcommittee Report" conclusion that the current NRC release criteria appropriately balance public safety with patient access to medical treatment. However, the NRC's position as established in a recently issued Regulatory Issue Summary (RIS) 2011-01, "NRC Policy on Release of Iodine-131 Therapy Patients under 10 CFR 35.75 to Locations Other than Private Residences" is that although 10 CFR 35.75 does not expressly prohibit the release of a radioactive patient to a location other than a private residence, the NRC strongly discourages this practice because it can result in radiation exposures to members of the public for which the licensee may not be able to fully assess compliance with 10 CFR 35.75(a) and may result in doses which are not as low as reasonably achievable (ALARA).

In summary, the gap analysis findings indicate that there are gaps in the available existing empirical data for release of patients to locations other than their primary residences, and particularly for exposure scenarios at nursing homes and exposure scenarios to hotel staff and guests. Gaps also were identified in the analysis of internal doses delivered to members of the public primarily from radioiodine contamination released from the patient's body, when considering today's patient radioiodine administration and release protocols.

References

Empirical

1. Greaves C, Tindale W. “Radioiodine therapy: care of the helpless patient and handling of the radioactive corpse,” J.Radiol Prot. **2001** Dec; 21(4): 381-92.

2. Jørgensen HB, Høilund-Carlsen PF, Nielsen VE. “External dose rates in radioiodine treatment of benign goitre: estimation versus direct measurement,” Scand J Clin Lab Invest. **2006**; 66(6): 509-16.

3. Barrington SF, Anderson P, Kettle AG, Gadd R, Thomson WH, Batchelor S, Mountford PJ, Harding LK, O'Doherty MJ. “Measurement of the internal dose to families of outpatients treated with 131I for hyperthyroidism,” Eur J Nucl Med Mol Imaging. **2008** Nov; 35(11): 2097-104.

4. Monsieurs M, Thierens H, Dierckx RA, Casier K, De Baere E, De Ridder L, De Saedeleer C, De Winter H, Lippens M, van Imschoot S, Wulfrank D, Simons M. “Real-life radiation burden to relatives of patients treated with iodine-131: a study in eight centres in Flanders (Belgium),” Eur J Nucl Med. **1998** Oct; 25(10):1368-76.

5. Tsuchimochi S, Nakajo M, Umanodan T, Fukushima N, Shigaki S, Kiku T. “A study on the isolation period of patients with metastatic thyroid cancer treated by 131I according to a new guideline,” Kaku Igaku. **2001** Nov; 38 (6):747-54.

6. Venencia CD, Germanier AG, Bustos SR, Giovannini AA, Wyse EP. “Hospital discharge of patients with thyroid carcinoma treated with 131I,” J Nucl Med. **2002** Jan; 43(1):61-5.

7. Rutar FJ, Augustine SC, Colcher D, Siegel JA, Jacobson DA, Tempero MA, Dukat VJ, Hohenstein MA, Gobar LS and Vose JM. “Outpatient Treatment with ^{131}I-Anti-B1 Antibody: Radiation Exposure to Family Members,” J Nucl Med. **2001;** 42(6): 907-915.

8. Grigsby PW, Siegel BA, Baker S, Eichling JO. “Radiation exposure from outpatient radioactive iodine (131I) therapy for thyroid carcinoma,” JAMA. **2000;** 283(17):2272-4.

9. Al-Maskery I, Bererhi H. “Radiation exposure levels in family members of Omani patients with thyrotoxicosis treated with radioiodine (I-131) as outpatients,” Sultan Qaboos Univ Med J. **2009** Aug; 9(2):148-52.

10. Barrington SF, O'Doherty MJ, Kettle AG, Thomson WH, Mountford PJ, Burrell DN, Farrell RJ, Batchelor S, Seed P, Harding LK. “Radiation exposure of the families of outpatients treated with radioiodine (iodine-131) for hyperthyroidism,” Eur J Nucl Med. **1999** Jul; 26(7):686-92.

11. K. Koshida, K. Nishizawa, S. Koga and T. Orito. “Levels of 131I activity in patients to enable hospital discharge, based in external exposure of family members of the patient in Japan,” J.Radiol Prot. **1999**; 83(3): 233-238.

12. G. S. Pant , S. K. Sharma, C. S. Bal, Rakesh Kumar and G. K. Rath. "Radiation dose to family members of hyperthyroidism and thyroid cancer patients treated with ^{131}I," Radiat Prot Dosimetry. **2006;** 118 (1): 22-27.

13. W. Muhammad, S. Faaruq, Matiullah, A. Hussain and A A Khan. "Release criteria from hospitals of 131I Thyrotoxicosis therapy patients in developing countries-case study," Radiat Prot Dosimetry. **2006;** 121(2): 136-139.

14. Hänscheid H, Lassmann M, Luster M, Thomas SR, Pacini F, Ceccarelli C, Ladenson PW, Wahl RL, Schlumberger M, Ricard M, Driedger A, Kloos RT, Sherman SI, Haugen BR, Carriere V, Corone C, Reiners C. "Iodine biokinetics and dosimetry in radioiodine therapy of thyroid cancer: procedures and results of a prospective international controlled study of ablation after rhTSH or hormone withdrawal," J Nucl Med. **2006**; 47(4):648-54.

15. Jacobsen A, Plato P, Toeroek D., "Contamination of the home environment by patients treated with iodine-131: Initial results," *Am J Publ Health*. **1978**; 68:228-230.

16. Plato P, Jacobson A, Homann S., "In vivo thyroid monitoring for iodine-131 in the environment." *Inter J Applied Radiat Isotopes*. **1976**; 27:539-545.

17. Toeroek D, Jacobson A, Plato P., "Radiation protection of families of radioactive patients,"*Health Phys*. **1978**; 35:911-912.

Analytical

18. W K. Tuttle and P H. Brown. "Applying Nuclear Regulatory Commission Guidelines to the Release of Patients Treated with Sodium Iodine-131," J Nucl Med Technol. **2000**; 28:275–279.

19. Sparks RB, Siegel JA, Wahl RL. "The need for better methods to determine release criteria for patients administered radioactive material," Health Phys. **1998** Oct; 75(4):385-8.

NRC Documents

20. U.S. Nuclear Regulatory Commission NUREG-1492, "Regulatory Analysis on Criteria for the Release of Patients Administered Radioactive Materials," **1996**.

21. U.S. Nuclear Regulatory Commission Regulatory Guide 8.39, "Release of Patients Administered Radioactive Materials," **1997**.

22. Advisory Committee on Medical Uses of Isotopes, "Patient Release Report," **2010**.

National & International Documents

23. International Commission on Radiological Protection Report 94, "Release of Patients after Therapy with Unsealed Radionuclides," *Annals of the ICRP,* 34(2), **2004**.

24. National Council of Radiation Protection Report Number 155, "Management of Radionuclide Therapy Patients," **2006**.

Analysis of Feasibility of Closing Gaps in Existing Data (Task 2)

For Task 2, the Office of Nuclear Regulatory Research was requested to address the following: (1) how the agency could collect additional data to resolve the gaps identified during Task 1 reviews; and (2) the feasibility of collecting such data and the scope of the study.

This task was intended to address the feasibility of closing data gaps identified in Task 1, in particular the absence of adequate field data on doses to members of the public resulting from released patients who were administered radioactive materials. To date there has been little data collected to validate the calculations and assumptions on which patient release is based.

Dose to a member of the public in proximity of the released patient may arise from two sources: external and internal exposures. External exposure refers to radiation that is emitted from the radioactive material inside the patient's body that then irradiates the exposed person. Internal exposure is more complex, referring to the radioactive material in the patient that may be released from the patient's body in several ways, such as via perspiration, saliva, vomiting, exhalation, and in excreta. This released material will contaminate surfaces, towels, sheets, eating implements, etc., with which they come in contact. A member of the public could inhale or ingest the contaminant, and as a result receive an internal dose. Radioactive material may also be transferred directly from the patient to a member of the public by sneezing and coughing.

Internal exposures are a concern especially in cases where the administered material may be volatile and is administered in large doses. Such is often the case with patients undergoing treatment with I-131, and I-131 is therefore the material of concern in this task for both external and internal doses. An important factor to consider in planning for this task is that children are at higher risk than adults when internal exposures are considered, and should therefore be included in any data collection efforts or analytical assessments. Pregnant women should also be considered due to potential higher risks to the embryo/fetus. Current patient release practices are based on the assumption that internal doses received by exposed members of the public, including family members, are likely to be a small fraction of the external doses and can therefore be neglected. This assumption was made at the time when patient release was based on activities at release not exceeding 30 mCi. Currently, with the dose-based release criterion, patients are being released immediately after administration of up to a few hundred mCi, and these increased levels of activity may invalidate the prior assumption of negligible internal doses, particularly with regard to children.

If data is collected, the staff concluded that while the external dose portion of the study would be easier to perform, the internal dose portion could be more problematic. The external dose portion could be performed by providing and monitoring the potentially exposed people with personal dosimeters. It may be difficult to find an adequate number of people willing to participate. The internal dose portion requires monitoring potentially exposed people, including children, for possible intakes of I-131 using special radiation detection equipment. This monitoring would also have to be repeated several times during the exposure period to ensure that sufficient data is collected to enable calculations of the resulting internal doses. Therefore, in addition to the difficulty of finding a sufficient number of people to participate, as in the case with external doses, the logistics of monitoring for intake is also likely to be difficult.

The staff also sees complexities with data collection either in a hotel or nursing home environment due to potential patient non-consent, corresponding approval(s) from the related authorities/facilities, public perception of the facilities (e.g., hotels or nursing homes), and possible study result inaccuracies due to behavioral changes of participants knowing that they are being monitored. If it is feasible to conduct the above measurements, it is very unlikely that the sample size would be large enough to allow reaching definitive conclusions regarding the adequacy of current practices. The best that can be expected is a qualified conclusion.

To overcome the difficulties created by the impossibility of proving the negative, namely, that doses above specified limits are not being exceeded, an alternative or supplement to monitoring exposed members of the public could be to perform a limited empirical assessment, using models to calculate doses. The staff could obtain data on levels of radiation fields around hospitalized patients, as well as levels of contamination measured on surfaces, walls, sheets, air, etc., in the patient's room. Such data is generally available from the hospital's radiation protection staff or radiation protection program. Using this data, together with reasonable assumptions to allow for differences between hospital and home or hotel settings, the staff could obtain at least an order of magnitude estimate of the doses to members of the public.

To overcome the potential insufficient patient release data sampling explained above, simulations that include software and tissue equivalent phantoms, using realistic dose calculations, coupled with time-and-motion studies, could be used to obtain reasonable dose estimates. Such a simulation may fill some of the current data gaps in this area and could allow for data extrapolation analysis. This simulation would likely be sufficient to make a determination of whether or not internal dose is a concern, and whether the external doses received support the adequacy of current patient release criteria. If staff's calculations indicate areas of concern, such as unexpectedly high internal doses, then additional effort would be devoted to refining these assessments. The staff anticipates that an optimum approach to undertaking this study would be semi-empirical modeling supported by any available empirical data that may be useful in selecting the most realistic assumptions and parameters.

Feasibility of Revisiting Calculations and Underlying Assumptions for Assessing Dose from Released Patient (Task 3)

For Task 3, the Office of Nuclear Regulatory Research was requested to address the following: (1) assess the feasibility and resources needed for revisiting the dose assessment used to support the 1997 patient release rulemaking, and (2) provide a recommendation on the feasibility and the resources and timeline needed for expert elicitation as another approach to revisiting the dose assessment.

The current patient release rule is dose-based and not based on dose assessments. However, dose assessments are needed to implement the rule. The current patient release rule and practices in the United States are radiation-dose-based, namely, patients may be released from the hospital if it is unlikely that any member of the public will receive a dose in excess of 5 mSv (0.5 rem) as a result of being in proximity to the patient. Because members of the public are not monitored to verify that this is indeed the case, calculations are used to translate the dose criterion to activity of the medical radionuclides administered to the patient, and these activities are then used by licensees as surrogates for radiation dose to determine whether the patient may be released. The calculations use simple models and conservative assumptions.

The assessments described in NUREG-1492, "Regulatory Analysis on Criteria for the Release of Patients Administered Radioactive Material," were used in part to select among different release options, but the patient release criterion (that release may be authorized if the total effective dose equivalent to any other individual from exposure to the released individual is not likely to exceed 5 mSv (0.5 rem)) will not be re-examined. Only the calculation methods, that were subsequently used to provide guidance for licensees in NUREG-1492, and that is incorporated in NUREG-1556, Volume 9, "Consolidated Guidance about Materials Licenses: Program-Specific Guidance About Medical Licenses," Appendix U, "Model procedures for release of patients or human research subjects administered radioactive materials," (NUREG-1556) will be reviewed.

The 5 mSv dose criterion for patient release was a policy decision, not based on calculations. The policy decision was informed by analysis involving balancing the risk of exposure to a low dose of radiation from the patient to a member of the public against the benefits of not keeping patients for extended periods of time in the hospital following administration of byproduct material. It is the licensee's responsibility to ensure that the released patient will likely meet the dose criterion. However, because of the difficulty of ensuring that such a dose-based criterion is met, U.S. Nuclear Regulatory Commission (NRC) has performed calculations designed to derive a surrogate, measurable quantity that licensees may use as a tool or aid in showing compliance with the dose criterion. If the licensee is in compliance with the surrogate quantity, then it is acceptable to the NRC to assume that the licensee is also in compliance with the dose criterion in the regulations. Derivation of this tool is described in NUREGs-1492 and 1556. The results of the calculations in the NUREGs are presented in the form of tables of administered activities and of dose rates measured at 1 meter from the patient which, if met, may be used to release the patient. Thus, patients are being released using surrogate release criteria and not the primary dose criterion.

It should be noted, however, that the calculations and tables provided by the NRC represent guidance and suggested methods that NRC would consider acceptable in showing compliance. There is nothing in the regulations preventing licensees from doing their own calculations, using their own data and assumptions, to show compliance with the 5 mSv release criterion. The only necessity in such a case is for the licensee to be able to justify the methods, data and assumptions used in the calculations. Such an approach is likely to be less conservative than the guidance provided by NRC because it is likely to be site-specific, whereas NRC's guidance, not being based on any specific situation, serves as a generic screening tool, and hence must be conservative by its nature.

There have been complaints that the calculations used in patient release are excessively conservative and should therefore be re-examined to remove these conservatisms. A review by staff of these calculations shows that they are, indeed conservative, but that this conservatism is appropriate for the following reasons. The patient release rule is dose-based, and only requires licensees to show that they are releasing patients in a manner that complies with the rule. Licensees may use any method of calculation they wish in showing compliance, using any parameters and assumptions they deem appropriate, provided they document their calculations and support their assumptions. Therefore, conservatism is not built into the rule. The calculations performed by NRC and described in the NUREGs, and the tables that are based on these calculations, are intended to serve as screening tools for the convenience of licensees who may not wish to do their own calculations, or who do not have the technical expertise to do them. As in the case of all screening tools, they must by their nature be conservative because they assume that the patient is being released with no knowledge of what will happen following release, that is, who the patient will come in contact with, how long that contact will be, etc. Under such circumstances, conservatism is necessary because limiting, but plausible, scenarios must be assumed. Licensees who have specific information on the behavior of patients after release may use that information to adjust their calculations. Nevertheless, in reviewing dose assessments, the staff will evaluate the calculations and determine whether the models used are too basic and whether the assumptions and parameters are too conservative. This would include a review of the assumptions associated with internal dose and location of release. If that is found to be the case, staff could improve the calculations, and it can also regenerate the tables used by licensees using the improved calculations.

The staff may consider expert elicitation when reviewing dose assessments if it determines that it would be useful. Expert elicitation is widely used in formulating radiation protection recommendations and standards because many of the parameters that enter into dose and risk assessment are a matter of expert opinion, and are usually selected by a panel of experts. However, in the case of patient release dose estimates, the staff views the calculations as being fairly straightforward, and the assumptions and parameter values that are used in these calculations are few and easy to select. It is the staff's opinion that expert elicitation in this case would not be cost effective and is not likely to be needed. However, once the review is started and the details are established, the staff will initiate expert elicitation if it seems suitable. As an alternative to the formal process of elicitation, the staff will solicit opinions from many people who work in the relevant fields in order to incorporate as much of their field experience in the calculations as is feasible.

Advisory Committee on the Medical Use of Isotopes (ACMUI)
Patient Release Subcommittee Comments on
Draft Commission Paper on Data Collection for Patient Release
December 2, 2011

Subcommittee Members: S. Langhorst, Ph.D. (Chair); S. Mattmuller, MS, R.Ph, BCNP; O. Suleiman, Ph.D.; B. Thomadsen, Ph.D.; J. Welsh, M.D.; L. Weil; P. Zanzonico, Ph.D.

NRC Staff Request: ACMUI Patient Release Subcommittee to provide opinions and/or comments on Draft Commission Paper on Data Collection for Patient Release (Version 26, dated October 27, 2011).

Subcommittee Recommendations

The Subcommittee supports additional field measurements and improved modeling. While this encompasses certain aspects of both Option 3 and 4, the Subcommittee did not feel that either Option as stated captured the sense of the Subcommittee. Measurements of surface contamination and of activity internalized, in contrast to external-dose measurements, would more directly validate or dispute the contentious assumption that internal dose is of minimal significance in the context of release of radionuclide therapy patients, particularly with respect to patients receiving higher administered activities and released to locations other than their primary residences. The Subcommittee feels that such data could be collected through a field study done with family members and hospital, nursing home, and hotel staff willing to participate, and would provide valuable data on the conservative nature of the parameters used for patient release calculations. Additionally, external exposure measurements to cohorts not already in the literature would be useful. The Subcommittee believes the data thus collected could be reasonably applied to situations of patient release to any location. The Subcommittee further recommends that any such data gathering, analysis, and reporting be done through a fully transparent peer-reviewed process rather than internally by NRC staff.

Additional Subcommittee Discussions beyond the Scope of the Draft Commission Paper

In the course of its discussion of the Draft Commission Paper on Data Collection for Patient Release, the Subcommittee considered the following issues in light of the possibility of performing additional data collection activities related to patient release. We recognize these comments go beyond the scope of the Commission's directions to NRC staff in developing the draft commission paper, but the Subcommittee feels these comments may be helpful to future data gathering efforts related to patient release.

Explore use of existing data resources – Some existing data collection resources may be used to gather data relating to parameters impacting patient release. For example, radiation measurements done by the Transportation Security Administration (TSA) may provide or slightly adjust its data

collection protocols to provide information on numbers of released patients who travel after their radionuclide therapy administration, or numbers of non-patients who have detectable levels of contamination as a result of being associated with a released patient. Other locations where radiation scanning is routinely performed, such as nuclear power plants, national laboratories, nuclear fuel fabrication facilities, etc., may also provide comparable data collection capabilities.

Consistency of patient precautions and patient understanding of instructions – The Subcommittee believes the best ways to alleviate concerns related to patient release would be to develop reasonable and consistent precautions for patient release for various locations. Examples of recent articles focusing on this topic include:

> Greenlee, et.al. "Current Safety Practices Relating to I-131 Administration for Diseases of the Thyroid: A Survey of Physicians and Allied Practitioners." *THYROID*. 2011;21:151-160.
>
> Kloos, R.T. "Survey of Radioiodine Therapy Safety Practices Highlights the Need for User-Friendly Recommendations." *THYROID* Vol. 2011;21:97-99.
>
> The American Thyroid Association Taskforce on Radioiodine Safety. "Radiation Safety in the Treatment of Patients with Thyroid Diseases by Radioiodine ^{131}I: Practice Recommendations of the American Thyroid Association." *THYROID*. 2011;21:335-346.

The development of reasonable and consistent precautions should include evaluation of patient understanding of and/or ability to follow instructions to implement these precautions. This may also include providing instructions for individuals working at different locations likely to receive multiple released patients, such as hotels and nursing homes. The Subcommittee suggests these instructions emphasize that compliance with these precautions will ensure that the risk of health effects to others from exposure to the released patient is reduced to that comparable to the risk associated with variations in background radiation, which are too small to be observed and may be nonexistent altogether.

Subcommittee Specific Comments on the Draft Commission Paper

Given the Commission directions contained in Staff Requirements Memorandum (SRM)-COMGBJ-11-0003, the Subcommittee offers the NRC staff the following opinions and comments on the draft commission paper.

1. **Page 2, Summary, last sentence** –

   > "The staff recommends that the Commission approve Option 3, whereby an evaluation would be conducted of the methods and assumptions in NUREGs 1492 and 1556 which are used in support of releasing patients to determine if improvements are warranted."

   This sentence is not consistent with the **last sentence, Enclosure 2** –

"The staff anticipates that an optimum approach to undertaking this study would be a combination of semi-empirical modeling supported by some field measurements on a few exposed members of the public."

In discussion with NRC staff, the Subcommittee understands that the intent of NRC staff in recommending Option 3 was to also include an option to collect some field measurements if existing empirical data are not sufficient. We suggest this intent be included in the Summary section of the Draft Commission Paper.

2. **Page 3, second paragraph under Task 1, last sentence** – The Subcommittee believes this sentence is ambiguous. Is it stating that "…no studies have been published regarding internal doses to members of the public …" generally *or* only in the context of patients released to other than their primary residences? It is subsequently stated in this sentence that neither have such studies been published on "…internal and external doses to members of the public, for patients released to locations other than their primary residences and particularly for exposure scenarios at nursing homes and exposure scenarios to hotel staff (e.g. front desk clerk) and guests…" The latter statement is correct, with the exception of the Subcommittee's ACMUI Patient Release Report, which included public dose calculations for released patients going to a hotel; this Report should be cited here. However, if this sentence is meant to assert that no studies have been published on internal doses generally, that is not correct. There are at least three such studies in the peer-reviewed literature.

   Jacobsen A, Plato P, Toeroek D., "Contamination of the home environment by patients treated with iodine-131: Initial results," *Am J Publ Health*. 1978;68:228-230.

   Plato P, Jacobson A, Homann S., "In vivo thyroid monitoring for iodine-131 in the environment." *Inter J Applied Radiat Isotopes*. 1976;27:539-545.

   Toeroek D, Jacobson A, Plato P., "Radiation protection of families of radioactive patients,"*Health Phys*. 1978;35:911-912.

   In any case, the term, "studies," should be clarified to indicate that it refers to actual field measurements. We also recommend that "(e.g. front desk clerk)" be dropped here and in the **last paragraph, Enclosure 1**, since exposures to all hotel staff merit consideration.

3. **Summary of Staff Gap Analysis (Task 1)** – This section, including the list of references, should be labeled in the footer as Enclosure 1.

4. **Enclosure 1, Reference Number 6** – The Health Physics Society withdrew the referenced Position Statement from its web page soon after it was posted and is currently revising it. It therefore should not be referenced at this point.

5. **Enclosure 2** – The Subcommittee believes that various statements made in Enclosure 2 may be considered provocative in that they are not supported by reference documents or do not appear to assume that patients and licensees are appropriately following instructions/guidance as directed by the SRM. We have listed here those statements and our specific concerns we have with each.

"This task was intended to address the feasibility of closing at least some of the data gaps identified in Task 1, namely the absence of adequate field data on doses to members of the public resulting from released patients who were administered radioactive materials. To date there has been little data collected to validate the calculations and assumptions on which patient release is based. That is, it is not known whether members of the public are, in fact, receiving doses that are less than 5 mSv from the released patients."

From the Subcommittee's understanding of the gap analysis used in the Draft Commission Paper, adequacy of the field data is not judged beyond its source being a peer-reviewed publication. The Subcommittee believes this paragraph should be reworded so that it is consistent with the Draft Commission Paper. Parts of the paragraph state that doses may be exceeded, but given the constraint of the SRM that the NRC staff considers that all instructions and guidance are being followed, we believe that the wording should be modified to include that doses exceeding the limit would not be likely if instructions and guidance are followed.

"The exposed member of the public could inhale or ingest the contaminant, and as a result receive an internal dose. Radioactive material may also be transferred directly from the patient to a member of the public by sneezing, coughing, or kissing. A breast feeding patient may also transfer the radioactive material via the milk to a child through breast feeding, although breast feeding patients are provided with instructions on stopping breast feeding for a period of time after treatment."

The Subcommittee believes that the last sentence on breastfeeding and the example of kissing should be dropped as they are both examples of prohibited behavior that patients are warned against in the instructions given to them, and any recommendations involving questions about the instructions given to patients or how the patients follow the instructions runs contrary to the SRM.

"For example, per unit activity of ingested I-131, a 1-year-old child will receive both effective and thyroid doses that may be up to 10 times higher than the doses received by an adult for the same intake."

The Subcommittee believes this statement requires a cited peer-reviewed reference to in order to keep this sentence in this paragraph.

"On the other hand, the data may show doses that are higher than 5 mSv, as some available data suggests that this may be the case, and a reasonable conclusion would be that the release criteria appear inadequate and should be re-evaluated."

The Subcommittee believes the "available data" statement requires a cited peer-reviewed reference to in order to keep this sentence in this paragraph.

6. **Enclosure 3** – Concerning underlying assumptions discussed in this Enclosure, the Subcommittee believes that NRC staff should include reference to the Federal Register publication of the patient release final rule (62 FR 4120) that the 5 mSv dose limit applies to an individual's exposure from the released patient *for each patient release*. The discussion of risk (i.e., harm) in this enclosure should more explicitly reference the application of the three fundamental principles of the use of radioactive materials by recognizing the benefit of these medical procedures, the risk of harm to

the patient if these medical procedures are not available or are constrained, and that all these issues must be considered when establishing approval for radioactive material medical use, public dose limits, and the reasonable application of precautions released patients should follow.

- The Principle of Justification: Any decision that alters the radiation exposure situation should do more good than harm.

- The Principle of Optimization of Protection: The likelihood of incurring exposure, the number of people exposed, and the magnitude of their individual doses should all be kept as low as reasonably achievable (ALARA), taking into account economic and societal as well as medical factors.

- The Principle of Application of Dose Limits: The total dose to any individual from regulated sources in planned exposure situations other than medical exposure of patients should not exceed the appropriate limits specified.

And the Subcommittee believes this discussion of harm should also reference studies or expert opinion of harm associated with aspects of patient release, such as:

Hahn, et.al. "Thyroid Cancer after Diagnostic Administration of Iodine-131 in Childhood." *Radiation Research*. 2001;156:61-70.

"Radiation Risk in Perspective," Position Statement of the Health Physics Society, PS 010-2, July 2010 [http://hps.org/documents/risk_ps010-2.pdf , last accessed December, 2, 2011].

Higashi, et.al. "Delayed Initial Radioactive Iodine Therapy Resulted in Poor Survival in Patients with Metastatic Differentiated Thyroid Carcinoma: A Retrospective Statistical Analysis of 198 Cases." *The Journal of Nuclear Medicine*. 2011;52:683-689.

Goldsmith, S.J. "The Real Cost of Theoretic Risk Avoidance: The Need to Challenge Unsubstantiated Concerns About ^{131}I Therapy." *The Journal of Nuclear Medicine*. 2011;52:681-682.

7. **Enclosure 3, page 1, paragraph 4, 2nd sentence & page 2, 1st full sentence** – The Subcommittee believes licensee responsibilities should be described identically as in the regulations, and so recommend that the words "indeed" and "are in fact" be replaced with "likely."

8. **Enclosure 3, page 1, paragraph 4, last 5 sentences** – The Subcommittee believes these sentences imply that a licensee can only determine a patient releasibility using the method and tables described in these NUREGs. A statement should be added to clarify that the NUREG tables represent a possible tool to determine patient releasibility, and that licensees are allowed to perform their own patient-specific projected-dose calculations to demonstrate compliance with the 5 mSv dose criterion.

NRC response as indented and italicized insertions to:

Advisory Committee on the Medical Use of Isotopes (ACMUI)
Patient Release Subcommittee Comments on
Draft Commission Paper on Data Collection for Patient Release
December 2, 2011

Subcommittee Members: S. Langhorst, Ph.D. (Chair); S. Mattmuller, MS, R.Ph, BCNP; O. Suleiman, Ph.D.; B. Thomadsen, Ph.D.; J. Welsh, M.D.; L. Weil; P. Zanzonico, Ph.D.

NRC Staff Request: ACMUI Patient Release Subcommittee to provide opinions and/or comments on Draft Commission Paper on Data Collection for Patient Release (Version 26, dated October 27, 2011).

Subcommittee Recommendations

The Subcommittee supports additional field measurements and improved modeling. While this encompasses certain aspects of both Option 3 and 4, the Subcommittee did not feel that either Option as stated captured the sense of the Subcommittee. Measurements of surface contamination and of activity internalized, in contrast to external-dose measurements, would more directly validate or dispute the contentious assumption that internal dose is of minimal significance in the context of release of radionuclide therapy patients, particularly with respect to patients receiving higher administered activities and released to locations other than their primary residences. The Subcommittee feels that such data could be collected through a field study done with family members and hospital, nursing home, and hotel staff willing to participate, and would provide valuable data on the conservative nature of the parameters used for patient release calculations. Additionally, external exposure measurements to cohorts not already in the literature would be useful. The Subcommittee believes the data thus collected could be reasonably applied to situations of patient release to any location.

NRC Response:

The NRC respects the Subcommittees view but continues to support recommending Option 3. The staff believes the difficulty of obtaining participants, demonstrating that the data is unbiased, and drawing definitive conclusions based on a potentially small sample size continue to be obstacles in supporting the feasibility of collecting empirical data.

The Subcommittee further recommends that any such data gathering, analysis, and reporting be done through a fully transparent peer-reviewed process rather than internally by NRC staff.

NRC Response:

If the Commission approves the collection of empirical data, the NRC staff will follow any applicable federal contracting procedures to develop a data collection protocol and issue a contract for the collection of such data. NRC may also request contractor support to provide assistance with analytical assessments that the staff cannot perform. The staff will internally perform the tasks that are within its areas of expertise.

Additional Subcommittee Discussions beyond the Scope of the Draft Commission Paper

In the course of its discussion of the Draft Commission Paper on Data Collection for Patient Release, the Subcommittee considered the following issues in light of the possibility of performing additional data collection activities related to patient release. We recognize these comments go beyond the scope of the Commission's directions to NRC staff in developing the draft commission paper, but the Subcommittee feels these comments may be helpful to future data gathering efforts related to patient release.

Explore use of existing data resources – Some existing data collection resources may be used to gather data relating to parameters impacting patient release. For example, radiation measurements done by the Transportation Security Administration (TSA) may provide or slightly adjust its data collection protocols to provide information on numbers of released patients who travel after their radionuclide therapy administration, or numbers of non-patients who have detectable levels of contamination as a result of being associated with a released patient. Other locations where radiation scanning is routinely performed, such as nuclear power plants, national laboratories, nuclear fuel fabrication facilities, etc., may also provide comparable data collection capabilities.

NRC Response:

The NRC agrees that there may be merit to exploring whether the TSA can be helpful in providing additional information on the number of people who travel shortly after undergoing nuclear medicine or brachytherapy procedures. If the Commission approves the collection of extensive data gathering, the staff will explore this approach to supplement data. The staff will also consider the feasibility of obtaining information from other locations routinely performing radiation scanning.

Consistency of patient precautions and patient understanding of instructions – The Subcommittee believes the best ways to alleviate concerns related to patient release would be to develop reasonable and consistent precautions for patient release for various locations. Examples of recent articles focusing on this topic include:

Greenlee, et.al. "Current Safety Practices Relating to I-131 Administration for Diseases of the Thyroid: A Survey of Physicians and Allied Practitioners." *THYROID*. 2011;21:151-160.

Kloos, R.T. "Survey of Radioiodine Therapy Safety Practices Highlights the Need for User-Friendly Recommendations." *THYROID* Vol. 2011; 21:97-99.

The American Thyroid Association Taskforce on Radioiodine Safety, "Radiation Safety in the Treatment of Patients with Thyroid Diseases by Radioiodine 131I: Practice Recommendations of the American Thyroid Association." *THYROID*. 2011; 21:335-346.

The development of reasonable and consistent precautions should include evaluation of patient understanding of and/or ability to follow instructions to implement these precautions. This may also include providing instructions for individuals working at different locations likely to receive multiple released patients, such as hotels and nursing homes. The Subcommittee suggests these instructions emphasize that compliance with these precautions will ensure that the risk of health effects to others from exposure to the released patient is reduced to that comparable to the risk associated with variations in background radiation, which are too small to be observed and may be nonexistent altogether.

NRC Response:

The NRC recognizes the importance of reasonable, consistent, and patient specific precautions for all released patients and is aware of the documents cited. However, examining the merits of instructions as the part of the release criteria is beyond the scope of this study. Further, the staff was explicitly instructed to assume during its gap analysis that precautions and instructions are being followed by the released patients.

Subcommittee Specific Comments on the Draft Commission Paper

Given the Commission directions contained in Staff Requirements Memorandum (SRM)-COMGBJ-11-0003, the Subcommittee offers the NRC staff the following opinions and comments on the draft commission paper.

1. Page 2, Summary, last sentence –

"The staff recommends that the Commission approve Option 3, whereby an evaluation would be conducted of the methods and assumptions in NUREGs 1492 and 1556 which are used in support of releasing patients to determine if improvements are warranted."

This sentence is not consistent with the **last sentence, Enclosure 2 –**

"The staff anticipates that an optimum approach to undertaking this study would be a combination of semi-empirical modeling supported by some field measurements on a few exposed members of the public."

In discussion with NRC staff, the Subcommittee understands that the intent of NRC staff in recommending Option 3 was to also include an option to collect some field measurements if existing empirical data are not sufficient. We suggest this intent be included in the Summary section of the Draft Commission Paper.

NRC Response:

The NRC does not believe that the two cited statements are inconsistent. However, to ensure that they are not misinterpreted, the second statement, in Enclosure 2, was modified to clarify its meaning.

2. Page 3, second paragraph under Task 1, last sentence – The Subcommittee believes this sentence is ambiguous. Is it stating that "…no studies have been published regarding internal doses to members of the public…" generally *or* only in the context of patients released to other than their primary residences? It is subsequently stated in this sentence that neither have such studies been published on "…internal and external doses to members of the public, for patients released to locations other than their primary residences and particularly for exposure scenarios at nursing homes and exposure scenarios to hotel staff (e.g. front desk clerk) and guests…" The latter statement is correct, with the exception of the Subcommittee's ACMUI Patient Release Report, which included public dose calculations for released patients going to a hotel; this Report should be cited here. However, if this sentence is meant to assert that no studies have been published on internal doses generally, that is not correct. There are at least three such studies in the peer-reviewed literature.

Jacobsen A, Plato P, Toeroek D., "Contamination of the home environment by patients treated with iodine-131: Initial results," *Am J Publ Health*. 1978;68:228-230.

Plato P, Jacobson A, Homann S., "In vivo thyroid monitoring for iodine-131 in the environment." *Inter J Applied Radiat Isotopes*. 1976;27:539-545.

Toeroek D, Jacobson A, Plato P., "Radiation protection of families of radioactive patients,"*Health Phys*. 1978;35:911-912.

In any case, the term, "studies," should be clarified to indicate that it refers to actual field measurements. We also recommend that "(e.g. front desk clerk)" be dropped here and in the **last paragraph, Enclosure 1**, since exposures to all hotel staff merit consideration.

NRC response:

The NRC was referring to empirical data from studies specifically in context of patients released to places other than their primary residence. The ACMUI Patient Release Report was not included because it was based on analytical calculations and not empirical data. As suggested, the staff has clarified the intended context of the statements and the "front desk clerk" has been removed to expand consideration to all hotel staff.

3. Summary of Staff Gap Analysis (Task 1) – This section, including the list of references, should be labeled in the footer as Enclosure 1.

NRC Response:

Staff agrees and made the suggested change.

4. Enclosure 1, Reference Number 6
The Health Physics Society withdrew the referenced Position Statement from its web page soon after it was posted and is currently revising it. It therefore should not be referenced at this point.

NRC Response:

Even though the reference to the Position Statement was valid at the time of the gap analysis, the staff accepts the comment and removed the reference.

5. Enclosure 2 – The Subcommittee believes that various statements made in Enclosure 2 may be considered provocative in that they are not supported by reference documents or do not appear to assume that patients and licensees are appropriately following instructions/guidance as directed by the SRM. We have listed here those statements and our specific concerns we have with each.

NRC Response:

The NRC agrees that various statements made in Enclosure 2 do not include reference documents or appear to assume that licensees and patients are not following instructions/guidance. The staff made appropriate changes.

"This task was intended to address the feasibility of closing at least some of the data gaps identified in Task 1, namely the absence of adequate field data on doses to members of the public resulting from released patients who were administered radioactive materials. To date there has been little data collected to validate the calculations and assumptions on which patient release is based. That is, it is not known whether members of the public are, in fact, receiving doses that are less than 5 mSv from the released patients."

From the Subcommittee's understanding of the gap analysis used in the Draft Commission Paper, adequacy of the field data is not judged beyond its source being a peer-reviewed publication. The Subcommittee believes this paragraph should be reworded so that it is consistent with the Draft Commission Paper. Parts of the paragraph state that doses may be exceeded, but given the constraint of the SRM that the NRC staff considers that all instructions and guidance are being followed, we believe that the wording should be modified to include that doses exceeding the limit would not be likely if instructions and guidance are followed.

NRC Response:

The NRC does not agree with the Subcommittee's recommendation to include that doses exceeding the limit would not be likely if instructions and guidance are followed because it presumes the validity of an assumption that has not been determined. However, the staff removed the last sentence; i.e.: "That is, it is not known whether members of the public are, in fact, receiving doses that are less than 5 mSv from the released patients."

In addition, the staff will review the publications employed as references for the gap analysis to determine whether or not instructions and guidance were being followed, and if not, these references will not be cited as instances showing that the 5 mSv may have been exceeded.

"The exposed member of the public could inhale or ingest the contaminant, and as a result receive an internal dose. Radioactive material may also be transferred directly from the patient to a member of the public by sneezing, coughing, or kissing. A breast feeding patient may also transfer the radioactive material via the milk to a child through breast feeding, although breast feeding patients are provided with instructions on stopping breast feeding for a period of time after treatment."

The Subcommittee believes that the last sentence on breastfeeding and the example of kissing should be dropped as they are both examples of prohibited behavior that patients are warned against in the instructions given to them, and any recommendations involving questions about the instructions given to patients or how the patients follow the instructions runs contrary to the SRM.

NRC Response:

NRC considered the comment and removed these statements.

“For example, per unit activity of ingested I-131, a 1-year-old child will receive both effective and thyroid doses that may be up to 10 times higher than the doses received by an adult for the same intake.”

The Subcommittee believes this statement requires a cited peer-reviewed reference to in order to keep this sentence in this paragraph.

NRC Response:

NRC considered the comment and removed the statement.

“On the other hand, the data may show doses that are higher than 5 mSv, as some available data suggests that this may be the case, and a reasonable conclusion would be that the release criteria appear inadequate and should be re-evaluated.”

The Subcommittee believes the “available data” statement requires a cited peer-reviewed reference to in order to keep this sentence in this paragraph.

NRC Response:

NRC considered the comment and removed the referenced text.

6. Enclosure 3 –
Concerning underlying assumptions discussed in this Enclosure, the Subcommittee believes that NRC staff should include reference to the Federal Register publication of the patient release final rule (62 FR 4120) that the 5 mSv dose limit applies to an individual’s exposure from the released patient *for each patient release*. The discussion of risk (i.e., harm) in this enclosure should more explicitly reference the application of the three fundamental principles of the use of radioactive materials by recognizing the benefit of these medical procedures, the risk of harm to the patient if these medical procedures are not available or are constrained, and that all these issues must be considered when establishing approval for radioactive material medical use, public dose limits, and the reasonable application of precautions released patients should follow.

−The Principle of Justification: Any decision that alters the radiation exposure situation should do more good than harm.

− The Principle of Optimization of Protection: The likelihood of incurring exposure, the number of people exposed, and the magnitude of their individual doses should all be kept as low as reasonably achievable (ALARA), taking into account economic and societal as well as medical factors.

− The Principle of Application of Dose Limits: The total dose to any individual from regulated sources in planned exposure situations other than medical exposure of patients should not exceed the appropriate limits specified.

And the Subcommittee believes this discussion of harm should also reference studies or expert opinion of harm associated with aspects of patient release, such as:

Hahn, et.al. “Thyroid Cancer after Diagnostic Administration of Iodine-131 in Childhood.” *Radiation Research*. 2001;156:61-70.

“Radiation Risk in Perspective,” Position Statement of the Health Physics Society, PS 010-2, July 2010 [http://hps.org/documents/risk_ps010-2.pdf , last accessed December 2, 2011].

Higashi, et.al. “Delayed Initial Radioactive Iodine Therapy Resulted in Poor Survival in Patients with Metastatic Differentiated Thyroid Carcinoma: A Retrospective Statistical Analysis of 198 Cases.” *The Journal of Nuclear Medicine*. 2011;52:683-689.

Goldsmith, S.J. “The Real Cost of Theoretic Risk Avoidance: The Need to Challenge Unsubstantiated Concerns About 131I Therapy.” *The Journal of Nuclear Medicine*. 2011;52:681-682.

NRC Response:

The NRC recognizes the importance of the three fundamental principles of the use of radioactive materials but believes they were already taken into consideration when NRC developed the patient release criteria. Enclosure 3 addresses the feasibility of revising the calculations and underlying assumptions for assessing dose from released patients. In the context of addressing feasibility of performing an assessment, an in-depth discussion of risk (i.e., harm) is outside that scope. Nor is reference to the Federal Register publication regarding the application of the dose limit to each patient release relevant to that scope.

7. Enclosure 3, page 1, paragraph 4, 2nd sentence & page 2, 1st full sentence – The Subcommittee believes licensee responsibilities should be described identically as in the regulations, and so recommend that the words “indeed” and “are in fact” be replaced with “likely.”

NRC Response:

The ACMUI comment was accepted and the suggested change was made.

8. **Enclosure 3, page 1, paragraph 4, last 5 sentences** –
The Subcommittee believes these sentences imply that a licensee can only determine a patient releasibility using the method and tables described in these NUREGs. A statement should be added to clarify that the NUREG tables represent a possible tool to determine patient releasibility, and that licensees are allowed to perform their own patient-specific projected-dose calculations to demonstrate compliance with the 5 mSv dose criterion.

NRC Response:

The ACMUI comment was accepted and the suggested change was made.

Organization of Agreement States

Cheryl Rogers, Chair, Wisconsin
Alan Jacobson, Chair-Elect, Maryland
David Walter, Past-Chair, Alabama
Bridget Stephens, Treasurer, Texas
Pat Gardner, Secretary, New Jersey
Mike Welling, Director, Virginia
Lee Cox, Director, North Carolina

November 28, 2011

U.S. Nuclear Regulatory Commission (NRC)
Said Daibes, Ph.D., Health Physicist
11545 Rockville Pike
Rockville, Maryland 20852

Subject: Data Collection Regarding Patient Release

Dear Dr. Daibes,

The Organization of Agreement States (OAS) Executive Board (Board) has reviewed the above document and offers the following comments for review by the Nuclear Regulatory Commission (NRC).

The Board supports pursuit of Option 3 (review the calculations and methods described in the NUREG) as the correct course to be taken. This represents the most reasonable approach to improving the guidance in NUREG-1556, Vol. 9, Appendix U. The Board supports the inclusion of an internal dose component in the patient release calculations for iodine-131 therapies. The re-evaluation of the calculations could also result in a less conservative method to determine patient release, which would more accurately reflect the higher doses patients receive. Utilizing the new dose assessment programs available to evaluate the calculations and methods for determining patient release would accurately reflect exposure to others, whereas options 2 and 4 would require volunteers to receive exposure.

The Board also recommends that all patients and families/guardians be given verbal and written instructions to minimize external and internal exposure to others regardless of the expected exposure.

In considering the other options, we offer the following comments:

- The data collected on patient release after these procedures are performed is circumstantial evidence that the patient will abide by all instructions/rules given to them. The constant, uncontrollable unknown is human behavior.

- Option 1 does not seem to be a sufficient response to the matter due to public knowledge and political deliberation over the subject.

- Option 2 relies heavily on patient behavior and also the biological aspects of human excretions. The research involving internal dose could be skewed by selecting patients who emit more perspiration than others, or someone infected with the flu before receiving a therapy dose of radioactive iodine. Each patient who undergoes these therapies has different symptoms and underlying conditions, therefore the data will inevitably be inaccurate based on the patient population selected. The patients are given verbal and written procedures to minimize external and internal exposure to others. It is up to the patient to follow these procedures. All data collected would be circumstantial, therefore still giving estimates and best guesses for future patients treated. This seems to be an expensive and time consuming way to collect circumstantial data. In addition, volunteers will be necessary to represent members of the public. The external dose can be calculated using the decay factors known, proximity to the patient, and time spent with them.

- Option 4 would still rely on circumstantial patient behavior to revise the calculations associated with patient release.

We appreciate the chance to comment on this subject, and stand ready to answer any questions you may have.

Sincerely,

Cheryl K Rogers

Cheryl K. Rogers, OAS Chair
Dept. of Health Services, RPS, Rm B157
1 W. Wilson St.
Madison, WI 53702
Phone: 608-266-8135
Fax: 608-267-3695
Email: cheryl.rogers@dhs.wisconsin.gov