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HAZARDOUS MATERIALS INFORMATION SYSTEM (HMIS) DATA QUALITY REVIEW

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MAY 1997

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IN REPLY
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FORWARD

The Hazardous Materials Information System (HMIS) Policy Group, through the Defense Logistics Agency (DLA), asked the DLA Office of Operations Research and Resource Analysis to conduct an independent review of HMIS data quality. Many different users throughout the Government rely upon HMIS as a primary source of hazardous materials data. It is important that data quality levels are adequate to meet the ever increasing requirements being placed upon HMIS.

We wish to thank all the functional area experts and Service focal point personnel and users who were so responsive and cooperative in supporting this study. We would also like to credit the Environment and Safety Policy Office and the Hazardous Material Policy Team within DLA who initiated and sponsored the effort.

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EXECUTIVE SUMMARY

DoD's Hazardous Materials Information System (HMIS) is used to manage data required for the use, transportation, storage and disposal of hazardous material by the US Government. HMIS records contain health and safety data from Material Safety Data Sheets (MSDS) and are supplemented with "value added" logistical data. Periodic distributions of HMIS data on CD-ROM are made to over 18,000 addresses.

Military Service users of the HMIS have expressed concerns about data quality to the HMIS Policy Group. The Defense Logistics Agency (DLA) is the executive agent for HMIS and is a member of the HMIS Policy Group. An objective review of HMIS data quality was conducted to provide the HMIS Policy Group and data entry focal points with information needed to address customer concerns, and to take appropriate corrective action.

The approach taken to meet the study objective included discussing HMIS data quality issues with selected users, focal points, and policy staff throughout the Government, and manually reviewing record samples from the HMIS database to determine error rates. Sample reviews concentrated on the safety, ingredient and label sections of the record. Error measurement criteria were established, and forty-three 'mandatory' fields were selected for investigation. An analysis of a sample of 250 HMIS records stratified into five Service groups showed that over half the sample records had one or more errors. The data field error rate was 4.6% for current records and ranged from 1.2% to 6.3% among Service groups. The entire database was also reviewed to assess degree of record completeness in selected optional fields.

While HMIS design has evolved over time, it is currently inadequate to meet new requirements and interface needs, and to ensure quality input. Business processes, organizational structures and funding levels are different among Service groups and contribute to observed data quality differences. Regulatory guidance for HMIS reporting is interpreted differently by each Service group and is not being enforced. OSHA Form 174 is a 'suggested' MSDS format that results in a wide variety of input formats and completeness. Quarterly distribution of the HMIS CD-ROM is not complete. However, despite these findings, HMIS is a valuable resource for users.

Although a re-design initiative to improve HMIS data quality is already underway, several additional steps should be taken to improve current data quality levels and to control future quality. The HMIS community should obtain consensus on a 'required' form and format. The HMIS Policy Group should interpret regulatory guidance for focal points, identify 'mandatory' or critical fields, and enforce these requirements. The Service groups should strengthen standard business practices, review HMIS funding, and where needed increase it. The HMIS Policy Group should incorporate a data quality engineering effort into the system re-design effort, and provide study feedback to focal points for corrective action.

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SECTION 1

INTRODUCTION

DoD's Hazardous Materials Information System (HMIS) has evolved over the past 19 years into an automated information system (AIS) with over 200,000 records. HMIS records contain data mandated by the Occupational Safety & Health Administration (Employee Right-to-Know) and Federal and DoD regulations to assist in the use, transportation, storage and disposal of hazardous material by the US Government. A Material Safety Data Sheet (MSDS) is required by the Federal Acquisition Regulation (FAR) for all hazardous material procured by the Government. MSDS information constitutes the bulk of each HMIS record; however, it is augmented by value added logistical data. Various Government organizations receive MSDSs, review them for accuracy and completeness, add transportation, storage, disposal and label data as required, and enter corresponding records into the HMIS. Periodic distributions of HMIS data on CD-ROM are made to over 18,000 addresses throughout the US Government.

Users of the HMIS have expressed concern about data quality to the HMIS Policy Group. Their concerns appear to center around completeness, consistency and timeliness of current HMIS records. The Defense Logistics Agency (DLA) is the executive agent for HMIS and a member of the Policy Group. Because of the increasing use and high visibility of HMIS data for evolving environmental reporting mandates such as the Emergency Planning and Community Right-to-Know Act (EPCRA), it is important to examine data quality. An objective review of HMIS data quality provides the HMIS Policy Group and data entry focal points the information needed to address these concerns and to take appropriate corrective action.

1.1 OBJECTIVE

To conduct an independent review of HMIS data quality. The review will identify specific user problems and will quantify the extent, scope and cause of repetitive errors. It will also recommend steps that could be taken to improve data quality without a major data quality improvement effort.

1.2 SCOPE

The scope of this effort was limited to data quality of current HMIS records from an automated information system (AIS) perspective. Criteria for data quality includes accuracy, completeness, consistency, timeliness, uniqueness and validity of HMIS data elements. The definitions of data quality characteristics used in this study are those provided in DoD's "Data Quality Management Guidelines", September, 1996. Briefly, they are as follows:

a. Accuracy is the degree of agreement between a data value and a source assumed to be correct.

b. Completeness is the extent to which the data satisfies all demands or requirements.
c. Consistency is the degree to which the data is free from variation or contradiction.
d. Timeliness refers to the degree to which specified data values are up to date and readily available for use.
e. Uniqueness refers to the state of being the only record of its kind in the data base.
f. Validity is the condition where data values pass all checks for acceptability.

Although technical accuracy of data is a quality characteristic, verification of the data's scientific attributes (i.e., chemical, physical, safety and biological, etc.) was not addressed. This review was intended to be an assessment of data quality in order to provide increased insight and awareness. It was not intended to be a full-scale, data quality engineering project to improve validity, accuracy and reliability.

SECTION 2

METHODOLOGY

2.1 ANALYTICAL APPROACH

The approach taken to meet the study objective included discussing HMIS data quality issues and problems with selected users, focal points and policy staff throughout the Government. It also involved sampling records from the most current HMIS database and examining them to determine error rates and problem areas. In addition, the entire database was reviewed to gain further insights into data quality. Specifically, the following tasks were completed:

a. Visit the primary HMIS focal points to discuss their data entry process, and visit selected users to discuss issues and concerns with HMIS data quality.

b. Select a sample of records stratified across government organizations to review for data quality errors. Separately evaluate mandatory and optional fields, and quantify error rates observed in the mandatory fields. Identify percentages of blank or invalid data in selected optional fields.

c. Similarly review a sample of HMIS records within selected commodity groups and quantify error rates. Commodity groups are defined by the combination of a specific item name and Federal Supply Class (FSC).

d. Compare a sample of original MSDS documents provided by the manufacturers of hazardous materials with the corresponding HMIS record to evaluate entered data and to determine the source of missing data.

e. Use available indices to review selected fields of the HMIS database such as the safety focal point, MSDS date, and hazard characteristic code (HCC) to identify additional opportunities for follow-on corrective action. Many HMIS fields are indexed to allow users to quickly search and retrieve desired data.

f. Review a sample of similar data records available from a commercial service to provide a basis of comparison with HMIS.

2.2 SPECIFICS OF SAMPLING AND REVIEW PROCESS

A stratified sample (i.e., fixed increments over the entire HMIS file) of 250 records from the most recent HMIS database available was selected to give the desired number of records in each of five subsamples. The sample was drawn from the July 1996 CD-ROM to provide 50 records for each of five subsamples (organizational groups) within the US Government. Sample sizes of 50 were considered adequate to accurately reflect the database and to meet statistical requirements for statements of estimation error. A

"sufficiently large" subsample size is generally accepted as 30 or more to be able to use sample average and standard deviation to judge the size of the error made in estimating a population average.

The five organizational group samples are for the major Service group focal points within the US Government and include the Army, Air Force, Navy, DLA and Other, which is primarily the General Services Administration. These Service group focal points are responsible for creating and maintaining the records in HMIS. Appendix A lists key data used to uniquely identify the Service group sample records examined for validity and completeness. Samples were also taken across ten commodity groups to similarly examine for data errors and to judge data consistency for records within each group. Finally, the entire database was reviewed using selected indexed fields to further assess data quality.

An HMIS record has over 200 fields grouped into five sections - safety, ingredient, transportation, disposal and label. These sections and some example fields of special interest with HMIS field names in parentheses are as follows:

A. Safety Section
   1. Federal Supply Class (FSC)
   2. National Item Identification Number (NIIN)
   3. Commercial and Government Entity (CAGE)
   4. Part number indicator (PNIND)
   5. Part number/trade name (PARTNO)
   6. Manufacturer's name (MFRNAME)
   7. Emergency Phone (EMERPHON)
   8. Safety focal point (SAFFOCALPT)
   9. Date MSDS prepared (DATEMSDS)
   10. Safety data review date (SAFTECHREV)

B. Ingredient Section
   1. Ingredient name (INGREDNT)
   2. Ingredient percentage (PERCENT)
   3. Chemical Abstract Service number (CAS)

C. Transportation Section
   1. Transportation focal point (TRNFOCALPN)
   2. Transportation technical review date (TRNTECHREQ)
   3. Hazard characteristic code (HCC)

D. Disposal Section
   1. Disposal focal point (DSPFOCPT)
   2. Disposal technical review date (DSPTECHREV)
   3. Environmental Protection Agency code (EPCODENEW1)
   4. Environmental Protection Agency name (EPNAMENEW1)

E. Label Section
   1. Common name (COMMONAME)
   2. Label required (LABLREQD)
   3. Signal word (SIGNALWORD)

The sample evaluations concentrated on the safety, ingredient and label sections of the records. Each sample record was manually reviewed for errors in 43 fields considered "mandatory" since they roughly correspond to the requirements of OSHA Form 174. The fields selected are listed in Appendix B. The remaining fields in the safety, ingredient and label section of the records were not included in the sample error rates since they were considered optional . There has been less emphasis and control over their contents even when such data has been provided.

The transportation and disposal sections were also considered optional for this review. There are large blocks of blank data in the transportation and disposal sections of the HMIS records. These sections were evaluated for the entire database by reviewing the index on the transportation focal point and disposal focal point fields. These sections were also not part of the sample evaluations, but were reviewed to assess degree of completeness.

The record evaluation consisted primarily of counting blank or invalid entries observed *in the 43 mandatory fields*. While many of the invalid entry errors were N/P (i.e., not provided) or N/K (i.e., not known), it was still counted as an error because mandatory information was not available to the user. Timeliness and uniqueness were evaluated on the database as a whole. The entire file was browsed in a few indexed fields to identify problem fields or areas that may be opportunities for improvement such as blocks of blank data and comparisons among Service groups.

SECTION 3

RESULTS

3.1 PROCESS OVERVIEW

A Material Safety Data Sheet is a multi-page document that describes a hazardous material. It constitutes the bulk of an HMIS record and is required by the FAR to be available or be provided with any hazardous material acquired by the US Government. It is usually prepared by the material manufacturer and included in the documentation provided to the Government during the procurement process. OSHA Form 174 is the most recent, suggested MSDS format, but no standard format is required for an MSDS. They are provided in a wide range of different formats and degrees of completeness.

Once the MSDS is received by the procuring activity, it is forwarded to the Service focal point responsible for the item procured. The process by which an MSDS becomes an HMIS record on a CD-ROM is comprised of several steps. First, the focal point collects supplemental logistics information needed for a complete HMIS record, reviews the entire package and enters the data into a file on a personal computer. If problems such as missing or illegible data arise during this processing, the focal points attempt to resolve them by contacting the manufacturer for the needed information. Next, the files of entered data are transmitted electronically or on magnetic media to the information processing center (IPC) at the Defense Supply Center, Richmond, Virginia where all data files are consolidated into the HMIS database. Periodically, the IPC sends the HMIS database on several magnetic tapes to the Naval Computer and Telecommunications Area Master Station Atlantic, Norfolk, Virginia where HMIS CD-ROMs are prepared and distributed.

Generally, HMIS users access safety, ingredient, transportation, disposal, label or environmental data in the HMIS depending on their requirements. Typical problems encountered are blank or invalid fields or the inability to find a specific record. Users with such problems, including during emergencies such as a chemical spill or employee overexposure, would contact the appropriate focal point or manufacturer directly for technical support.

3.2 RESULTS OF DATABASE AND SAMPLE REVIEWS

HMIS data quality was analyzed by reviewing data in five Service group subsamples, a commodity group sample and the entire database.

3.2.1 Service Group Samples

Table 3-1 summarizes the results of examining 250 records stratified into five Service groups. It shows the number and percentage of records with one or more errors, and

the range of the number of errors observed in each group. It also shows the average error rate for those records containing errors and a percentage of errors based upon the number of fields reviewed. Although 43 fields were reviewed, there were actually 34 chances for an error to be counted. For example, if a manufacturer's address was blank, it was counted as one error, even though four separate fields were involved (i.e., street, city, state and zip code.) The last column is the total number of errors counted divided by the total chance for error (i.e., sample size multiplied by 34 fields). Table 3-1 also shows a further separation of the sample into 211 newer records, (i.e., those with a post-1986 safety technical review date (field SAFTECHREV)) across Service groups. It also shows the results for a subsample of the 26 newest records, (i.e., those with an MSDS date (field DATEMSDS) greater than 1993).

Over half of the newer records contain one or more errors. The average is 2.8 errors per record for those records that had at least one error, with the field error rate at 4.6%. Table 3-1 shows lower error rates in the newer records across all Service groups. This is to be expected, since most of the older records were entered before the Hazardous Communication Standards Act of 1985 required that additional data for new fields be added to each HMIS record. Differences among Service groups are also evident, ranging from a field error rate of 1.2% for Service group C to 6.3% for Service group D. The sample of newest records shows the lowest field error rate, 1.5%.

In addition, the last row of Table 3-1 shows the results of a similar review of a sample of records provided by a commercial service for MSDS information. Sample records were provided in the ANSI Z400.1-1993 format. The commercial sample had 21 records with one or more errors, and average error rate of 1.5 for those records that had at least one error, and a 2.2% field error rate. The review of commercial records is described further in Section 3.4.

Table 3-2 shows the results of the Service group sample evaluation for several fields of specific interest to give an indication of the number of non-blank and valid entries. Only CAGE code, emergency phone and signalword were considered mandatory fields and included in the error counts of Table 3-1. The remaining fields of Table 3-2 were considered optional and not included in the error counts in Table 3-1, but were reviewed to assess their degree of completeness. Summarizing Table 3-2, 90% of the sample records had a valid CAGE, 92% contained a valid emerphon, 48% had a valid HCC, 75% had non-blank ingredient percentages, half contained a non-blank signalword, 60% had transportation data and 12% contained disposal data. The observed sample percentages for HCC, transportation and disposal data agree with the results of the review of the entire database (Section 3.2.3). This is one indication the sample is representative of the population. Commercial sample results are also provided in Table 3-2 where fields are similar.

Table 3-1. HMIS Data Quality - Sample Review

SERVICE GROUP	SAMPLE SIZE	# with ERRORS	% with ERRORS	ERROR RANGE	ERROR AVERAGE	% of FIELD ERROR
GROUP A						
ALL RECORDS	50	37	74	1 to 14	4.5	9.9
NEWER RECORDS	38	25	66	1 to 14	3.0	5.7
GROUP B						
ALL RECORDS	50	44	88	1 to 14	3.0	7.6
NEWER RECORDS	45	39	87	1 to 14	2.6	6.3
GROUP C						
ALL RECORDS	50	19	38	1 to 14	6.4	7.1
NEWER RECORDS	40	9	23	1 to 6	1.8	1.2
GROUP D						
ALL RECORDS	50	28	56	1 to 14	5.9	9.8
NEWER RECORDS	42	20	48	1 to 14	4.4	6.1
GROUP E						
ALL RECORDS	50	27	54	1 to 10	3.2	5.1
NEWER RECORDS	46	23	50	1 to 7	2.3	3.4
GOV'T TOTALS						
ALL RECORDS	250	155	62		4.3	7.9
NEWER RECORDS	211	116	55		2.8	4.6
NEWEST RECORDS	26	10	38		1.3	1.5
COMM'L SAMPLE	50	21	42	1 to 4	1.5	2.2

NOTE: NEWER RECORD DEFINED AS YEAR OF FIELD 'SAFTECHREV' IS GREATER THAN 86
NEWEST RECORD DEFINED AS YEAR OF FIELD 'DATEMSDS' IS GREATER THAN 93

Because of management interest in a comparison of stocked items and local purchase items, a further analysis was done which showed 142 records of the 250 sampled were for stocked items. Eighty-five of the 142 stocked items had non-blank transportation entries compared to 29 of the 108 local purchase items. Similarly for HCC, 88 of the 142 stocked item records had a valid HCC, and 31 of the 109 local purchase items had a valid HCC. Also, 135 of 142 stocked items had valid CAGEs compared to 91 of 108 local purchase items. Stocked item data is consistently better than non-stocked item data in the fields reviewed.

Table 3-2. HMIS Data Quality - Field Review

SERVICE GROUP	SAMPLE SIZE	CAGE (cage)	EMERPHN (emerphon)	HAZCCOD (hcc)	INGREDIENT (percent)	LABEL (signalword)	TRANSPT (trntechreq)	DISPOSAL (disptechrev)
GROUP A								
VALID ENTRIES	50	48	47	25	43	7/50	46	7
% OF SAMPLE		96	94	50	86	100	92	14
GROUP B								
VALID ENTRIES	50	43	44	22	37	42/50	24	4
% OF SAMPLE		86	88	44	74	100	48	8
GROUP C								
VALID ENTRIES	50	48	42	50	37	36/50	48	11
% OF SAMPLE		96	84	100	74	100	96	22
GROUP D								
VALID ENTRIES	50	46	48	20	34	30/50	29	3
% OF SAMPLE		92	96	40	68	100	58	6
GROUP E								
VALID ENTRIES	50	41	49	2	37	10/50	2	6
% OF SAMPLE		82	98	4	74	100	4	12
GOV'T TOTAL								
VALID ENTRIES	250	226	230	119	188	124/250	149	31
% OF TOTAL	100	90	92	48	75	100	60	12
COMM'L SAMPLE								
VALID ENTRIES	50		50		50		16	6
% OF SAMPLE			100		100		32	12

The ingredient section of Service group samples was also evaluated in specific fields. Service group samples had 1105 associated ingredient records, but 230 of these were invalid since they contained supplemental text from other sections which were improperly included in this section. While this practice provides additional information for a user able to track it through the record, it is considered an error from an automation perspective. Of the 875 remaining ingredient records, 15% had blank Chemical Abstract Service (CAS) numbers, and 24% had invalid ingredient percentages.

During the sample evaluations, a number of areas were identified that contributed to errors in each of the Service groups. These are areas that can be improved upon through direct corrective action and increased guidance or education for future processing. The Appendix A file number and summary for each Service group follows:

a. Service Group A (File ATT03). This group had 12 older records which typically contained more blank entries than the newer records. The primary fields containing errors were blank manufacturer addresses, N/P in route of entry and

carcinogenicity fields, N/K in appearance and odor, blank work practices and some use of the ingredient file for supplemental text. Half of the HCCs were blank or invalid, and seven records had a signalword. Forty-six records had transportation data, but the disposal section was typically blank.

b. Service Group B (File ATT06). This group had 5 older records. Forty-five of 50 records were for local purchase items. Seven records had invalid CAGE codes, and 22 had a valid HCC. This group frequently used the ingredient file for supplemental text and referred to other fields within the safety section for information. Forty-two records had a signalword, almost half had transportation data and the disposal section was typically blank.

c. Service Group C (File ATT09). This group had 10 older records. It had the lowest error percentages of all groups. All of the records had a valid HCC, and all but two had transportation data. Disposal and environmental fields were typically blank and 36 had signalwords. Eight had blank emergency phone numbers, but only one of these was a newer record.

d. Service Group D (File ATT12). This group had 8 older records. Many of the records showed N/P in the route of entry and carcinogenicity fields, and fields in the control measures area frequently had blanks. Thirty records had a signalword and transportation data, while few had any disposal or environmental data. This group has relatively few total records compared to the other groups.

e. Service Group E (File ATT15). This group had 4 older records. Forty-six of 50 records were for local purchase items. Nine records had invalid CAGE entries. Many of these records also showed N/P in the route of entry and carcinogenicity fields. All but two records were missing the HCC, and ten had a signalword. Few records had any transportation, disposal or environmental data.

3.2.2 Commodity Group Sample

Table 3-3 shows information similar to the Service group sample for ten commodity groups in eight Federal Supply Class (FSC) areas. Four of the commodity groups are in the top 10 "Toxic Release Inventory" chemicals for DoD's EPCRA Section 313 Report in 1995. The overall results are consistent with Service group sample results, with an average of 2.8 errors per record that had at least one error, and a 3.3% field error rate across the 366 records viewed.

The commodity group sample records showed a mix of errors similar to the Service group sample in the label, transportation and disposal sections. However, the primary purpose of reviewing selected commodity groups was to check data consistency for records within each group. Consistency here was considered to be the same or similar entries among the

Table 3-3. HMIS Data Quality - Commodity Group Review

COMMODITY GROUP	FSC	SAMPLE SIZE	# with ERRORS	% with ERRORS	ERROR RANGE	ERROR AVERAGE	% of FIELD ERROR
LEAD ACID BATTERY	6140	40	18	45	1 to 7	2.2	3.1
HYDROQUINONE	6750	11	7	64	1 to 7	2.4	4.5
METHYL ETHYL KETONE*	6810	59	23	39	1 to 13	3.1	3.5
HYDROCHLORIC ACID*	6810	30	13	43	1 to 8	3.1	3.9
PHENOL*	6850	11	9	82	1 to 14	4.4	10.7
TONER	6850	20	6	30	1 to 1	1.0	0.9
TOLUENE*	8010	40	11	28	1 to 9	3.5	2.9
ADHESIVE/WELD	8040	59	48	81	1 to 9	2.6	6.3
DIESEL FUEL	9140	62	2	03	1 to 2	1.5	0.1
HYDRAULIC FLUID	9150	34	11	32	1 to 7	2.5	2.4
COMMODITY TOTALS		366	148	40		2.8	3.3

NOTE: * Denotes one of the top 10 "Toxic Release Inventory" chemicals for DoD's EPCRA Section 313 Report in 1995.

records within each of 20 fields or areas reviewed. For example, the health hazard description should be similar for all toluene records. To help make the results more understandable, consistency was judged to be low, medium or high depending on the degree of agreement observed. A high assessment was made when fields were observed to have 80% or higher agreement; a low assessment was for observations of a wide variety of values or entries; and medium was everything else. Table 3-4 shows the results of the review. A blank cell or HI means high consistency was observed.

Only lead acid battery and phenol were judged to have less than high consistency overall, although there were many fields with low or medium consistency within the other commodity groups. Fields showing the most inconsistency overall include route of entry, health hazard description and label signal word.

Table 3-4. HMIS Data Quality - Consistency Review*

COMMODITY: / FIELDS:	LEAD ACID BATT.	HYDRO-QUI-NONE	METHYL ETHYL KETONE	HYDRO-CHLOR. ACID	PHENOL	TONER	TOLU-ENE	ADHE-SIVE/ WELD	DIESEL FUEL	HYDRA-ULIC FLUID	OVER-ALL
HCC	MED	MED			LOW						HI
APP&ODOR	MED				MED						HI
PHY/CHEM	MED			MED	MED					MED	HI
FLASHPT			MED		LOW					MED	HI
EXTMED				LOW	MED						HI
STABILITY											HI
ROE	LOW	LOW			MED	MED				LOW	MED
HEALTHHAZ		MED	MED		MED	MED				MED	MED
CARC	LOW				MED				MED		HI
OVEREXP		MED		MED	MED					MED	HI
EMER/FA			MED								HI
SPILL		MED		MED							HI
WASTEDISP	MED	MED				MED					HI
HANDPREC					MED					MED	HI
RESPPROC											HI
VENTIL											HI
GLOVES				MED						MED	HI
EYEPROT											HI
WORKPRAC			MED	MED	MED	MED					HI
SIGNLWORD	LOW	LOW	LOW	LOW	MED				MED		MED
OVERALL	MED	HI	HI	HI	MED	HI	HI	HI	HI	HI	

* Blanks where entries should be expected denote a "HI" rating.

3.2.3 Database Review

Table 3-5 shows the results of searching the entire HMIS database for non-blank or valid entries in selected indexed fields. Of the 209,157 total records, 94% had a non-blank safety focal point, and over 47% had valid HCC's. The results of the database review (by field) in Table 3-5 agree with the results of the data field sampling review in Table 3-2. For example, the data field review showed 48% of the sample records had a valid HCC, compared to 47% of the complete database. Other fields in the transportation and disposal sections showed similar agreement. The data field review showed 60% of the sample records had a non-blank transportation focal point, while 58% of the complete database had a non-blank transportation focal point. Both the sample data and the entire data base showed 12% valid disposal focal points. Most of the records without transportation data are for local purchase items identified by a letter in the NIIN (i.e., National Item Identification Number).

Table 3-5. HMIS Data Quality - Database Review

DATABASE FIELD	ARMY	NAVY	AF	DLA	OTHER	TOTAL	% OF TOT
FSC/NIIN<NB>						209157	100
SAFFOCALPT<NB>	888	74317	50116	49956	22178	197455	94
DATEMSDS<01JAN85>	100	6092	1457	8565	3800	20014	10
DATEMSDS<01JAN87>	79	2489	5688	4701	2045	15002	7
HCC<valid>	263	34944	1907	49420	11677	98211	47
TRNFOCALPT<NB>	1263	39449	10596	49569	19644	120521	58
DSPFOCPT<NB>	29	4866	5649	10383	3041	23968	12
EPCODENEW1<NB>	20	2778	2617	3094	1592	10101	05
EPNAMENEW1<NB>	29	4866	5646	10383	3041	23965	12
LABLREQD<NO>	15	29	1475	2187	50	3756	2

NOTE: <NB> - number of non-blank entries
<date> - number of entries equal to date
<valid> - number of valid entries

During the sample and database reviews, a few fields or areas were identified as candidates for more extensive evaluation and update. Table 3-6 summarizes by type the fields that are candidates for follow-on action. The update could be accomplished in a variety of ways. These include direct corrective action by the respective focal points, incorporation into the present HMIS database conversion process or through an independent data quality engineering effort.

Table 3-6. HMIS Data Quality - Candidates for Follow-on Action

FIELD	TYPE	CONDITION
FSC	KEY	INDEX SHOWS FEW ERRORS (e.g., 24 ARE < '1005')
NIIN	KEY	INDEX SHOWS FEW ERRORS (e.g., 79 HAVE 'O' IN NIIN)
CAGE	KEY	10% OF SAMPLE RECORDS ARE INVALID
EMERGENCY PHONE	MANDATORY	8% OF SAMPLE RECORDS ARE BLANK
SAFETY FOCAL POINT	MANDATORY	6% OF DATABASE ARE BLANK
ROUTE OF ENTRY	MANDATORY	MEDIUM CONSISTENCY AND SOME N/K ERROR
HEALTH HAZARD	MANDATORY	MEDIUM CONSISTENCY AND SOME N/K ERROR
OVER EXPOSURE	MANDATORY	SOME N/K AND N/P ERRORS
CARCINOGENICITY	MANDATORY	FREQUENT N/P IN FIELDS
SIGNAL WORD	MANDATORY	MEDIUM CONSISTENCY AND HALF ARE BLANK
OSHA PEL & ACGIH TLV	MANDATORY	FREQUENT N/K OR 'NOT ESTABLISHED' IN FIELDS
HAZARD CHAR. CODE	OPTIONAL	38% OF SAMPLE STOCKED ITEMS ARE INVALID
INGREDIENT PERCENT	OPTIONAL	25% OF SAMPLE RECORDS HAVE N/K IN FIELDS
CAS NUMBER	OPTIONAL	15% OF SAMPLE INGREDIENT RECORDS ARE BLANK
TRANSPORT'N CODES	OPTIONAL	15% OF SAMPLE STOCKED ITEMS ARE BLANK
DISPOSAL FIELDS	OPTIONAL	88% OF DATABASE RECORDS ARE BLANK

One field that is part of the unique key for HMIS records is assigned outside HMIS. This is the FSC portion of the NSN. High consistency was expected, but considerable variability was observed within database records for the same basic material. For example, a search of 'toluene' in the field 'Part Number/Trade Name' produced 271 records and 15 different FSCs. There may also be an opportunity for increased consistency in the FSC portion of this key HMIS field.

Two quality criteria that impact the entire HMIS database are uniqueness and timeliness. Uniqueness is introduced by use of a MSDS serial number and five unique key fields listed in the example record layout in Section 2.2. They are FSC, NIIN, CAGE, part number indicator and part number/trade name. The MSDS serial number is system generated, but it is of no value in locating a desired record if one does not already know it. The timeliness of an HMIS record, from MSDS receipt date to CD-ROM distribution, varies from Service group to Service group and depends upon distribution cut-off dates, which also vary within the year. A typical range is from four to six months, but more recently this time lag approached a year.

3.3 COMPARISON WITH ORIGINAL MSDSs

A comparison of original MSDSs, processed by focal points after 1986, with corresponding HMIS records was done to determine if the MSDS was a source of blank or invalid data observed in the sample and database reviews.

A comparison of 44 of these original MSDSs provided by Service focal points showed a close match with the entered data. Frequently, text was summarized or manipulated to fit a field, but the information content was generally the same. A few errors were found such as incorrect route of entry indications, but virtually all of the detailed data was entered correctly. Additionally, data such as an address or a Chemical Abstract Service (CAS) number not on the original MSDS had been added from other sources.

Sixteen of these 44 MSDSs had HMIS records with errors that were blank , N/P or N/K in a mandatory field. This provided an opportunity to determine the source of missing data. Data that was available on the original MSDS was missing in the HMIS record on eight of the 16 records compared. Similarly, of the 79 total errors observed in these sixteen records, roughly half of the missing data was available on the original MSDS. There were also a few instances where data was not specifically provided in the MSDS, but with some investigation could have been obtained from other sections. For example, records for white paint and blue enamel had N/P in the appearance and odor field, but the item name could have been entered there.

A review of these post-1986 processed MSDSs shows that there was a close match between HMIS records and the original MSDS when data was entered. However, not all available data was entered properly. To keep this finding in perspective, the total errors observed and summarized as a 4.6% field error rate in Table 3-1 could have been lower if all of the data available on the original MSDS were properly entered and processed. The

blank, N/P or N/K errors in mandatory fields were due to incomplete MSDSs in some cases, and lack of processing discipline in others. Available data was missed or lost somewhere between MSDS receipt by a focal point and the appearance of an HMIS record.

3.4 BENCHMARK WITH COMMERCIAL SERVICES

Commercial sources of hazardous materials data were investigated to compare similar measures of data quality with HMIS results. There are a number of commercial sources of MSDS information such as the Chemical Manufacturers Association (CMA), Knight-Ridder Information Inc. and 3E Corporation. They provide MSDS information on a fee-for-service basis in various formats, including the ANSI Z400.1-1993 or a company unique format. Generally, these sources provide limited data search and retrieval options. Data may be received by FAX, mail or downloaded electronically depending upon the Service group. In addition, many chemical manufacturers or distributors such as Fisher Scientific Inc. will provide, free of charge, a copy of an MSDS for their products. Also, a number of universities are providing Internet access to specialized databases of chemicals and hazardous materials.

While commercial sources are available for safety and health information, HMIS is unique in its operation as a database of MSDS and "value added" logistics information such as manufacturers CAGE, hazard characteristics code and environmental coding. The HMIS database is provided on low cost CD-ROM with an extensive search capability built-in. It must also meet interface requirements with various other government AISs such as the Environmental Reporting Logistics System (ERLS).

Although HMIS is unique, benchmarking with a commercial service was completed by reviewing a sample of 50 records from one commercial service. Appendix A, page A-7, lists the accession number and substance name for the sample records. Thirty-seven of the 43 'mandatory' fields reviewed for HMIS were available on the commercial sample records, and were treated like HMIS in calculating errors. The overall results are summarized in Tables 3-1 and 3-2 and discussed earlier.

Most errors observed were in the Physical and Chemical Properties section when data such as boiling point or melting point was not available in the record. All records had the commercial service listed as the company name, address and emergency phone number, and all had CAS numbers and percentages for ingredients. The commercial database used the ANSI Z400.1 standard. As a result, the commercial database records typically had more text describing health hazard, exposure and toxicological areas then HMIS, which does not use the ANSI Z400.1 standard. A limited amount of transportation and disposal data was provided.

3.5 DISCUSSION

This section describes the results of discussions with various members of the HMIS community.

Thousands of users within the Government regularly access information contained in HMIS and depend upon it to do their work. Typically, this group includes industrial hygienists, environmental engineers and medical professionals that are concerned with workplace safety or potential environmental hazards. In addition, some users need transportation related data because of shipping and storage requirements. Staff and managers use it to meet a wide variety of reporting requirements. Although disposal is a major section within HMIS, it has been little used. Environmental reporting is the most recent addition to the HMIS requirement and is a growing area of interest.

Focal points are those responsible for receiving HMIS information within each Service group, reviewing it, providing a technical evaluation of the information, supplementing the data with logistics information where needed, entering data into the system and providing technical support to other users. Based upon discussions with major focal points and users, current problems with data quality are many and varied. They can be grouped into four problem areas -- process, system, policy and procedure, and data design as outlined in "Data Quality Management Guidelines".

3.5.1 Process Problems

Each Service group has its own process and organizational structure to meet their HMIS responsibilities. HMIS handbooks and manuals are available to assist in creating records, but they are supplemented by Service unique guidance. Service groups also have widely varying resource levels allocated to collect and enter required data. The annual effort among Service groups ranged from less than two work years to over 20 work years. Responsibility for different sections of the HMIS record also rests with different organizations, depending upon the Service group. This lack of standard processes contributes to the different quality levels observed in the samples.

The record creation process by its nature relies extensively on professional judgment, and many different people are involved in the process of reviewing the MSDS and entering data into HMIS. Both government and contractor personnel may be responsible, depending upon the particular Service. Professionals reviewing both the original MSDS and supplemental data have a wide range of backgrounds and skills. These include chemists, chemical engineers, industrial hygienists and safety specialists, for example.

3.5.2 System Problems

Many records that were accurate when first created now contain outdated information. Data such as manufacturer names, addresses and phone numbers change over time. Companies may go out of business or get bought up. There is currently no requirement

or efficient way to keep a record current until information is needed on a specific record. This is especially pertinent to the transportation section of the HMIS record. Shipping names, for example, change frequently but are not updated regularly if they are there at all.

Data processing support operations have occasionally contributed to partially or totally missing records. Focal points will submit data to be added to HMIS, but the files are not always properly added to the system. One Service estimates 5% of records submitted are partially or totally dropped during processing. Also, records rejected at the collection site may not be corrected and re-submitted. Follow-up checks to verify records added catch some problems, but others may go undetected until much later.

3.5.3 Policy and Procedure Problems

HMIS began primarily as a system to meet occupational and employee safety needs, but has evolved to address additional needs such as shipping labels and environmental reporting for the Environmental Protection Agency (EPA). In 1987 HMIS was re-designed to accommodate the new MSDS format, OSHA Form 174, and the requirements of the Hazardous Communication Standard (HCS) Act. New requirements were generally not funded to capture, maintain and distribute the new data for older records.

OSHA Form 174 is a suggested rather than required format for an MSDS. This results in a wide range of completeness and a wide variety of MSDS formats received by the focal points. Searching for the data needed for an HMIS record takes more time than it should because data is scattered throughout the various input forms. It also takes additional time when one is rejected and returned as inadequate, or follow-up calls are required to get the missing data. DoD attempted to standardize on a required MSDS format, but the attempt was rejected. Independently, many of the larger chemical manufacturers and distributors have adopted the ANSI Z400.1-1993 standard for the MSDS, and some have made their MSDSs available on the Internet.

The FAR requires that an MSDS be available for hazardous material or be provided by a manufacturer as part of the bid package five days before contract award. Even though the policy is in place, it is not always practiced or enforced. A recent DoD Inspector General report found that 4 of 11 activities inspected were not including the appropriate Defense Federal Acquisition Regulation Supplement (DFARS) clause in contracts for the procurement of hazardous materials. Even with the clause in place, an MSDS may not get to the procurement officer, or if provided, it may not be passed on to the appropriate focal point for review and input. The increased use of local purchase authority and credit cards can aggravate the situation. The focal point will be unaware of the missing record until information about it is needed.

A number of different federal regulations impact HMIS reporting requirements (e.g., 10 CFR, 29 CFR, 40 CFR, 49 CFR and FED-STD-313), but they are not being consistently interpreted and followed by the Service focal points. For example, some include

coverage for local purchase items while others do not. Some enter transportation data only for stocked items, and none are currently entering disposal data since most materials are consumed or re-cycled. This situation has resulted in large blocks of blank data within HMIS.

3.5.4 Data Design Problems

HMIS has experienced a lack of design discipline during its evolution that is typical of most legacy systems within the Government. These automated, mainframe-based, database systems were developed before the existence of standard procedures for either automated system design or database implementation. Occasionally, design decisions were made by functional experts without the benefit of an automation perspective.

Numerous changes have been made to HMIS since its inception in 1978. The original system structure and field definitions were generated based upon OSHA Form 20, the MSDS suggested by OSHA at that time.. The database structure and fixed field lengths that were adequate at first soon became inadequate to accommodate required data. This contributed to an assortment of practices in an attempt to enter as much data as possible into the system. Abbreviations, summaries and improper placement of data throughout the record have all contributed to data quality problems experienced by some users in getting the information they need.

The lack of specific field edits during data entry in most sections of the HMIS record, especially during the early years, is a primary contributor to current data problems. Many of the fields are still open text, which makes it difficult to control data input, and problems may not surface until years after the records are created. Although the new system design incorporates additional edit capabilities for future records, many of the problems with the current records will remain unless corrected during a conversion process.

Duplicate entries can exist for the same product. This happens primarily when a record is created for local purchase items that use a local stock number. Standard identifiers such as universal product code (UPC), national stock number (NSN) or Chemical Abstract Service (CAS) numbers are not complete or adequate by themselves to uniquely identify a record. Also, there may be many different common names or descriptions for one chemical ingredient. All of these contribute to the difficulties users experience when attempting to access specific data in HMIS.

There are a number of other AISs in the Government that are used to track or manage hazardous materials. These include the DoD Hazardous Substance Management System, Depot Maintenance Hazardous Material Management System, Environmental Logistics Reporting System, and the Air Force Environmental Management Information System. Some require a direct interface with HMIS for automated data transfer, and without corrective action, data quality problems will be passed on to interfacing systems.

SECTION 4

CONCLUSIONS

Quantification of data quality or error rates within HMIS depends upon the criteria used to measure quality. This examination concentrated on the safety, ingredient and label sections of the HMIS record. The evaluation of 43 "mandatory" fields in 250 records sampled resulted in relatively low error rates that would have been higher if 'optional' fields were evaluated. For example, if ingredient percentages or hazard characteristic codes were included, the error rates would increase above the 4.6% field error rate observed because of the blank or N/K entries present.

Error rates across all Service groups have decreased over the three time periods reviewed, but over a third of the 'newest' sampled records still had one or more errors. While data field error rates among Service groups showed a range of overall quality levels from 1.2% to 6.3% for the 'newer' records, the 1.2% rate demonstrates that improvements throughout the community are possible and should be expected. The review of 366 records in ten commodity groups showed error rates similar to the Service group samples. These showed generally high consistency of data in the same fields of different records within a commodity group, but some fields had medium or low data consistency.

The partial database review and full sample reviews revealed that each Service group had strengths, but there are a number of areas that are opportunities for data quality improvement. The comparison of a few original MSDSs with the corresponding HMIS record showed that incomplete MSDSs and lack of processing discipline account for blanks, N/K or N/P in some mandatory fields. Different error rate levels were found in key fields, mandatory fields and optional fields of special interest. These key, mandatory and optional fields are candidates for follow-up corrective action by Service focal points to improve HMIS data quality levels.

Each Service group has provided different resource levels and guidance intended to ensure critical data needs are being met. A mix of civilian and contractor support is present among the Service groups, and the annual effort ranges from less than two work years in one Service group to over 20 work years in another. These are primary reasons for the observed range of error rates in mandatory fields and degree of record completeness in optional fields.

The use of a suggested rather than required MSDS format has contributed to many of the data quality errors observed. It allows a wide variety of input formats and increases the risk of not finding required data during the review process. A "required" format such as the ANSI Z400.1-1993 and community consensus of what a "mandatory" data field will be is necessary to significantly increase record completeness and consistency among all Service groups. Some manufacturers are already following this standard and voluntarily provide data required to complete an HMIS record.

The use of mostly open text fields in the HMIS record has also contributed to errors. It is difficult to edit or control data entry in fields where virtually anything including blanks can be entered. Refined formats and comprehensive field edits where possible would improve data quality and consistency over time. Also, because of the placement of supplemental text in various fields throughout many records, interfaces with other automated information systems is very difficult and will continue to be so until procedures are set and followed where needed.

Different users have different requirements and expectations of the system and would view data quality differently. For example, the user preparing environmental reports may need more precision in the ingredient section then is available or needed for health and safety users. The safety section is the oldest and most complete within the HMIS. The transportation and disposal sections are less complete, in differing degrees, because of their age, use and relative priority.

HMIS is a valuable resource to its users. Most commented upon the lack of timeliness for CD-ROM releases, but they were generally able to get the information they needed to do their jobs, either directly from the database or from another user or focal point. Occasionally, direct contact with a manufacturer is required for data, and this is a time consuming process. Inconsistent fields may be confusing but still provide useful information to some users. Notes directing the reader to different sections of the record also provide information, even though this is an unacceptable practice if interfaces with other AISs are required. Typical user views ranged from a reluctance to use the system because of data quality problems to those who use it regularly but may verify critical data externally.

Most of the HMIS community is aware of the database's problems, and changes to correct some of them are already being planned through system re-design. The current effort to convert HMIS from a flat-file, mainframe system to a relational, interactive system has already improved data quality in many areas. This study has identified some additional areas within the HMIS database that warrant attention. Unless resources are made available to update records in critical areas, HMIS will continue to appear to be incomplete or inconsistent whenever a record with an error is encountered by a user.

SECTION 5

RECOMMENDATIONS

Many changes to improve the quality of HMIS data are already underway with the HMIS re-design effort within DLA. In addition to the changes being made regarding database structure, automated editing and accessibility, there are a few additional steps that should be taken to improve the quality level of current and future records.

Industry and the regulatory authorities within the Federal Government (i.e., CMA, OSHA, EPA and DoD) should jointly agree on a "required" form and format for the MSDS. The ANSI Z400.1- 1993 standard should serve as the basis for an HMIS record and be supplemented where necessary to meet Service group requirements. This standardization would reduce processing time at the focal points and improve overall record quality. It would help develop consistent, understandable records that provide useful information to the widest variety of users. If a temporary burden of standardization is not placed on industry (the source of information), a larger burden falls on the government to create standard data records from non-standard input.

The HMIS Policy Group should provide a consistent interpretation of federal regulations for the focal points. It should identify which fields are truly "mandatory" versus optional and under what conditions. If transportation or storage data is critical for all items procured, for example, its collection and distribution should be enforced. Without such specific guidance, quality levels in these areas will likely remain problematic. Also, allowable values or ranges should be established where possible to minimize the use of open text fields. Once these are established, strict data field edits can be introduced into the data entry process to add processing discipline and to minimize the possibility of bad data being accepted.

The Service groups should strengthen standard business practices to improve the consistency of future HMIS records. Service groups should review the levels of funding they provide to meet their HMIS requirements and adjust them to support standard practices. The HMIS Policy Group should update and distribute centralized guidance and policy to further encourage standard practices.

The Federal Acquisition Regulation requirement for the Government to have or to receive an acceptable MSDS prior to award should be re-emphasized and enforced. The HMIS Policy Group should have policy reminders sent by the Service group policy organizations to all their procurement offices.

Quarterly distributions of the HMIS database on CD-ROM should be strictly followed. Although on-line access via the Internet should be available soon for most users, the requirement by many users for a CD-ROM will continue for some time.

A data quality engineering project should be conducted as part of the HMIS data conversion process to improve the validity, completeness and reliability of current records. Although HMIS is somewhat "self-cleansing" over time with the receipt of new MSDSs, the project would assist in updating fields where higher quality is critical in older records. Such a project would also lay the foundation for a continuing quality control process that could be invoked periodically by those responsible for HMIS to ensure that the new system and processes are effective in controlling future data quality.

The results of this study should be distributed to all focal points as feedback for follow-up corrective action. Areas where errors were identified are opportunities for processing improvement in the future through increased attention and education.

APPENDIX A. Key Data for Record Samples

Sample	Page
Group A (File ATT03)	A-2
Group B (File ATT06)	A-3
Group C (File ATT09)	A-4
Group D (File ATT12)	A-5
Group E (File ATT15)	A-6
Commercial Assession Number and Substance Name	A-7

Browse Table: ATT3

	FSC	NIIN	CAGE	PNIND	PARTNO
1	8010	LS0010001	81348	A	SEMI-GLOSS INTERIOR LATEX WHITE
2	8010	00B060045	58381	A	WOOD TONER/SATIN - OAK
3	6850	00B150058	53084	A	HTH (R) DRY CHLORINATOR GRANULAR
4	8010	00B220066	06758	A	PROPLUS SATIN GRAY PAINT
5	8030	00K000535	1N060	A	PDL 401 COMPONENT A
6	6750	00K001001	19139	A	123 7973,MICRO POSITIVE RESIST DEVLPR 809
7	6810	00K001490	18873	A	EPN TECHNICAL
8	6810	000503426	62910	A	HEXANES
9	8030	000800031	55208	A	SR-40
10	8010	001118005	60035	A	GA4-005 MIL-E-52798
11	8030	001449658	86961	C	EPON (R) RESIN 826
12	8010	001617375	33201	A	MIL V 173
13	8040	001806200	98911	A	ARMSTRONG RESIN C-7.
14	8040	002003793	ARIST	A	UNSATURATED POLYESTER RESIN
15	6810	002411193	18873	A	NITRIC ACID STRONG
16	6810	002628573	5A188	A	FERROUS SULFATE
17	6850	002811985	5W216	A	DRY CLEANING SOLVENT
18	8010	002868495	58963	A	TT-P-24E TYPE II 27875 WHITE PC 700W17
19	8010	002970569	61196	C	ENAMEL ALKYD LUST WHITE 37875 ID 741720
20	6810	002998497	62910	A	BARIUM CHLORIDE, CAT #3756
21	8040	004555359	76381	A	ADHESIVE #8011
22	8030	005152271	14439	A	CS 3100, PART A
23	8010	005305326	81348	A	LACQUER CAMOUFLAGE
24	8010	005774739	3Z268	D	DOD-E-24607 WHITE 27880, B24607W
25	8010	005978229	39934	A	F0201
26	8010	006164009	3Z268	C	MIL-P-14105 OLIVE DRAB 34088, B141050D
27	8030	006644019	83574	C	PR-1005-L
28	8010	007219487	0FTT5	A	SO-SURE IVORY 17778-14B171 (G/O) LACQUER
29	8010	007542609	0HN95	A	7703 - LATEX PAINT
30	8040	008237944	4E001	B	SCOTCH WELD(TM)1838 B/A,TAN EPOXY ADH,PT-B
31	8010	008531859	61196	B	ENAMEL ALKYD GLOSS BLUE 15123 ID742518
32	8010	009018039	80592	A	TT-E-509 C1 1VOC COMPLIANT (25622 BLUE)
33	8010	009357063	61196	A	LACQUER ACRYLIC RED 11136, ID794104
34	8030	009652004	14439	D	GS 3204 PART A
35	6750	010120960	19139	C	140 3377,COLOR DEVLPR REPL,PROCESS E-4,PT C
36	8040	010398132	0HK08	A	GLUE STIC
37	5970	010620885	04552	B	STYCAST 2651-40
38	8010	011046528	33461	D	CAT, MIL-C-83286, 36320, 03GY088CAT
39	8010	011319194	61196	B	ENAMEL ALKYD SG MC GREEN 24052 ID 745402
40	8040	011609551	30676	A	VERSILOK 204
41	8010	012205971	0GU91	A	R0634 LATEX PRIMER W ACRYSOL, LATEX TOPCOAT
42	8010	012661096	33461	A	MIL-C-85285B, 17925, TYPE I 03W127A
43	8010	012853047	33461	A	MIL-C-85285B, 17038, TYPE I, 03BK071
44	8030	013000797	30256	A	DMS-4-828 MOLDABLE SHIM MATERIAL, PART A, BASE.
45	6840	013285994	DOWEL	A	GARLON (R) 3A HERBICIDE
46	8010	013340908	39934	A	TT-E-2784
47	8010	013504744	55849	C	MIL-P-24441/23 F-153 TYPE III, GRAY RO 1.8 B, 3714800
48	8010	013725713	2N948	A	215-OFF WHITE RUST SCREEN
49	7930	013813473	0TFB3	A	BARE KNUCKLES ULTRA STRIPPER
50	8010	013973825	54636	A	POLYURETHANE VARNISH, A67V1, HIGH GLOSS
51	7930	014181390	0G3N5	A	ENVIROZYME E-Z COMP

Browse Table: ATT6

	FSC	NIIN	CAGE	PNIND	PartNo
1	1220	LDF004048	12405	A	HYSOL AD2001 (FORMERLY 50-900), 50-900 RW0R
2	6850	00N001250	57868	A	LDC-04 ACTIVATOR & ETCH SOLUTION
3	8030	00N004059	01058	B	MICCROSOL E-1291 RED (SEE SUPP DATA)
4	8010	00N008172	90300	A	DERUSTO,871 SHELL PINK,DISCONTINUED 1182
5	8010	00N009437	33461	A	03BR64, MIL-C-46168, D/SAND, TYPE II
6	6850	00N010760	53417	B	CE-27 RUST STRIPPER, 4421
7	6850	00N012205	1BL51	B	ACORN 540B ADHESIVE
8	6810	00N014834	60928	A	STEARIC ACID, 95%, 17536-6
9	3439	00N016328	61404	B	934 SOLDERING FLUX, 16570
10	6850	00N017741	13929	A	COPPER STRIP SOLUTION SCM 4560
11	6810	00N019070	21267	A	FLUX-OFF PLUS, ES795
12	6850	00N020502	07977	A	CUSTOM PLASMA STANDARD, PLCR2-2X
13	8010	00N021910	30676	B	CHEMGLAZE A382
14	8010	00N023342	25461	A	AEROSOL SPTAY PAINT, AP220 MEDIUM GRAY
15	9515	00N024871	61497	A	GALVANIZED SHEET-HSLA STEEL HOT DIPPED, 3H0
16	5640	00N026359	15270	A	DELTA BOARD UNFACED, ALL DENSITIES
17	7510	00N027862	32988	A	DESIGN HIGGINS 18 COLOR SYSTAMATIC SET (SUP
18	6850	00N029288	BLAIR	A	105-105S SPRAY FIX NO ODOR WORKABLE MATTE (
19	5610	00N030745	CTSCE	A	RAPID SET CONCRETE MIX
20	9525	00N032197	01371	A	6151, ALCAN ALUMINUM METAL 6XXX SERIES ALLO
21	6810	00N033668	04448	A	ANTI-STATIC EAS-16
22	6850	00N035131	14668	A	RB68M ELECTROSTATIC TONER REPLENISHER, 1713
23	6850	00N036505	14668	A	TCM68 CLEAR TONER
24	6810	00N037935	60928	A	CHLOROBENZENE, 99+%, SPECTROPHOTOMETRIC GRA
25	6810	00N039408	RICCA	A	3780, HYDROCHLORIC ACID 1% THRU 50% (V/V) SUPDAT)
26	8010	00N040891	72818	A	GLID-GUARD ALKYD TANK & STRUCTURAL ENAMEL (SUPDAT)
27	9150	00N042345	77493	A	HIGH PERFORMANCE GEAR LUBRICANT (SAE 80W90
28	6850	00N043844	55371	A	19588, AROCLOR 1248 SOLUTION AT 1 UG/UL IN (SUPDAT)
29	8040	00N045327	18731	A	ALUMINOX, S8020
30	8010	00N046861	33200	A	GRIP & SEAL STAIN KILLER 116-11
31	5610	00N048408	FOSRO	A	NITOFLOR HARDTOP
32	6810	00N050024	0MWG0	A	POLY(ETHYLENE TEREPHTHALATE), 418
33	7930	00N051738	0TMN6	A	PYA/MONARCH 8-2-1
34	3439	00N053403	27911	A	BARE WIRE OR ROD, 320(20CB-3)
35	7930	00N054971	BURKE	A	BUCKEYE GONE, 5375
36	6810	00N056487	77902	A	69493, AMERLITE IRA-900C (OH) CONDENSATE (SUP DAT)
37	7930	00N058096	0KCW1	A	SHOOTERS CHOICE BLACK POWDER CLEANING GEL
38	4130	00N059623	9S286	A	ECOPAC
39	9545	00N061172	0MMA6	A	ALUMINUM WIRE, 11064
40	8010	00N062757	16772	A	SPRAY PAINTS, 7813 GLOSS WHITE
41	1365	00N064262	AERKX	A	PUNCH, M-4
42	8010	00N065908	85519	A	SOLID TIMBER STAIN (458 LINE), 458472 (II)
43	8010	00N067647	CHMRX	A	SONOPLEX 200 ACTIVATOR, 06-102A
44	6630	00N069532	0JL17	A	A COMPONENT OF 418.1 CALIBRATION MIX, 540-84-1
45	3439	00N071120	0U0F5	A	MILD STEEL ELECTRODE 5/23, 20503000
46	8030	001429128	01139	G	POLYSILOXANE CATALYST, RTV9891
47	9130	002851294	81355	A	JP-5 MIL-T-5624L
48	8030	007535004	04963	A	EC-801 INDUSTRIAL SEALANT B-1/2
49	8010	010237473	98502	B	X-369,PT B (SEE 463-7-26,MIL-P-23377D,TY 1)
50	6810	011632111	63415	A	FERROUS SULFATE HEPTAHYDRATE
51	8520	014152925	0PWJ2	A	HANDI-FRESH ANTIMICROBIAL SOAP, 310108

Browse Table: ATT9

	FSC	NIIN	CAGE	PHIND	PART NO
1	6810	OODOO4573	57020	A	ZINC NITRATE
2	6810	00D001400	4T252	A	TETRAVER HARDNESS REAGENT
3	6525	00D003178	18873	A	CRONEX HIGH STABILITY FIX[illegible]/REPLENISHER-WORKING STRENGHTH
4	6750	00D004466	19139	A	110 1724 C DEVELOPER, BLACK, 750 GRAMS
5	6810	00D005417	11273	A	37528-50 CALCIUM CARBIDE
6	6840	000276467	8K073	A	BOROCIL IV
7	6140	000839658	25244	A	GC680-6V-8AH
8	6750	001250058	19139	D	164 4152 KODAGRAPH LIQUID DEVELOPER, CONCENTRATE
9	9130	001487103	2X948	A	GASOLINE
10	6810	001695163	1V771	B	SODIUM HEXAMETAPHOSPHATE
11	5960	001880948	08594	C	5D22
12	5960	002206525	82219	A	X7108
13	9150	002345199	5A565	A	VVL-751D #1 AND #2
14	9140	002426749	7U271	A	WATER WHITE KEROSENE
15	9160	002531173	78583	A	YELLOW BEESWAX SP 6
16	6810	002643934	81349	A	SULFURIC ACID, TECHNICAL
17	6810	002703260	70829	A	3748 SODIUM IODIDE
18	6810	002817450	USMAT	A	DFG MERCURY (SPECTROMERC)
19	4220	002873740	1JK08	A	CARBON DIOXIDE
20	6810	003564936	6A021	A	DISTILLED WATER,TECHNICAL
21	2530	004363162	27315	A	215N134F2 AND 218T605
22	6850	005016189	71984	B	DOW CORNING 7 RELEASE PASTE COMPOUND
23	5915	005521773	81831	A	FA528
24	5330	005999548	10009	B	HIGH TEMP VALVE STEM PACKING,325
25	6850	006641409	3R483	A	MCGUARD A.P. ANTIFREEZE
26	5910	007328544	14655	A	KGT3030
27	6850	007822740	98733	G	D-70 DEVELOPER
28	6850	008260981	92381	B	FAULT FINDER PENETRANT GROUP 1 #1075
29	9130	008733896	15958	A	TURBINE FUEL, AVIATION JP-4
30	9150	009144587	77912	A	RISLONE ENGINE TREATMENT
31	5960	009441113	96341	A	MYT92
32	5910	009772889	06001	A	28F670FC
33	3439	010087580	84311	A	TIN LEAD ANTIMONY ALLOY: XM-200 CORE
34	6750	010249494	19139	A	170 8882,STABLZR & REPLNSHR,PROC C-41,PT A
35	5330	010413600	14153	A	GASKET: PART NO. UNKNOWN
36	5330	010536904	44940	A	168-0136 GASKET
37	6810	010761734	4A444	A	CHLORIDE STANDARD SOLUTION
38	3680	011013999	6S222	A	FREKOTE 44-NC AEROSOL
39	2910	011289537	61112	A	QUICK START DIESEL STARTING FLUID, LP-535
40	6510	011534638	58574	A	ACETONE ALCOHOL PREP PADS/SWABSTICKS
41	6850	011801074	020C3	B	UNICOR, TYPE J, CORROSION INHIBITOR
42	6140	012059494	ENEPS	A	ENERGIZER RECHARGABLE POWER SYSTEMS BATTERY
43	6350	012314190	4M364	A	FREON 12 CARTRIDGE
44	8030	012623560	05972	A	GASKET ELIMINATOR 515 FLANGE SEALANT,51531,51574
45	6635	012671856	76381	A	INSPEX II DRY SILVER FILM,98-0439-4734-4
46	6750	012851766	19139	C	818 3428;FLEXICOLOR AR DEVELOPER REPLENISHER;PT C; KAN449572
47	6810	013124075	7K791	B	HYDRAZINE CHEMETES, ULR CHEMETS, VACUETTES
48	6850	013389147	4T581	D	DE-SOLV-IT INDUSTRIAL FORMULA CITRUS SOLVENT
49	6850	013648328	4L319	A	DARACLEAN 282
50	6850	013834068	0YJU0	B	SIERRA ANTIFREEZE-COOLANT
51	6135	997212275	4M310	A	LITHIUM/MANGANESE DIOXIDE BATTERY

Browse Table: ATT12

	FSC	NIIN	CAGE	PNIND	PART NO
1	8010	00F006667	54636	A	B62A213 SLATE GRAY
2	9150	00N050177	HLTHY	A	HILTON HY-PER LUBE, HSF-200
3	6810	00N064973	86035	A	DILUTE HYDROCHLORIC ACID (1+3), R5757
4	6810	00N067871	8Y898	A	FLUORENE, 0-786
5	6810	00N068018	8Y898	A	BENZENETHIOL, 0-978
6	6850	000561794	56883	A	ACID CLEANER,DESCALER
7	6135	001000425	77542	A	ZINC-CARBON BATTERY-LOW MERCURY P/N 904
8	6910	001064800	60737	G	V AGENT SIMULANT VIAL,(SEE SUPP DATA)
9	6135	001201032	81350	A	CARBON-ZINC (C-ZN) (LECLANCHE) BATTERY,BA-5
10	8040	001450019	98634	A	SCOTCH-WELD 3911 METAL DEGREAS'G (SEE SUPP)
11	6135	001648775	81350	A	CARBON-ZINC (C-ZN) (LECLANCHE) BATTERY,BA-4
12	6135	001949354	2A917	A	PRIMARY BATTERY,MERCURY BA1277/U
13	2640	002423467	97789	A	UNIVERSAL CEMENT
14	6810	002703237	22527	A	THIOUREA T101
15	8010	002972108	80244	A	TT-E-485F,ENAMEL,SEMIGLOSS,TY I, 327-X24087
16	6140	004019632	50056	A	NICKEL-CADMIUM (NI-CD) BATTERY,SEALED,4VB60
17	8040	004545160	98911	B	A-12 PART B,EPOXY RESIN ADHESIVE
18	1375	005298512	1D557	A	DETONATOR,ELECTRICALLY INITIATED
19	5640	006187515	81349	A	ASBESTOS
20	6505	006646911	81349	A	MERTHIOLATE, MERTHIOLATE SODIUM
21	6850	007534870	80706	A	DECONTAMINATING AGENT DS2
22	6135	008085093	2A917	A	BATTERY,MERCURY BA-1093/U
23	5970	008392763	71984	A	5 COMPOUND
24	8010	008807290	N/D	A	AP-1006 WHITE FLEXIBLE PRIMER COATING
25	6135	009260827	2A917	A	PRIMARY BATTERY,MERCURY
26	6135	009352577	51828	B	ALKALINE BATTERY BA-3044/U
27	6135	009613603	S7424	A	PRIMARY BATTERY,MERCURY MR50
28	2520	009996465	72447	D	STEEL
29	6135	010342239	90303	A	LITHIUM/SULFUR DIOXIDE BATTERY BA-559810
30	6910	010432090	60737	C	B-2 AGENT SIMULANT VIAL
31	6850	010518569	74659	A	MOLE.SIEVES TYPE 13-X BEADS(10A) SEE SUPP
32	6140	010612818	74025	A	BATTERY,STORAGE
33	6140	010723124	6M493	A	NICKEL-CADMIUM SEALED CELL BATTERY
34	9150	010861987	7B131	A	CRATER 2X, 00948
35	8040	010996683	20420	A	PHILLYBOND #6 HARDENER
36	6135	011065542	83740	A	ENERGIZER
37	6665	011121644	0CG91	E	BUFFER SOLUTION
38	6870	011241435	BR799	C	ARGON
39	1376	011321692	99530	A	BALL POWDER PROPELLANT,P/N 9345271
40	6665	011340885	06421	E	SIMULANT TUBE,YELLOW
41	8010	011424697	29642	A	UNIGLAZE BLACK,UNIGLAZE WHITE (ENAMEL)
42	4210	011609653	56161	A	10505288
43	6850	011675318	OAU34	A	COAGULANT,WATER TREATMENT
44	8040	011766288	04963	A	EC-1945-A METAL PRIMER
45	8030	011903938	80070	A	AUTOCOAL 8039 CCF COMP I,SEALING COMP
46	1240	012018299	19200	A	9360169 MOUNT,TELESCOPE (M64A1)
47	6850	012125019	71984	A	90-006 AEROSPACE SEALANT BASE
48	6850	012247524	01139	A	SS4004,SILICONE COMPOUND
49	8040	012349861	30676	A	TS3320-19 PRIMER ADHESIVE,EPPM (SEE SUPP)
50	1305	012572559	73877	A	CARTRIDGE,CALIBER RIMFIRE (SEE SUPP)
51	4230	012761905	77902	A	SKIN DECONTAMINATING KIT,M291-E
52	8040	013027729	55636	A	NORLAND OPTICAL ADHESIVE 61
53					

Browse Table: ATT15

	FSC	NIIN	CAGE	AUTH	PART NO
1	6810	P90058025	08514	A	STABILIZER NOVIGANTH HC, 90058
2	6850	00F001222	16522	A	POLYESTER BODY FILLER
3	6810	00F002707	18260	A	ETHYLENE OXIDE/CARBON DIOXIDE
4	8010	00F003762	08882	A	SPEEDY DRY COATINGS 1505-1510/1547/1565
5	8040	00F004822	02684	B	RP 6410 RESIN
6	6810	00F005824	85713	A	NATURAL RED OXIDE, 3171
7	8010	00F006830	54636	A	POLANE, F63 E 4 DECIBEL ORANGE, LEAD COLOR
8	8010	00F008019	90227	A	Y8034S ENAMEL REDUCERS
9	6850	00F009002	91342	A	GOLDEN LAN CONDITIONER 11X1122A
10	6840	00F010089	86441	A	SCOURGE INSECTICIDE W/SBP-1382
11	6520	00F011041	31976	A	HARD/REG INLAY WAX, CASTING WAX
12	9150	00F012700	60218	A	GP-460
13	8030	00F013696	53024	A	MH 452 TUF-TRAC JET BLACK
14	6850	00F014655	39712	A	TEAM 397 MISHAP
15	6550	00F015686	05545	A	11472 NUTRIENT AGAR
16	6850	00F016637	HOHCH	A	B-709
17	8010	00F017575	OADJ1	A	78528 CONSEAL
18	7510	00F019131	76708	A	01-ER-15703 ER146 EPOXY RESIN INK, ROYAL BLUE
19	8010	00F020105	16522	A	596 YELLOW CREAM HARDENER
20	7930	00F021087	TRUTE	A	DG-10 TRU-TEST HEAVY DUTY CONCRETE DEGREASER
21	8010	00F022085	16522	A	263E LIGHTWEIGHT BODY FILLER
22	8010	00F023075	90227	A	B8827L
23	6750	00F024055	PHOTO	B	PHOTOCOLOR CHROME SIX BLEACH FIX PART B
24	8010	00F025001	90227	A	541U IMRON POLYURETHANE ENAMEL
25	6810	00F025892	70829	A	2135 GLYCEROL,ANHYDROUS
26	8030	00F026872	62377	A	80003 FORM-A-GASKET 1C SEALANT
27	8010	00F027830	71191	A	TT-E-489F CLASS A, COLOR 13538
28	6520	00F028815	33339	A	ADHESIVE: V.P.S TRAY
29	6550	00F029795	51404	A	478874 URINE SLOPE REAGENT
30	3439	00F030749	INLA2	B	INLAND ALUMA-TI SHEET
31	8010	00F031713	ACMEA	A	71 URE-A-BAN FISHEYE ELIM.
32	8720	00F032693	8C002	A	GREENVIEW GARDEN-MATE
33	7510	00F033716	KMADD	A	455-461 ROTARY
34	6505	00F034720	0K706	A	SODIUM THIOSULFATE INJECTION
35	6810	00F036603	0MU35	A	RPC-080 2,2',3,3',4,4',5,6,6'-NONACHLOROBIPHENYL
36	6550	00F037569	TOXIL	B	TOXI-TUBES B
37	8010	00F038500	KRYLO	A	COLORWORKS 4207 BLUE
38	6810	00F039469	23373	A	943-A (ACTIVATED CARBON)
39	9160	00F040467	0KSX4	A	77309 SET-UP WAX STICKS
40	8010	00F041439	85570	A	825X631 DES POLYU GUNSHIP MILC83286 34
41	8010	00F044859	54636	A	B22 Y 100 BASE B SOLID COLOR STAIN
42	6520	00F045850	95551	A	PERIPHERY
43	6810	00F046879	75602	A	QA331W KEFLIN
44	6550	00F047924	05545	A	21779 GROUP A SELECTIVE STREP AGAR W/5% SB
45	3439	00F048903	78764	A	6061 ALUMINUM RODS & PARTS
46	3439	00F049858	93932	A	C65100 LOW SILICON BRONZE (B)
47	8010	001663151	09869	A	RED 31136
48	6850	005859145	13091	A	BIOGENIC SOLVENT EMULSION DEGREASER 377C
49	6135	010503193	90303	B	MN1300 (D) ALKALINE MANGANESE DIOXIDE CELL
50	9150	012476313	13868	B	SILIKROIL (AEROSOL)
51	8040	014175040	82464	A	MD-400

REC #	OHS/MDL#	SUBSTANCE NAME
1	OHS04435	CEROUS NITRATE, HEXAHYDRATE
2	OHS05021	CHROMIUM 2-ETHYLHEXANOATE
3	OHS10000	FLUOROURACIL
4	OHS10500	GLYCOLIC ACID
5	OHS11990	ISOPHORONE
6	OHS14440	METHYL DICHLOROACETATE
7	OHS17999	HIGHLY REFINED MINERAL OILS
8	OHS20010	PYROGALLOL
9	OHS20500	SELENIUM
10	OHS24440	TRIS(HYDROXYMETHYL)AMINOMETHANE
11	OHS29965	4-ETHYNYLTOLUENE
12	OHS30012	4-GLYCIDYLOXY-N, N-DI-GLYCIDYLANILINE
13	OHS30500	10, 10'OXYDIPHENONOXARSINE
14	OHS34444	DI-PARA-TOLYLIODONIUM TETRAKIS(PENTAFLUOROPHENYL)BORATE
15	OHS39750	FERRIC CHLORIDE, 75% SOLUTION
16	OHS40000	ETHYL ALCOHOL, 96%
17	OHS41001	BUN ACID SOLUTION
18	OHS41142	BUFFER SOLUTION, PH 10.00 +/- 0.01
19	OHS45498	ACID SPILL KIT
20	OHS50013	SILICONE DC 510 FLUID, 30,000 CST
21	OHS50501	ALUMINUM HYDROXIDE, COMPRESSED GEL
22	OHS54513	ROSOLIC ACID
23	OHS55274	SODIUM PETROLEUM SULFONIC ACIDS
24	OHS59378	HANDY HI-TEMP ALLOY 870
25	OHS60010	ACRIDINE ORANGE
26	OHS60500	REINECKE SALT MONOHYDRATE
27	OHS64913	CHLOTHIOPHOS
28	OHS67915	P-TOLUENESULFONIC ACID
29	OHS69999	P-DIETHYLAMINOBENZYLIDENE D-PHENETIDINE
30	OHS70000	FATTY ACIDS; C12-20 AND C12-20 UNSATURATED
31	OHS71005	ACRIFLAVINE NEUTRAL
32	OHS73595	SEVERELY HYDROTREATED HEAVY NAPHTHENIC DISTILLATE
33	OHS76994	METHACRYLIC ACID, 2,3 EXPOXYPROPYL ESTER, POLYMER WITH ...
34	OHS78013	DDI
35	OHS80001	2-HEPTADECYL-1-HYDROXYETHYLIMIDAZOLINE
36	OHS83010	METHYL 2-CHLOROACRYLATE
37	OHS88311	DIAMOND (UNCOATED) MAN-MADE (TM) DIAMOND
38	OHS89999	REICHHOLD PRODUCT NO. 2
39	OHS92004	COPPER BIS(2-ETHYLHEXANOATE)
40	OHS92008	2-AMINOBIPHENYL
41	OHS93070	2,3-DIETHYL-5-METHYLPYRAZINE
42	OHS98950	AMBERLITE CG-400 ION-EXCHANGE RESIN
43	OHSAA047	BONIDE HORNET WASP & BEE BOMB
44	OHSAA100	BONIDE DURSBAN 2E INSECTICIDE
45	OHSAA152	BONIDE LIQUID ROTENONE/PYRETHRINS SPRAY
46	OHSAA220	DRAGON WETTABLE OR DUSTING GARDEN SULPHUR
47	OHSAA606	ZINEB 75% WETTABLE POWDER
48	OHSAA801	SWAT 8E INSECTICIDE-MITICIDE
49	OHSAA906	DE-PESTER ROACH & ANT BOMB
50	OHSAA911	DURSBAN E-2 INSECTICIDE

APPENDIX B. HMIS Fields Selected as Mandatory for Review

1. FSC
2. NIIN
3. Manufacturer's CAGE
4. Part Number Indicator
5. Part Number/Trade Name
6. Company's Name
7. Company's Street
8. Company's City
9. Company's State
10. Company's Zip Code
11. Company's Emergency Phone Number
12. Safety Focal Point
13. Date MSDS Prepared
14. Safety Data Review Date
15. Ingredient Name
16. OSHA PEL
17. ACGIH TLV
18. Appearance and Odor
19. Boiling Point
20. Melting Point
21. Vapor Pressure
22. Flash Point
23. Extinguishing Media
24. Stability
25. Route of Entry - Inhalation
26. Route of Entry - Skin
27. Route of Entry - Ingestion
28. Health Haz Acute and Chronic
29. Carcinogenicity - NTP
30. Carcinogenicity - IARC
31. Carcinogenicity - OSHA
32. Signs/Symptoms of Overexposure
33. Emergency/First Aid Procedures
34. Steps if Mat'l Released/Spill
35. Waste Disposal Method
36. Precautions-Handling/Storing
37. Respiratory Protection
38. Ventilation
39. Protective Gloves
40. Eye Protection
41. Work Hygienic Practices
42. Label Required
43. Signal Word.

APPENDIX C. Glossary

AIS	Automated Information System
ANSI	American National Standards Institute
CAGE	Commercial and Government Entity
CAS	Chemical Abstract Service
CD-ROM	Compact Disc - Read Only Memory
CFR	Code of Federal Regulations
CMA	Chemical Manufacturers Association
DFARS	Defense Federal Acquisition Regulation Supplement
DLA	Defense Logistics Agency
DoD	Department of Defense
DORO	DLA Operations Research Office
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
FAR	Federal Acquisition Regulation
FED-STD	Federal Standard
FSC	Federal Supply Class
GSA	General Services Administration
HCC	Hazard Characteristics Code
HCS	Hazard Communications Standards
HMIS	Hazardous Materials Information System
IPC	Information Processing Center
MSDS	Material Safety Data Sheet
NIIN	National Item Identification Number
N/K	Not Known
N/P	Not Provided
OSHA	Occupational Safety & Health Administration

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The Hazardous Materials Information System (HMIS) is used to manage data required for the use, transportation, storage and disposal of hazardous material by the US Government. In response to concerns expressed by some users, DORO was tasked to conduct an independent review of data quality. An analysis of 43 mandatory fields in 250 sample records showed a 4.6% field error rate for newer records, and over half the records had one or more errors. The review of 366 sample records in ten commodity groups showed generally high data consistency for records within each group, but areas of weakness were observed. HMIS has experienced problems in system evolution, different business practices at the major focal points, a wide variety of input formats and different interpretations of regulatory guidance. Despite the study findings, HMIS is a valuable resource for users. The study identified a number of areas that are candidates for corrective action, and made recommendations to improve current and future HMIS data quality.

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