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Matching prosthetics order records in VA National Prosthetics Patient Database to healthcare utilization databases

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Abstract—The National Prosthetics Patient Database (NPPD) is the national Department of Veterans Affairs (VA) dataset that records characteristics of individual prosthetic and assistive devices. It remains unknown how well NPPD records can be matched to encounter records for the same individuals in major VA utilization databases. We compared the count of prosthetics records in the NPPD with the count of prosthetics-related procedures for the same individuals recorded in major VA utilization databases. We then attempted to match the NPPD records to the utilization records by person and date. In general, 40% to 60% of the NPPD records could be matched to outpatient utilization records within a 14-day window around the NPPD dataset entry date. Match rates for inpatient data were lower: 10% to 16% within a 14-day window. The NPPD will be particularly important for studies of certain veteran groups, such as those with spinal cord injury or blast-related polytraumatic injury. Health services researchers should use both the NPPD and utilization databases to develop a full understanding of prosthetics use by individual patients.

Key words: artificial limbs, costs and cost analysis, equipment and supplies, eyeglasses, hearing aids, indwelling catheters, prostheses and implants, rehabilitation, stents, wheelchairs.

INTRODUCTION

In fiscal year (FY) 2008, the Department of Veterans Affairs (VA) provided prosthetic and sensory devices, repairs, and related services to over 1.9 million veterans at a cost of more than $1.6 billion [1]. The VA Prosthetics and Sensory Aids Service (PSAS) oversees procurement, replacement, and repair of these items. The range of items is very wide: prosthetics and orthotics, assistive devices of all kinds, and everything that is implanted in or on a patient for an intended period of ≥30 days. Thus, cardiac stents, bandages, injection catheters, and surgical fixtures are all ordered through PSAS. The most common devices and services include home oxygen therapy, eyeglasses, orthopedic devices, and surgical supplies. In this article, we use the term *prosthetics* to refer to all of these items and services.

Abbreviations: CPT = Common Procedural Terminology, DALC = Denver Acquisition and Logistics Center, DDC = Denver Distribution Center, DSS = Decision Support System, FY = fiscal year, HCPCS = Healthcare Financing Administration Common Procedure Coding System, HERC = Health Economics Resource Center, ICD-9 = International Classification of Diseases-9th Revision, ID = identification, IE = inpatient encounter, IP = inpatient group, NDE = National Data Extracts, NP = mixed NPPD group, NPPD = National Prosthetics Patient Database, OP1 = outpatient group 1, OP2 = outpatient group 2, OPC = Outpatient Care File, PSAS = Prosthetics and Sensory Aids Service, PTF = Patient Treatment File, SCRSSN = scrambled Social Security number, VA = Department of Veterans Affairs, VISTA = Veterans Health Information Systems and Technology Architecture.

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Prosthetic devices and services constitute an important and timely research area. They play an important role in the care of veterans who have sustained polytrauma and blast-related injuries [2–3]. As the longevity of Americans increases, demand is growing for assistive devices. Congressional scrutiny of payments for long-term oxygen therapy suggests the value of research on the comparative effectiveness and cost-effectiveness of high-cost prosthetics [4–5]. The trend toward home-based healthcare, such as home monitoring of chronically ill patients with the VA Home-Based Primary Care program [6] or for patients with polytraumatic injury [7], may also lead to a greater reliance on home care products distributed by the PSAS. A related issue is the extent to which assistive devices can substitute for personal care at home or in long-term care [8–9]. In some cases, the VA has the option to purchase and customize products from a variety of internal and external sources. If National Prosthetics Patient Database (NPPD) cost data were validated, then the dataset could be used to assess the implications of each option for cost and quality [10]. Finally, the range and cost of alternative devices and services within particular classes, such as wheelchairs and scooters [10] or artificial limbs [11], point to the need for cost-effectiveness analyses in all areas of rehabilitation, whether home-based or institutional.

The VA records orders for prosthetic items in the NPPD. The database includes orders for new items as well as for rentals and repairs. Each record represents an individual item identified by a Healthcare Financing Administration Common Procedure Coding System (HCPCS) code. There is little clinical or demographic data, but the patient identification (ID) variable may be used to find such information in other VA databases [12]. The NPPD includes items that are ordered by VA providers for an individual, including items ordered by non-VA providers working on contract; it does not include items ordered for ward stock.* The NPPD cannot be used to determine whether or for how long the patient used a particular prosthetic item. In this respect, it is similar to a pharmacy prescription database that records whether a prescription was filled but not whether the patient took the medication.

The NPPD has been employed in several published analyses. Downs introduced the NPPD as a research tool through an analysis of artificial limbs, comparing FY1999 frequencies across regional VA networks and between VA and commercial providers [11]. Render et al. collated data from the NPPD and other VA sources, estimating a total prosthetics spending of $30.6 million at six VA sites in FY1999 [13]. In an unpublished study, Fitzgerald and Reker described limitations in FY2001 NPPD data, reported the proportion of records with zero or missing cost, and estimated the level of questionable outlier payments to the top 500 prosthetics vendors.† Hubbard et al. employed the NPPD to describe the distribution and cost of wheelchairs and scooters in the VA from FY1999 to FY2001 [10,14]. Although Hubbard et al. used data from utilization files in conjunction with NPPD records, no published study has matched individual NPPD records to related inpatient or outpatient encounters around the same time [14].

Some prosthetics research will require person-level data on other aspects of care. They can be found in VA utilization databases such as the Patient Treatment File (PTF), the Outpatient Care File (OPC), and Decision Support System (DSS) National Data Extracts (NDEs). PTF and DSS inpatient NDEs report inpatient services, while OPC and DSS outpatient NDEs record outpatient services [15–16]. Each is organized by encounter and provides clinical and demographic data. The NPPD provides researchers with certain data fields beyond those in these utilization data, such as HCPCS codes and costs for particular prosthetics, but it is unknown a priori whether they also indicate prosthetics encounters that cannot be observed or inferred from other sources. If all NPPD prosthetics orders correspond to prosthetics-related encounters in DSS and PTF/OPC, then the NPPD would be needed only to provide detail about specific prosthetics orders and the direct cost of prosthetics. Conversely, consulting NPPD in addition to the utilization databases will be necessary if there are prosthetics dispensed without a provider encounter or if the prosthetics-related encounters cannot be located with certainty in the utilization data.

To address this issue, we investigated the extent to which NPPD records can be matched to inpatient and outpatient encounters recorded in the DSS NDEs, OPC, and PTF. We had two hypotheses:

1. NPPD records can be matched to prosthetics-related events in the OPC (outpatient) and PTF (inpatient) utilization files within ±28 days.

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†Fitzgerald SG, Reker D. Assessment of the National Prosthetics Patient Database: Preliminary studies of validity. Pittsburgh (PA): VA Rehabilitation Research and Development; 2003.

2. NPPD records can be matched to prosthetics-related events in the DSS NDE inpatient and outpatient utilization files within ±28 days.

We believed that the match rates would be high because both the DSS and NPPD draw prosthetics information from the Veterans Health Information Systems and Technology Architecture (VISTA) Prosthetics Package. Two datasets that draw from the same source could be expected to have similar records. OPC/PTF and the DSS NDEs have extremely high overlap when DSS records that have the value of the National Patient Care Database in the variable ENCFLAG are selected [17]. Thus, by choosing the NPPD records in the DSS, we expect to find similar results with OPC/PTF as we do with the DSS.

METHODS

Data Years

We obtained NPPD, DSS, OPC, and PTF data for FY2002 and FY2005. FY2002 data were the newest available when we obtained them from the PSAS in 2003. After reviewing results of the FY2002 analyses, a PSAS staff member recommended an additional analysis of the most recent data then available, from FY2005, because data-processing improvements since FY2002 could have led to different results. We therefore performed a similar set of analyses on FY2005 data.

National Prosthetics Patient Database Date Fields

A common method for searching utilization data is to look for all records pertaining to a particular individual that fall within a prespecified time period, such as the time from study enrollment to the end of a follow-up period. NPPD has two date fields. One is the data entry date (CREATEDT), which records when the prosthetics order entered VISTA. By VA policy, it should be within 5 days of the date when a physician enters a prosthetics request (consult) into the patient's electronic medical record. The data entry date often falls before the patient receives the prosthetic item, although in some cases it can come afterward. The second field is delivery date (DELIVRDT). It represents the date when payment for the order cleared in the VA financial system (IFCAP [Integrated Funds Distribution, Control Point Activity, Accounting, and Procurement]). The delivery date is not necessarily the date the prosthetic item was delivered, however. We therefore used the data entry date as an approximation of the encounter date (or service date) the clinician ordered the item.

Procedure Codes

Prosthetics devices and services are referenced by two types of HCPCS codes. The first type, Level I codes, is a procedure code in the Common Procedural Terminology (CPT) system. These are services and procedures provided in a physician's office. The second type, Level II codes, represents additional items and services excluded from CPT by design. They cover devices, supplies, and procedures provided outside of a physician's office. Level II codes are distinguished by a leading alphabetic character rather than a leading digit (e.g., V2020). Examples of common HCPCS codes in the NPPD include V2199 (lens, single vision, not otherwise classified), A4670 (automatic blood pressure monitor), and V5014 (hearing aid repair/modifying).

The utilization databases employ two procedure code sets. Outpatient records in OPC and DSS use the HCPCS system. Although the variable names refer to CPTs, both Level I and Level II codes are allowed. PTF and the DSS NDEs for inpatient care use the International Classification of Diseases-9th Revision (ICD-9) procedure coding system. To ensure comparability between inpatient and outpatient results, we would have liked to use the same coding system for both. ICD-9 codes cannot be matched one-to-one with HCPCS codes, however, because there are substantially fewer ICD-9 codes.

We believed that the match between the NPPD and utilization databases would be better for prosthetics items referenced by Level II codes than for those referenced by Level I (CPT) codes. It was straightforward to test this using outpatient records, as we could simply select those records using Level II codes. For inpatient records, however, the distinction between Level I and Level II was not evident from the ICD-9 procedure code. We therefore reviewed the entire set of ICD-9 procedure codes and developed two lists. The first list included all procedures that involve prosthetics in some fashion; this was designed to be similar to the entire HCPCS set. The second list, a subset of the first, included only those codes that refer directly to a prosthetic device, such as surgical placement of a cardiac stent. This list was intended to relate more specifically to the Level II HCPCS codes.

Categories of Prosthetics Items

Our next step was to classify prosthetics items into ten broad categories based on their names and descriptions available in published guides. **Table 1** describes the categories. We chose them based on heuristic groupings of HCPCS codes rather than by name alone.

The categories clarify several facts about prosthetics in the NPPD. First, the term includes nondurable equipment like dialysis catheters, as well as durable items like prosthetic limbs and hearing aids. Second, it includes some items that are placed in or on the body for relatively short periods, such as external fixation devices. Note that certain services delivered on contract, such as long-term oxygen therapy, may include instruction, delivery, and other services that are secondary to the prosthetic item itself. As noted earlier, a multipart item such as a wheelchair could be entered as a single NPPD record or as multiple records, one for each part. In all cases, we followed the observed coding.

Encounter Definition

Our analyses rely on encounters recorded in VA utilization databases, and so we define an encounter as they do. This section defines encounters by setting: outpatient, inpatient, and items mailed from VA's Denver Acquisition and Logistics Center (DALC).

Outpatient Encounters

Outpatient encounters are contact between patients and providers in person, by telephone, or through videoconferencing. VA utilization datasets exclude patient consults that do not lead to a procedure, such as contacts for purely research or administrative purposes.

A physician or other provider enters a prosthetics consult into the patient's electronic medical record. In most cases, the patient then obtains the item from the prosthetics clinic at the same facility. Rehabilitative clinics for physical therapy and occupational therapy also dispense certain prosthetics items, while a few others, such as oxygen therapy equipment, are received at home. Obtaining a prosthetic item on an outpatient basis therefore involves at least two encounters: a first with the physician who prescribes the item and enters an electronic order and a second when the patient obtains the item. In some cases, additional encounters are required to assess feasibility of the item for the patient, such as a home visit after an initial order for long-term oxygen therapy.

In some cases, the initial encounter record in DSS or OPC will not give evidence of a prosthetic consult. If the consult is placed during an encounter whose primary purpose was something else, then the procedure code assigned to the visit is likely to pertain to the primary topic rather than to the prosthetic. Moreover, entering a prosthetics consult does not automatically generate a prosthetics procedure code for the encounter. Thus, we are most likely to find a match for an NPPD record to an encounter at the prosthetics clinic or at an intervening prosthetics-related consultation, such as with a physical medicine and rehabilitation clinic.

Inpatient Encounters

We defined inpatient encounters (IEs) by an admission and discharge (adding stays that had not discharged by the end of the FY would not change our results meaningfully). We also considered residential rehabilitation, domiciliary, and long-term care stays to be IEs. We treated emergency department visits as inpatient or outpatient depending on how they were coded in the utilization data.

Table 1.
Categories of prosthetics items.

Category Abbreviation and Name	Description
Noncardiac Implanted Devices	Noncardiac catheters and other devices not otherwise specified, including stents, shunts, electrodes, stimulators, and access devices.
Dialysis	Kidney dialysis of all types.
Fixtures	Surgical fixtures, internal or external.
Eyeglasses	Glasses, contact lenses, frames, etc.
Maxillofacial	Maxillofacial items.
Orthopedics	Orthopedic implants and devices other than fixtures, including prosthetic limbs and orthotics.
Plastics	Plastic and reconstructive surgery, including artificial skin grafts and breast implants.
Drug Delivery Devices	Infusion pumps of all types.
Supplies	All supply items, including most durable medical equipment (e.g., canes, wheelchairs), oxygen equipment, batteries, and bandages.
Cardiac	All cardiac items, including catheters and leads.

There is a single encounter record for prosthetics placed during surgery. Procedures performed at the bedside, such as an evaluation for a prosthetic by a physician in the physical medicine and rehabilitation clinic, would not create a separate inpatient record. If a patient in a rehabilitation or long-term care program obtained outpatient care at a VA facility during his or her stay, however, then a separate outpatient record would be created.

Denver Acquisition and Logistics Center

A key issue for this study is whether a patient can receive a prosthetic item outside of an encounter. The answer is "no" for most items. Any nontrivial contact between a provider and a patient should be entered as an encounter. An exception is the VA's DALC (formerly the Denver Distribution Center [DDC]), which provides prosthetics items to VA facilities but can also mail them directly to some individuals [18]. In some cases, a patient can request an item from DALC and receive it by mail without having a provider encounter.

DALC activities do not appear in OPC outpatient datasets but do appear in the DSS NDEs for outpatient care. DSS indicates DALC records through several variables: the clinic stop code (variable CLSTOP), the indicator variable DDC (prior to FY2005 only), and the DALC supply cost variable (ODDCSUPL prior to FY2005, DD_SUP since FY2005). An important limitation is that DSS outpatient records do not contain procedure codes. Thus, a DALC record will indicate the person, date, and cost but not what item was dispensed. Because our matching method relied on procedure codes, we limited our search of outpatient prosthetics items to encounters in OPC and to similar records in the DSS NDEs for outpatient care. We did not search DALC records in the DSS NDEs for outpatient care.

Contract Care Encounters

We excluded encounters at non-VA facilities paid for by the VA, sometimes called contract care or purchased care. Records of most such encounters appear in the VA Fee Basis files [19]. They represented a small proportion of all VA encounters in FY2002 and FY2005. Among the 20 most common CPT codes in FY2004 outpatient Fee Basis files, only 2 had any obvious connection to prosthetics. They were 90935 and 90937, both of which pertain to kidney dialysis. As we will see, however, dialysis-related prosthetics orders are relatively rare in the NPPD, so we are not concerned that excluding the Fee Basis files substantially worsened our match rate. Contract care has been growing rapidly in recent years, however, and so future research should consider including non-VA encounters.

Cohorts of Prosthetics Users

Next, we describe the process for creating the FY2002 extracts. We used a similar process for the FY2005 extracts. We first searched OPC for all outpatient encounter records having a prosthetics-related Level I (CPT) or Level II HCPCS procedure code. We determined the list of codes through a manual review of all procedure codes in the official 2002 CPT/HCPCS guide [20]. From these records, we determined the set of unique patient IDs and randomly selected 4,000 of them. This is cohort outpatient group 1 (OP1). Finally, we located all NPPD records for these individuals in FY2002.

To create outpatient group 2 (OP2), we began by locating all OPC outpatient encounter records having a prosthetics-related Level II HCPCS procedure code. This represents a subset of encounters found when creating OP1. We determined the unique set of patient IDs and randomly selected 5,000 of them. We then located all of their NPPD records in FY2002.

Next, we turned to IE records in the PTF file. We located all records having a prosthetics-related procedure code. From these records we determined the set of unique patient IDs, and then randomly selected 1,000 of them. This is the inpatient group cohort (IP). We then located all NPPD records for these individuals.

The mixed NPPD group (NP) was the only one that did not use OPC or PTF encounter records. We determined the list of unique individuals represented by FY2002 NPPD records. The NP cohort is a random set of 5,000 of these people. We then extracted all their NPPD records.

When locating NPPD records, we dropped those that lacked a valid HCPCS code. For example, for many years shipping charges were reported as a separate record; the value NPPDNULL appeared in the HCPCS field in such cases. Blank or null HCPCS values occurred many times in FY2002 NPPD data but almost never in FY2005 data. We also dropped any person having no records at all in the NPPD. **Table 2** shows the count of individuals at each step.

Matching Methods

The matching process had two steps. In the first step, we simply counted the number of records by FY and category in the NPPD and in the OPC and PTF utilization data. We did not restrict the records to match by person ID (scrambled Social Security number [SCRSSN]) or HCPCS

Table 2.
Sample sizes for outpatient group 1 (OP1), outpatient group 2 (OP2), inpatient group (IP), and mixed National Prosthetics Patient Database (NPPD) group (NP).

Sample	FY2002				FY2005			
	OP1	OP2	IP	NP	OP1	OP2	IP	NP
No. of IDs Submitted	4,000	5,000	1,000	5,000	4,000	5,000	1,000	5,000
No. of IDs with No NPPD Records	0	0	3	0	870	677	258	0
No. of IDs with Only Invalid NPPD Records	1,084	733	263	117	2	1	0	79
No. of IDs with Any Valid NPPD Records (analysis samples)	2,916	4,267	734	4,893	3,148	3,322	742	4,921

Note: ID refers to patient's scrambled Social Security number. Invalid records are those with missing or null values for procedure code variable HCPCS PSAS. OP1 and IP include people who had HCPCS Level I or II procedure code during year in outpatient or inpatient records. OP2 is limited to those with prosthetic-related HCPCS Level II code in outpatient visit. NP is random set of those with valid NPPD records.
FY = fiscal year, HCPCS = Healthcare Financing Administration Common Procedure Coding System, ID = identification number, PSAS = Prosthetics and Sensory Aids Service.

code. This broad match offers a preview of the more specific matching to follow. Because all of our analyses are stratified by FY and category, a wide discrepancy between the NPPD and a utilization dataset in the number of records in a particular year-category pair would imply that matching with a more specific method will necessarily have poor results overall. Even if category-level matching is poor, however, a subset of records within the year-category pair could possibly match well if, for example, the categories were further subdivided.

The step used four variables: FY, category, person ID (SCRSSN), and date (CREATEDT). This is the smallest set of variables that could allow a unique match of encounter and NPPD records. Starting with the encounter date in the utilization data, we searched for every NPPD record that fell within the matching window and had the same FY, category, and SCRSSN. VA policy allows up to 5 days to enter a prosthetics order into NPPD, and so we allowed a matching window for the dates. We tried several windows: 0 days (exact match), ±7 days, ±14 days, ±21 days, and ±28 days. In a few cases we added ±90 days as well, to see how much the match rate improved under a very wide window.

A unique feature of DSS NDEs is separate reporting of labor and supply costs. Labor costs represent salary and benefits for employees. Supply costs represent nonlabor purchases such as equipment, pharmaceuticals, and all manner of prosthetics. A procedure tied to a prosthetic, such as stent implantation or glasses fitting, could involve labor costs alone, supply costs alone, or both. We therefore performed matching with two groups of DSS records: those having prosthetics labor costs >$0 and those having prosthetics supply costs >$0.

The second matching step requires careful interpretation. Because VA policy allows the NPPD order to be entered days after the physician consult that requests the item, the proportion of exact matches is not a measure of adherence to VA policy. We report the proportion of exact matches because once the match window is extended beyond 0 days, multiple NPPD records can be matched to the same encounter record. Thus, the matching percentages represent upper bounds on the true proportion that match in the given window. For example, suppose that a person had two inpatient operations in a 10-day period, each of which generates a single NPPD record for external fixation. Once the matching boundary exceeds 10 days, the two NPPD records for external fixation will be "matched" to both operations, resulting in four apparent matches rather than two.

RESULTS

Matching by Cohort

We began with cohort OP1, a random subset of individuals who had prosthetics-related outpatient procedure codes. **Table 3** shows the number of OPC prosthetics procedure records and NPPD records occurring in FY2002 and FY2005 for the people in cohort OP1. The total number of items varies considerably across datasets. Because the outpatient encounter file (OPC) captures procedures rather than items, it is unlikely to record many instances of supply deliveries. In practice, we found no supply-related HCPCS codes in the outpatient encounter data for these patients. Once the supply records are removed, the total number of records differs by less than 10 percent in

Table 3.
Count of Outpatient Care File (OPC) and National Prosthetics Patient Database (NPPD) records for persons in outpatient group 1 (OP1) and outpatient group 2 (OP2) by fiscal year (FY), source, and category.

Description	FY2002				FY2005			
	OP1 (*n* = 2,916)		OP2 (*n* = 4,267)		OP1 (*n* = 3,148)		OP2 (*n* = 3,322)	
	OPC	NPPD	OPC	NPPD	OPC	NPPD	OPC	NPPD
Noncardiac Implanted Devices	289	52	14	40	926	166	47	154
Dialysis	0	5	265	8	0	56	1,438	18
Fixtures	2	101	128	185	1	167	71	277
Eyeglasses	1,607	2,297	1,214	2,230	1,918	2,648	570	1,982
Maxillofacial	0	13	156	30	0	19	768	55
Orthopedics	1,018	953	1,346	1,920	2,027	1,742	2,339	2,193
Plastics	7	7	1	6	6	2	13	21
Drug Delivery Devices	8	5	13	19	16	11	10	9
Supplies	0	4,260	3,601	7,900	0	7,960	8,983	9,775
Cardiac	148	62	7	67	1,091	132	21	99
Vision Implants, Hearing, Speech	829	107	53	86	1,633	331	329	494
Total	3,908	7,862	6,798	12,491	7,618	13,234	14,589	15,077
Total Without Supplies	3,908	3,602	3,197	4,591	7,618	5,274	5,606	5,302

Note: OP1 includes people who had prosthetics-related HCPCS Level I or II procedure code during year in outpatient records. OP2 is limited to those with prosthetics-related HCPCS Level II code in an outpatient visit.
HCPCS = Healthcare Financing Administration Common Procedure Coding System.

FY2002. A similar pattern holds in FY2005, although the remaining difference between NPPD and OPC is still large at 2,344 records.

We next analyzed cohort OP2, a random subset of individuals who had prosthetics-related Level II HCPCS procedure codes. **Table 3** shows the number of outpatient encounter (OPC) records with prosthetics procedure codes and the number of NPPD records for people in cohort OP2 in FY2002 and FY2005. The number of records is again quite discrepant within categories after supplies are removed. The NPPD again reported a much greater number of eyeglasses and supplies records in both years. Both the OPC and NPPD report a significant number of supply records for the OP2 cohort, although the OPC had notably fewer than the NPPD each year.

Several notable changes occurred between FY2002 and FY2005, as the NPPD staff had expected. The count of OPC records nearly doubled between years, somewhat greater increases than observed in NPPD records. In both years, many categories had wide discrepancies in counts. Between FY2002 and FY2005, the match rate with NPPD decreased for OP1 but increased for OP2.

Next, we analyzed the IP cohort, a randomly selected subset of individuals having inpatient prosthetics-related procedures. **Table 4** presents the number of IE records (PTF) and NPPD records for individuals in this cohort by FY and data source. Starting with inpatient NPPD records, we searched for prosthetics-related encounter records in the same fiscal year. Once supply records were removed, there were 81 percent more IE records than NPPD records.

Our final analysis used individuals in the NP cohort, a randomly selected subsample of all those with NPPD records in FY2002. Starting with their NPPD records, we searched the inpatient (PTF) and outpatient (OPC) encounter files for prosthetic-related services incurred by the same individuals. **Table 4** shows the distribution of records by category. There were substantially more records in the NPPD file for the individuals in cohort NP, even if one discounts supply records. Here the discrepancy is not mostly due to cardiac devices and noncardiac catheters but instead to eyeglasses and orthopedics.

Matching by Fiscal Year, Category, and Encounter Date

By construction, we matched a single NPPD record to every utilization record that fell within the matching window. The percentages in **Tables 5** through **8** are therefore labeled as upper bounds because they will overstate the true rate of one-to-one matching, possibly by a considerable margin. The upper bounds are preceded by the symbol < to reflect that the true matching rate will be

Table 4.
Count of Patient Treatment File (PTF) and National Prosthetics Patient Database (NPPD) records for persons in inpatient group (IP) and mixed NPPD group (NP) by fiscal year (FY), source, and category.

Description	FY2002				FY2005			
	IP (*n* = 734)		NP (*n* = 4,893)		IP (*n* = 742)		NP (*n* = 4,921)	
	PTF	NPPD	PTF/OPC	NPPD	PTF	NPPD	PTF/OPC	NPPD
Noncardiac Catheter, Other Device	556	118	227	64	943	287	943	287
Dialysis	38	4	32	15	49	11	49	11
Fixtures	4	28	44	115	5	63	5	63
Eyeglasses	0	242	1,091	3,065	1	258	1	258
Maxillofacial	0	6	71	17	0	5	0	5
Orthopedics	126	334	709	1,394	108	636	108	636
Plastics	0	3	2	3	1	3	1	3
Drug Delivery Devices	0	12	2	5	3	13	3	13
Supplies	6	1,931	1,197	6,907	6	3,611	6	3,611
Cardiac	920	144	149	50	1,209	311	1,209	311
Vision Implants, Hearing, Speech	4	22	276	44	7	43	7	43
Total	1,654	2,844	3,800	11,679	2,332	5,241	2,332	5,241
Total Without Supplies	1,648	913	2,603	4,772	2,326	1,630	2,326	1,630

Note: IP includes people who had prosthetics-related HCPCS Level I or II procedure code during year in inpatient records. NP is random set of those with valid NPPD records.
HCPCS = Healthcare Financing Administration Common Procedure Coding System, OPC = Outpatient Care File.

Table 5.
Nonsupply National Prosthetics Patient Database (NPPD) records matching Outpatient Care File (OPC) or Patient Treatment File (PTF) records by matching window.

Matching Window	Upper Bound on Percentage Matched (%)					
	FY2002			FY2005		
	OP1	IP	NP	OP1	IP	NP
NPPD Create Date = Service Date	3.1	0.9	8.5	2.5	2.0	1.7
NPPD Create Date = Service Date ± 7 days	<14.5	<9.8	<16.6	<15.0	<15.6	<8.0
NPPD Create Date = Service Date ± 14 days	<19.0	<12.6	<22.4	<18.2	<19.9	<10.4
NPPD Create Date = Service Date ± 21 days	<21.9	<14.5	<26.4	<20.2	<22.0	<12.0
NPPD Create Date = Service Date ± 28 days	<23.8	<15.7	<29.4	<21.9	<27.1	<13.6

Note: Service date is encounter date in utilization records. OP1 and IP include people who had a prosthetics-related HCPCS Level I or II procedure code during year in outpatient records. NP is random set of those with valid NPPD records.
FY = fiscal year, HCPCS = Healthcare Financing Administration Common Procedure Coding System, IP = inpatient group, OP1 = outpatient group 1, NP = mixed NPPD group.

lower. The larger the match window, the larger the gap between the true value and the upper bound.

We began by looking for matches between prosthetics-related procedures marked by CPT codes. These correspond to cohorts OP1, IP, and NP. We tried several date ranges. For each cohort, we show the percentage of NPPD records that had an inpatient or outpatient encounter record in the same category for the same individual within 7, 14, 21, or 28 days before or after the NPPD data entry date. We expanded the window to 60 and 90 days for FY2005 data on the basis of advice from a user of NPPD data. Results in **Tables 5** indicate that <30 percent of NPPD records can be matched to encounter records within a 56-day window (±28 days) around the NPPD data entry date. We could match no more than one-third of NPPD records within a 180-day window around the NPPD data entry date in FY2005 (results not shown).

Next, we searched again for matches by date between NPPD records and utilization records but now limiting the utilization records to those having a HCPCS code corresponding to a device. Most of these appear in the outpatient setting so we limited our data to outpatient

Table 6.
Nonsupply National Prosthetics Patient Database (NPPD) records matching Outpatient Care File records for prosthetics devices, by matching window and fiscal year (FY).

Matching Window	Upper Bound on Percentage Matched (%)	
	FY2002	FY2005
NPPD Create Date = Service Date	35.5	10.8
NPPD Create Date = Service Date ± 7 days	<47.2	<24.3
NPPD Create Date = Service Date ± 14 days	<53.9	<31.1
NPPD Create Date = Service Date ± 21 days	<59.9	<36.6
NPPD Create Date = Service Date ± 28 days	<65.0	<41.8

Note: Service date is encounter date in utilization records.

NPPD records and the OPC utilization file. To obtain the largest sample size, we used all individuals in the OP1 and OP2 cohorts, a total of 7,183 persons in FY2002 and 6,470 persons in FY2005 (**Table 2**).

By construction, all people in OP2 had at least one outpatient encounter record with a procedure code pertaining to a particular prosthetics device. Some, but not all, people in OP1 have at least one such record as well. Results in **Table 6** indicate a much greater match rate. Of FY2002 records, 35.5 percent have an exact match in the outpatient encounter data and as many as <65.0 percent match over a 56-day window around the NPPD data entry date. The matching rate was notably lower in FY2005, however, with only 10.8 percent matching exactly and <41.8 percent matching within a 56-day window. These results demonstrate that substantially better matching is possible when one selects only CPT/HCPCS codes pertaining to specific prosthetics devices. The drop in matching frequency between FY2002 and FY2005 does not have an obvious explanation.

We next turned to DSS records to see whether matching rates would vary substantially from those found using OPC and PTF. **Table 7** reveals that very few NPPD records for inpatient prosthetics could be tied to individual DSS inpatient records within ±28 days of the NPPD data entry date. We found considerable variation across FYs and DSS records. In FY2002, <30.4 percent of NPPD records could be matched to DSS outpatient records with positive prosthetics labor costs by date range, category, and person ID (**Table 8**). A much greater percentage, <100.0 percent, could be matched to DSS records with positive prosthetics supply cost. The pattern reversed in FY2005: <100.0 percent of NPPD records could be matched to DSS records with positive prosthetics labor costs, while <49.8 percent could be matched to DSS records with positive prosthetics supply costs.

DISCUSSION

Tables 3 and **4** revealed low matching rates between NPPD and utilization databases in the count of prosthetics-related records within broad categories. We see several possible causes. The excess of NPPD records for eyeglass prescriptions and fixtures could reflect the need for multiple orders for a single person, such as multiple pairs of frames and lenses or multiple types of fixtures used in a single procedure. Orders for prosthetics supplies and surgical fixtures appear to be the least likely to be reflected in encounter records. Some of the discrepancy in prosthetics supplies may have come from direct orders placed with DALC. NPPD processing software was enhanced in FY2008 to capture DALC orders for individual patients, thereby removing this possible source of discrepancy.

Table 7.
National Prosthetics Patient Database (NPPD) records matching Decision Support System (DSS) inpatient records by matching window and DSS record type.

Matching Window	Upper Bound on Percentage Matched (%)			
	FY2002		FY2005	
	DSS Inpatient Labor >$0	DSS Inpatient Supply >$0	DSS Inpatient Labor >$0	DSS Inpatient Supply >$0
NPPD Create Date = Service Date	0.4	1.7	0.1	0.5
NPPD Create Date = Service Date ± 7 days	<4.0	<19.5	<0.9	<5.2
NPPD Create Date = Service Date ± 14 days	<7.1	<33.2	<1.4	<8.3
NPPD Create Date = Service Date ± 21 days	<9.4	<42.3	<1.8	<10.8
NPPD Create Date = Service Date ± 28 days	<11.5	<49.9	<2.1	<12.8

Note: Service date is encounter date in utilization records.
FY = fiscal year.

Table 8.
National Prosthetics Patient Database (NPPD) records matching outpatient Decision Support System (DSS) National Data Extracts records by matching window and DSS record type.

Matching Window	Upper Bound on Percentage Matched (%)			
	FY2002		FY2005	
	DSS Outpatient Labor >$0	DSS Outpatient Supply >$0	DSS Outpatient Labor >$0	DSS Outpatient Supply >$0
NPPD Create Date = Service Date	9.3	38.2	54.4	22.8
NPPD Create Date = Service Date ± 7 days	<16.7	<63.4	<94.8	<27.5
NPPD Create Date = Service Date ± 14 days	<22.0	<90.5	<100.0	<31.8
NPPD Create Date = Service Date ± 21 days	<26.6	<100.0	<100.0	<37.4
NPPD Create Date = Service Date ± 28 days	<30.4	<100.0	<100.0	<49.8

Note: Service date is encounter date in utilization records.
FY = fiscal year.

The NPPD records more items than OPC in some categories but fewer items in other categories. A single NPPD order could pertain to multiple outpatient encounters if the item required visits to several clinics to ensure appropriateness and to select the proper item and size. Conversely, the NPPD could have more records than OPC in cases where multiple NPPD entries are needed for a single device, as for a wheelchair and its cushions. The latter does not occur categorically for major items; however, a multipart item is sometimes entered as a single order.

The results of **Tables 5** to **8** do not support our hypotheses that NPPD records could be matched to prosthetics-related encounters within ±28 days. There were modest gains in the match rate as the windows were expanded, but even at ±28 days, a substantial proportion cannot be matched. On the basis of earlier results in **Tables 3** and **4**, we expect that the match rate would have been even lower if supply records had been included.

The proportion of records that match varied considerably by data source. We found the highest rates when matching NPPD records to DSS outpatient records having positive prosthetics labor or supply costs or to OPC records with prosthetics-related Level II HCPCS codes (cohort OP2). Explaining the varying match rates across data sources will require careful examination of differences in coding practices in outpatient versus inpatient encounters. Likewise, an investigation of why DSS assigns prosthetics labor costs and prosthetics supply costs could illuminate the widely varying match rates seen in **Tables 7** and **8**.

Relatively low matching rates among inpatients could result in part from missing data. Historically, some inpatient events were not reliably captured. Examples include cardiac catheterization laboratory procedures and outpatient care received by residential and nursing home patients, among others [21]. VA developed the IE application to capture outpatient care provided to inpatients. IE achieved widespread implementation only after the FYs we studied. If it captures additional care that incorporates prosthetics, then we will likely find higher matching rates among inpatients in future years.

Missing data could also arise from comanagement. VA users rely on the VA for only 20 to 50 percent of their care, depending on enrollment priority group [22]. It seems unlikely, however, that this would explain our findings. Inpatients would not transfer to a non-VA provider for prosthetic services, and outpatient orders placed by a contract provider would lead to an order record in the NPPD and related encounters in the Fee Basis files. VA policy mandates that VA facilities provide all necessary prosthetics. This should prevent Fee Basis providers from receiving VA reimbursement for outpatient prosthetic and assistive devices provided in nonemergent situations, such as wheelchairs and hearing aids. The effect on inpatient and emergent care is unclear. We did not search Fee Basis files in this study because contract care constituted a very small proportion of all VA care in FY2002 and FY2005, but due to fast growth in contract care in recent years, we recommend that research on data from later years incorporate the Fee Basis data.

Determining a full set of prosthetics items received by a single individual before FY2008 will require consulting two sources. Items ordered through the NPPD and those ordered from DALC for bulk delivery to a medical center department will all appear in the NPPD. Items ordered through DALC for particular individuals do not

appear in the NPPD until FY2008. Before that year, they can be located in the DSS DDC NDEs.

The number of NPPD order records for an item does not indicate the number of VA inpatient and outpatient encounters that will be needed before and after the order. Thus, the utilization datasets will always be needed to understand how use of specific items relates to patterns of healthcare use within the VA. Elucidating the relation of individual prosthetics to VA encounters would be greatly eased if we could reliably link a particular NPPD order (and hence the item's identity) to related inpatient or outpatient care. Our results, however, indicate that this type of temporal matching often does not work.

Although we did not study NPPD costs, a general caution is in order: NPPD costs should not be added to costs in encounter data. DSS encounter-level files incorporate costs assigned to prosthetics recorded in the NPPD. Since FY2007, the encounter-level DSS files have excluded costs for orders filled by DALC (see VA Decision Support Office for details [23]). The VA Health Economics Resource Center (HERC) has estimated costs for each encounter in PTF and OPC, and they also cover prosthetics costs. Prosthetics researchers interested in using the HERC data are strongly encouraged to consult the relevant guidebooks for details on the handling of prosthetics costs [24–25].

An area for future research is alternative approaches to matching NPPD and encounter databases. One approach would be to rely on clinic stop codes rather than procedure codes. Each outpatient encounter is assigned a three-digit clinic stop code, which DSS calls the DSS Identifier. There are two clinic stop codes corresponding to the prosthetics department, numbers 417 (Prosthetics/Orthotics) and 423 (Prosthetic Supply Dispensed). Clinic code 417 is for evaluation, counseling, and treatment before or after an item is dispensed. Clinic code 423 covers dispensing of prosthetics, but also related activities such as "consultation, evaluation, education, information, and/or counseling concerning eligibility for prosthetic services, appliances, devices, and benefit claims and prescription processing" [26]. Searching for outpatient records with clinic stop codes 417 and 423 would reveal the total number of encounters with the prosthetics staff by an individual. DALC records could be found in DSS outpatient NDEs, although not in the OPC.

Another area for future research is a validation of the NPPD. The study by Fitzgerald and Reker provided preliminary estimates of completeness and plausibility in cost data but did not compare the dataset with an outside standard.* Determining the completeness of the data would require a time-consuming chart review possibly supplemented by interviews with providers and patients. Validating cost data would require additional research into contract payments for each item. It would be prohibitively expensive to carry out a full validation at even the VA station level, but a limited validation could be feasible if incorporated into a clinical trial that already featured chart review and an opportunity to interview patients and providers.

CONCLUSIONS

The results presented here suggest that many NPPD prosthetics records cannot be readily matched to outpatient or inpatient encounters. Unless one assumes that the NPPD is always correct and therefore any matching issues reflect errors in the encounter databases, it follows that both the NPPD and encounter databases will be needed to develop a complete picture of prosthetics services for an individual VA user and for cohorts of users.

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