Eur J Vasc Endovasc Surg **29**, 571–578 (2005)
doi:10.1016/j.ejvs.2005.02.002, available online at http://www.sciencedirect.com on SCIENCE DIRECT®

Quality of Data Reported on Abdominal Aortic Aneurysm Repair—A Comparison between a National Vascular and a National Administrative Registry

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Objective. *To study consistency of data and completeness of reporting in a national vascular registry, NorKar, and a national administrative registry, The Norwegian patient register (NPR).*
Design. *Comparative registry-based national study supplemented with a comprehensive control of patients registered in one major hospital.*
Material. *All patients registered with a procedure-code for treatment of AAA in NorKar or NPR during 2001 or 2002, were included.*
Method. *We compared the reporting of procedure-codes, diagnosis-codes and in-hospital deaths after treatment for abdominal aortic aneurysm (AAA) in the two registries to evaluate completeness. Consistency between procedure-codes and diagnoses were evaluated within both registries. Completeness of reporting to one NorKar Local Registry was investigated in more detail in one of the hospitals.*
Results. *Compared with the NPR numbers, NorKar contained 69% of the patients treated for AAA in Norway, while completeness for NorKar member hospitals was 84%. The detailed investigation in one of the hospitals showed a completeness of 91% and a false inclusion of 5.3% of all cases treated for AAA. The consistency between procedure-codes and diagnosis-codes was 93% in both registries. We found evidence of substantial underreporting of in-hospital deaths to NorKar in several hospitals. Overall reporting of early deaths to NorKar relative to completeness of reported cases was estimated to 72%.*
Conclusion. *There is an underreporting of patients with AAA to NorKar according to the NPR numbers and a need for better control of procedure-diagnosis consistency in both registries. There seems to be a substantial underreporting of early deaths to NorKar. Introduction of unique patient-identifiable data could improve the quality of both registries by making matching of data possible.*

Keywords: Abdominal aortic aneurysm; Vascular registries; Coding; Completeness; Consistency.

Introduction

Establishing registries for various medical conditions has become more common during recent years. In 2002, Norway had more than 60 official medical registries of which 50% received financial support from the authorities.[1] As registry based studies are getting more common, there is need for validation of the registries forming the basis for these investigations. So far there have been few publications on quality control on different vascular registries, and published studies have mainly focused on reproducibility of the reported data by recoding trials of random cases.[2–4] Analyses on completeness have to our knowledge only been performed for single hospitals and have ranged from 51 to 100%, with a considerable variation between the hospitals.[2] Reproducibility of entered data has in audits ranged from 76 to 100%[3–5] depending on the accuracy of the variables. To our knowledge no comparison of vascular surgical procedures in different national registries has been reported so far.

The objective of this project was to study quality of data on treatment of abdominal aortic aneurysm (AAA) in a national vascular registry compared to a national administrative registry, with focus on consistency between procedure-codes and diagnosis, completeness of reporting of procedures and in-hospital deaths. In addition, we wanted to evaluate

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1078–5884/000571 + 08 $35.00/0

the completeness of one local vascular database (NorKar Local Registry) by matching relevant data on AAA treatment available in various registries in one major hospital.

Material and Methods

The Norwegian vascular registry (NorKar)

The national registry of the Norwegian society for vascular surgery was established in 1995 and includes different arterial procedures. In 2001, 17 out of 23 departments of vascular surgery were reporting to the registry. NorKar is based on local databases (NorKar Local Registries) with patient-identifiable data in member-hospitals, which reports all cases anonymously to the central registry on a regular basis. The registry contains diagnosis-codes (limited to a maximum of three), procedure-codes (limited to a maximum of six) for each treatment and variables on risk factors, symptomatology, indication for surgery, surgeon's position, complications and vascular graft patency.

Norwegian patient registry (NPR)

The Norwegian patient registry, established in 1997, is an independent registry of all patient treatments in the public healthcare of Norway, and is owned by the Norwegian ministry of health. This administrative registry contains all patient consultations at the outpatient clinics as well as all hospital stays. The hospitals are getting compensation from the authorities on the basis of the volume of reported diagnoses and procedure-codes according to a DRG (Diagnosis Related Groups) -based system, and NPR consists of the reported data. In 2001, 60% of the hospitals' income was based on this system. Thus, there is a strong incentive for the hospitals to report their activity completely. Reporting to the administrative registry is also compulsory to formally discharge a patient from hospital. The registry contains diagnosis-codes, procedure-codes and several administrative variables like waiting time until admission, status at discharge from hospital (alive/dead) and the need for further care.

Coding-systems

Both registries use International Codes of Diseases ICD-10 for recording of diagnoses.[6] For coding of procedures, both registries use the Norwegian translation of the NOMESCO (Nordic Medical Statistics Committee) classification of surgical procedures (NCSP).[7] NCSP-E is the original English version of the coding-system, which was first published in 1996.[8] NCSP codes were designed to describe in order; organ system (first letter), functional anatomical region (second letter) and general surgical method (third letter). The last two numbers describe in order the specific procedure in the category by surgical technique and exact anatomical localisation. NCSP has been implemented in all Scandinavian countries with a translated version for each country. Both the vascular and the administrative registry contain date of admission, procedure and discharge from hospital, which also makes calculation of in hospital mortality possible. Thirty-day mortality is not available in any of the registries. The forms for each hospital stay are filled in by the residents and consultants of the vascular unit, the coding and other data from the forms are then entered to a computer by secretaries. But while data from the vascular registry is not used for administrative purposes, NPR data will be checked by the administrative staff of the hospital, and correction may be performed before reporting to the central authorities.

A search was done in the Norwegian patient registry and the Norwegian vascular registry for patients with the NCSP procedure-codes of open, endovascular and endoscopic repair of AAA (PDG10, PDG 21, PDG 22, PDG 23, PDG24, PDQ10, PDQ10+ PDQ30 and PDS 10) for the years 2001 and 2002. A similar search was done in both registries. The investigation is based on number of operations, with the consequence that there can be more than one registration per patient. Some of the relevant procedure-codes will also have been used for treatment of other conditions than AAA (I71.3-4, 8–9). In the present study, we defined procedure-diagnosis-consistency as a NCSP procedure-code combined with an ICD-10 diagnosis-code of a relevant indication for the procedure performed. We, therefore, developed a procedure-diagnosis-consistency table (Tables 1A and 1B) for all possible consistent combinations. Cases with a consistent combination for other indications than treatment for AAA, e.g. the implantation of bifurcated vascular graft (PDG20-24) combined with iliac artery aneurysm (I72.3), and implantation of endovascular prosthesis (PDQ10) together with aortic atherosclerosis (I70.0), were excluded from the investigation when no diagnosis of AAA was present. All the other cases with one or more of the defined procedure-codes were included, also when there was no ICD-10-code for AAA among the diagnosis-codes.

At the national level both registries are anonymous, but the administrative registry has a unique

Table 1A. Consistent combinations of NCSP procedure-codes and ICD-10 diagnosis codes relevant for abdominal aortic aneurism (AAA) repair

Code	NCSP	ICD-10		
	Chapter PD: infrarenal aorta and iliac arteries	AAA	Aortic occlusion	Iliac aneurysm
	Section; PDG: operation for aneurysm in the infrarenal abdominal aorta and iliac arteries*			
PDG10	Operation on the infrarenal aorta for aneurysm.	I71.3,4,8,9	None	None
PDG20	Bypass from aorta to iliac artery for aneurysm	I71.3,4,8,9	None	I72.3
PDG21	Bypass from aorta to bilateral iliac arteries for aneurysm	I71.3,4,8,9	None	I72.3
PDG22	Bypass from aorta to iliac artery and contralateral femoral artery for aneurysm	I71.3,4,8,9	None	I72.3
PDG23	Bypass from aorta to femoral artery for aneurysm	I71.3,4,8,9	None	I72.3
PDG24	Bypass from aorta to bilateral femoral artery for aneurysm	I71.3,4,8,9	None	I72.3
	Section; PDQ: implantation of endovascular prosthesis in the infrarenal abdominal aorta and iliac arteries			
PDQ10+PDQ30	Implantation of endovascular prosthesis in infrarenal aorta	I71.3,4,8,9	I70.0	None
	Implantation of endovascular prosthesis in iliac artery	I71.3,4,8,9	I70.2	I72.3
	Section; PDS: endoscopic operation on the infrarenal abdominal aorta and iliac arteries			
PDS10	Endoscopic operation on the infrarenal abdominal aorta	I71.3,4,8,9	I70.0	None

For aortic occlusion without AAA the relevant chapter for conventional bypass in NCSP is PDH; bypass from infrarenal aorta and iliac arteries.

* Reoperations after earlier reconstruction are to be coded in NCSP as PDU.74-99.

identification-number for each patient. The selection from this registry could, therefore, easily be controlled for double case registrations, which we did not find. In the vascular registry, the design of the database allows for double registration of both operations and patients, as there is no unique patient key. If two cases of the same age and sex, coming from the same county, were operated in the same hospital on the same day with exactly the same procedure-code and similar diagnoses, only one of these records was included in the evaluation.

Completeness of the reporting to our vascular registry was estimated according to numbers of the administrative registry assuming a nearly complete registration in the latter.

To correct for overall completeness of reporting from each hospital when studying reported in-hospital deaths in the vascular registry, we defined relative completeness as; completeness of reported in-hospital deaths divided by overall completeness of reporting to the vascular registry for each hospital.

The retrospective control of one local vascular database was done by additional searches through the operation registry and the anaesthesiological registry of one member-hospital. All patients with any recorded data indicating AAA was evaluated. The recorded diagnosis and procedure-codes were controlled in the medical record for each individual patient.

Data were retrieved from the two registries on Microsoft Excel® files and handled in Microsoft Access®. For statistical analysis we used SPSS 11.0 for Windows®. The investigation was approved by the local ethics committee.

Results

Completeness and consistency of data

For the period 2001 and 2002, we identified 1544 cases

Table 1B. Relevant ICD-10 diagnosis codes for the study of AAA-treatment

ICD-10	Text*
Section I71	Aortic aneurysm and aortic dissection
I71.3	Abdominal aortic aneurysm with rupture
I71.4	Abdominal aortic aneurysm without information of rupture
I71.8	Aortic aneurysm with undefined localisation, with rupture
I71.9	Aortic aneurysm with undefined localisation and without information of rupture
Section I72	Other aneurysm
I72.3	Aneurysm of iliac artery
I72.9	Aneurysm with undefined localisation
Section I70	Atherosclerosis
I70.0	Atherosclerosis of the aorta
I70.2	Atherosclerosis of artery in limb

* Translation of the Norwegian version.

with the relevant procedure-codes in the national administrative registry (NPR) reported from 29 different hospitals. Of these, 21 cases were excluded because the data were consistent with treatment for isolated iliac aneurysm or stent grafting of aorto-iliac obstructive disease. This left a total number of 1523 treatments for AAA in this registry (Table 2).

A corresponding search in the national vascular registry (NorKar) showed 1055 cases treated for AAA in 17 member hospitals after the exclusion of 18 case-doublets together with 15 cases for which coding was consistent with other indications for surgery. Thus, 69% of the total national number of treatments for AAA was reported to the vascular registry and within the member hospitals the completeness of reporting was 84%. Endoscopic aortic operation (PDS10) was not performed in any cases.

The number of cases where procedure- and diagnosis-code was consistent according to Table 1A, was 1417 (93.0%) for NPR and 990 (93.8%) for NorKar (Table 3). In non-member hospitals there was consistency in 242 of 265 cases (91.3%). For several hospitals the consistency of the data reported differed between NPR and NorKar.

In the administrative registry 362 cases (23.8%) had ruptured AAA according to their ICD-10 diagnosis. One thousand and fifty five cases (69.3%) were coded as having non-ruptured AAA, while in 106 cases (7.0%) the diagnosis-codes were not suited for classification of rupture status. In the vascular registry the number of cases with ruptured AAA was 244 (23.1%) according to the diagnosis, 746 (70.7%) were non-ruptured, while 65 cases (6.2%) could not be classified.

Completeness of ruptured cases was 72.5% in the vascular registry and 86.1% for non-ruptured cases. For cases where status of rupture could not be assessed from the ICD-10 coding, completeness was 78.3%.

According to data from the vascular registry, 34 procedures (3.2%) were secondary to a former vascular procedure. In the Norwegian patient registry there is no variable to discriminate between primary and secondary procedures in a similar way.

Table 2. Operations for AAA performed in Norway according to Norwegian patient registry, NPR, and in 17 member-hospitals according to the Norwegian vascular registry, NorKar, during the period 2001–2002

Operation	NPR, *N* (%)	NorKar, *N* (%)
Tube graft	885 (58)	633 (60)
Bifurcated graft	491 (32)	320 (30)
EVAR	132 (9)	91 (9)
Combinations	15 (1)	11 (1)
Total	1523	1055

Mortality

The reporting of in-hospital mortality varied strongly between different hospitals and between the administrative registry and the vascular registry within each individual hospital (Table 4). Some hospitals reported less than 50% of their in-hospital deaths to the vascular registry. Compared to numbers from the administrative registry, only 60% of patients who died in the hospital were reported to the vascular registry by the members, and the relative completeness of reporting in-hospital deaths was 72.3% (95% CI 65.2–79.4).

In the administrative registry, the crude national in-hospital mortality was 33.7% for ruptured and 5.0% for non-ruptured AAA (Table 5). In the vascular registry the corresponding mortality rates were 29.9% for ruptured and 3.1% for non-ruptured AAA, respectively, and mortality in member hospitals did not seem to differ from non-member hospitals.

Work-up of one local vascular database

The detailed evaluation involving one NorKar Local Registry showed that 134 patients met the search criteria (PDG10-24 or PDQ10). One patient was correctly coded, but not included because he was treated for an isolated iliac aneurysm. Of the remaining 133, two were found to be case-doublets, while further five patients were incorrectly included due to false procedure-codes (Table 6). The evaluation also revealed 10 patients in the database with registered data that could implicate AAA, but who had been lost to inclusion due to false coding of procedures. Further, we examined the records of 20 patients coded as operation for aorto-iliac occlusion with implantation of a bifurcated vascular graft (PDH20-24), but they were all correctly coded. By matching of the database with the local anaesthesiology registry, we found three patients that met the inclusion criteria, but who had been lost to registration in the vascular registry. Thus, the completeness of this NorKar local registry was 90.6 and 5.3% of the registered cases were falsely coded or doublets.

Discussion

Completeness of data

The reporting to the Norwegian patient registry is likely to be nearly complete because the reporting is compulsory for formally discharging a patient from hospital and to get reimbursement from the health

Table 3. Completeness of the Norwegian vascular registry, NorKar, compared to Norwegian patient registry, NPR, and consistency between diagnosis and procedure-codes in the two registries, for patients treated for AAA in Norway during the period 2001–2002

Hospital	Number of operations 2001–2002*	Completeness	Procedure-diagnosis-consistency	
		NorKar/NPR (%)	NPR (%) (range)	NorKar (%)
NorKar members				
A	>100	87.7	96.6	96.0
B	>100	93.7	95.4	97.0
C	>100	77.0	95.1	95.7
D	>100	94.1	95.1	96.9
E	>100	92.6	92.6	92.7
F	40–100	94.8	81.7	88.2
G	40–100	73.6	90.3	92.6
H	40–100	97.4	98.8	89.9
I	40–100	80.9	91.2	89.1
J	40–100	99.0	94.8	96.9
K	10–39	100	95.7	81.6
L	10–39	50.0	100	100
M	10–39	6.4	91.6	100
N	10–39	100	92.3	96.2
O	10–39	100	97.9	97.9
P	10–39	41.4	92.7	100
Q	10–39	13.8	92.8	96.0
Non-members†				
R1-2	40–100	–	91.4 (87.8–95.3)	–
R3-6	10–39	–	91.5 (87.9–97.3)	–
R7-12	<10	–	88.9 (50–100)	–
NorKar members	1258	83.9	93.4	93.8
Non-members	265	–	91.3	–
All	1523	69.3	93.0	–

* According to NPR numbers.
† Hospitals that were not members of NorKar are named R1-12.

Table 4. Reporting of in-hospital deaths following AAA repair for individual hospitals according to the Norwegian vascular registry, NorKar and Norwegian patient registry, NPR, and completeness of reporting in-hospital deaths to NorKar, in the years 2001–2002

Hospital	Number of operations 2001–2002*	Crude mortality NPR (%)	Crude mortality NorKar (%)	Completeness* of reported deaths (%)	Relative completeness† % (95% CI)
NorKar members					
A	>100	15.8	8.0	44.4	50.6
B	>100	9.8	6.0	57.1	61.0
C	>100	7.4	9.6	100	130.0
D	>100	11.7	7.1	58.3	61.3
E	>100	15.5	16.8	100	108.0
F	40–100	1.4	1.5	100	104.4
G	40–100	19.4	3.8	14.3	19.4
H	40–100	18.5	17.7	93.3	95.7
I	40–100	16.2	3.6	18.2	22.5
J	40–100	7.2	5.2	71.4	72.2
K	10–39	18.4	15.8	85.7	85.7
L	10–39	10.0	0	0	0
M	10–39	6.4	0	0	0
N	10–39	11.5	15.4	100	133.3
O	10–39	4.2	4.2	100	100
P	10–39	17.1	17.7	42.9	103.4
Q	10–39	27.6	0	0	0
Non members‡					
R1-2	40–100	8.7	–	–	–
R3-6	10–39	11.9	–	–	–
R7-12	<10	22.2	–	–	–
Members	1258	12.3	8.9	60.6	72.3 (65.2–79.4)
Non-members	265	10.6	–	–	–
Total	1523	12.0	–	–	–

* According to NPR.
† Relative completeness = reported in hospital deaths (%)/overall completeness of reporting (%).
‡ Hospitals that were not members of NorKar are named R1-12.

Table 5. Reporting of in-hospital deaths for ruptured and non-ruptured AAA in the Norwegian vascular registry, NorKar and Norwegian patient registry, NPR, in the years 2001–2002

Hospital	Number of operations 2001–2002*	Rupture NPR (%)	Rupture NorKar (%)	Non-rupture NPR (%)	Non-rupture NorKar (%)
NorKar members					
A	>100	30.4	21.2	4.7	1.6
B	>100	27.3	19.4	3.9	0
C	>100	28.0	30.4	2.2	3.0
D	>100	42.9	28.6	6.0	3.7
E	>100	41.2	53.6	8.7	8.1
F	40–100	0	5.9	2.4	0
G	40–100	40.0	10.0	8.9	2.6
H	40–100	50.0	45.5	5.4	6.1
I	40–100	46.7	14.3	8.5	2.4
J	40–100	25.9	16.7	0	0
K	10–39	30.8	30.0	13.0	9.5
L	10–39	100	0	0	0
M	10–39	28.6	0	2.8	0
N	10–39	20.0	30.0	7.1	6.7
O	10–39	33.3	28.6	0	0
P	10–39	83.3	100	3.1	6.7
Q	10–39	36.4	0	15.4	0
Non members†					
R1-2	40–100	25.0	–	4.7	–
R3-6	10–39	33.3	–	3.7	–
R7-12	<10	33.3	–	0	–
Members	1258	33.7	29.9	5.0	3.1
Non-members	265	29.6	–	4.2	–
Total	1523	33.1	–	4.8	–

In 6.1% (65 patients) in NorKar and 6.9% (105 patients) of the patients in NPR presence of aneurysm rupture could not be decided from the coding.

* According to NPR.

† Hospitals not being members of NorKar are named R1-12.

authorities. In our national vascular registry there is no economic motivation or administrative demands for reporting to the registry. The participation in the registry is not compulsory and the required workload and resources must be covered by each participating hospital. This can explain some of the discrepancy in numbers reported to the two registries for some member hospitals. Although data may be complete, there is also the possibility that the administrative registry may be overestimating the number of cases. Transfer of patients from one hospital to another postoperatively, may result in reporting of the same procedure-codes in both hospitals, and thus falsely increase the numbers of procedures reported. Due to the anonymous capacity of the data, the presence or magnitude of such over-reporting could not be assessed by this study. During recent years there has been criticism of the coding done by Norwegian hospitals, and the Office of the Auditory General of Norway has concluded that false coding has artificially raised the reimbursement to some hospitals. Because, operation for AAA is a demanding procedure, which requires large resources, over-reporting of this procedure may give economical benefits for the hospital.[9] It is our opinion that completeness of data cannot be firmly established before both registries include patient-identifiable data. This will improve the quality of both registries by making matching of data on patient level possible.

Table 6. Control of data on AAA-treatment in one local vascular database (NorKar Local Registry) in the period 2001–02

	N (%)
Patients included from the search in the NorKar local registry	133
Falsely included*	−7 (5.3)
NorKar patients lost to inclusion due to false procedure-code†	10 (7.2)
Patients lost to NorKar‡	3 (2.2)
Total 2001–02	139

* Two doublets.

† Found by controlling of patients registered in the NorKar local registry with data implicative of AAA who did not meet the search criteria on procedure-code.

‡ Found in the local anaesthesiological registry.

Diagnosis-procedure-consistency

Lack of procedure-diagnosis-consistency is a major problem since both the procedure-code and the diagnosis-code may be false. Misclassified patients may, therefore, either be lost or falsely included. The number of patients in this study may be overestimated because, cases with procedure-codes for AAA treatment but no ICD-10-code of AAA are included. However, reported patients with false procedure-codes may on the other hand have been lost to inclusion. To improve the quality when entering the data, algorithms and control-mechanisms of consistency should be implemented in the registration software. A study has also indicated that doctors' participation has raised the quality of coding,[10] but this has not guaranteed for satisfactory data quality in the Norwegian vascular registry.

Reporting of in-hospital mortality

Hospital mortality or 30d mortality are the most reproducible data when reporting on early results after treatment for AAA. This audit shows that there is great discrepancy between mortality reported by various hospitals in two different registries. The relative completeness of reported in-hospital deaths of 72%, strongly suggests a systematic underreporting to the vascular registry. There can be several reasons for this finding, and the explanation may differ between hospitals. Different routines when formally discharging patients that die during the hospital stay compared to those who survive may be one of the reasons for the underreporting to the registry. Furthermore, patients dying from complications after an AAA operation may be taken care of by other groups of personnel like anaesthesiologists or cardiologists who may be unaware of the vascular registry. Finally, one cannot exclude the possibility that some departments are less willing to report unfavourable results. No matter the reason, early mortality is probably the most crucial quality parameter in treatment of AAA, and it is the responsibility for the chief of any vascular department to make sure that the numbers presented in any registry are correct.

Validation of one local vascular database

The reason for doing the separate control of one NorKar Local Registry was mainly to estimate the efficacy of our inclusion criteria based on the defined procedure-codes. The control showed that 9.4% of all the patients operated for AAA, were not identified by our search in the local vascular database using our inclusion criteria. The possibility that patients have been lost to all hospital registries, and thus lost to our control, is probably small. The finding that 7.2% were registered with false codes, and that only 2.2% had not been recorded indicates that the greatest potential for improvement is in quality control of coding and data-entry. In addition, regularly matching of the local vascular database with other registries in the hospital would probably improve the completeness of data considerably.

Problems in coding

Since endovascular aortic aneurysm repair (EVAR), was established in Norway 1995, the coding for stent-grafting for AAA has been the same as the code used for aortic stent-implantation in atherosclerosis obliterans (ASO), although the devices are different. In contrast, the codes for implantation of bifurcated vascular grafts for aneurysm and obliterating atherosclerosis are divided into two different categories (PDG and PDH) according to indication, although the general surgical methods are similar and that indication is not supposed to be an inherent part of the NSCP system. The fact that it is for implantation of bifurcated graft, means that patients treated for concomitant AAA and ASO, cannot be coded for both indications. This may have resulted in an underestimation of concomitant treatment of aorto-iliac occlusion in patients treated for AAA.

Secondary procedures are relatively rare in open surgery for AAA, but have become quite common after the introduction of EVAR.[11] In the vascular registry there is a unique variable to classify the procedure as primary or secondary. In our national administrative registry there is no variable for classification of the procedure as primary or secondary to a previous operation for AAA. However, when assessing the procedure-codes we observed an inconsequent coding of secondary procedures, and thus we were unable to compare the registries according to this capacity. Clearer guidelines in coding and proper instructions of participating surgeons therefore seem mandatory.

Registry based studies

As medical registries and registry based reports are getting more common, we have tried to demonstrate some of their limitations and the need for quality control of data. Our study has shown that important information on AAA treatment can be attained from

the two different registries. Early mortality, length of stay in hospital, numbers treated and age of treated patients is information that can be achieved from a public patient registry like NPR. For data on risk factors, surgical details, results and case-mix, a vascular registry based on reproducible data filled in by qualified staff is mandatory.

There is need for defined strategies to assure for the correctness of data. These may include proper instruction of attending physicians, controlled entry of data and algorithms to ensure consistency of data. One possible strategy to obtain completeness of data as demonstrated in our study, is matching of different registries. To be able to check up on and further correct false registrations, patient identifiable data is mandatory. Otherwise matching can only provide an estimate for data quality. To avoid that assumptions are based on systematic weakness of data like under-reported in-hospital deaths, registry based studies must address the completeness and limitations of the data presented.

Conclusion

The evaluation showed an underreporting of procedures in patients with AAA to the national vascular registry (NorKar) relative to the national administrative registry (NPR), and demonstrates a need for better control of procedure-diagnosis consistency in both registries. Consistency of data could probably be improved by introducing algorithms in the entry software of the databases. There seems to be a substantial underreporting of early deaths in the vascular registry that calls for further investigations. Finally, we suggest that the two registries are made patient identifiable to facilitate improvement of data quality in general.

References

1 Health Technology Assessment: An introduction. (In Norwegian) Norwegian center for health technology assessment. Report no 8, 2003, p. 58.
2 Kantonen I, Lepäntalo M, Salenius JP, Forsström E, Hakkarainen T, Huusari H *et al*. Auditing a Nationwide Vascular Registry—the 4-year Finnvasc experience. *Eur J Vasc Endovasc Surg* 1997;**14**:468–474.
3 Laustsen J, Jensen LP, Hansen AK, The Danish National Vascular Registry. Accuracy of clinical data in a population based vascular registry. *Eur J Vasc Endovasc Surg* 2004;**27**:216–219.
4 Troëng T, Bergqvist D, Einarsson E, Elfström J, Nordgren L. Experiences from SWEDVASC/VRISS. *Ann Chir Gynaecol* 1992; **81**:248–252.
5 Lepäntalo M, Salenius JP, Luther M, Ylönen K. Introduction of a population-based vascular registry: validity of data and limitations of registration. *Br J Surg* 1994;**81**:979–981.
6 The international statistical classification of diseases and related health problems (ICD-10). ISBN 82-07-01992-1, 1998, (Norwegian).
7 Classification of surgical procedures, (NSCP) ISBN 82-7846-052-3 (Norwegian translation of the NOMESCO classification of surgical procedures), 1999.
8 Classification of surgical procedures. NOMESCO Publications No 46, 1996.
9 Bjerkestrand S. The office of the auditory general is commenting on false coding practice. *Tidsskr Nor Laegeforen* 2002;**122**:741 [Norwegian].
10 Yeoh C, Davies H. Clinical coding: completeness and accuracy when doctors take it on. *BMJ* 1993;**306**:972.
11 Sampram ESK, Karafa MT, Mascha EJ, Clair DG, Greenberg RK, Lyden SP *et al*. Nature, frequency, and predictors of secondary procedures after endovascular repair of abdominal aortic aneurysm. *J Vasc Surg* 2003;**37**:930–937.

Accepted 2 February 2005
Available online 4 March 2005