

Prudent Use of Antibacterial Drugs in Norwegian Aquaculture?

Surveillance by the Use of Prescription Data

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Grave K, Lillehaug A, Lunestad BT, Horsberg TE: Prudent use of antibacterial drugs in Norwegian aquaculture? Surveillance by the use of prescription data.

Acta vet. scand. 1999, 40, 185-195. – Antibacterial drug treatment in aquaculture during 1991-1996 was investigated using prescription data provided by the Norwegian Government Fish Inspection and Quality Control Service (NFCS). The majority of prescriptions (n = 5401) were for Atlantic salmon and rainbow trout (salmonids), while 383 prescriptions were for other species. Of the 13 different single substances or combinations prescribed during the study period, only 5 were approved for or had been subjected to clinical trials in salmonids. Of the prescriptions for the salmonids, 99% were for approved drugs or drugs subjected to clinical trials. The major proportion of the antibacterial drugs prescribed for other fish species were drugs which were approved for or which had been subjected to clinical trials in salmonids. In all fish species, the prescribing of antibacterial drugs which were neither approved for nor had been subjected to clinical trials was mainly for fish far below slaughter weight. The prescription data were validated against the drug statistics from the wholesalers and feed mills. It was concluded that the data indeed represented antibacterial drug prescribing in Norwegian aquaculture. The prescribing of antibacterial drugs proved to be almost completely reported to NFCS, which is responsible for the control of drug residues in farmed fish in Norway.

“off-label” use; validation; wholesalers; statistics; residues; control.

Introduction

The farming of Atlantic salmon and rainbow trout has totally dominated the Norwegian fish farming industry so far. Antibacterial drugs have thus only been approved for use in these fish species. In the 90's, a small-scale production of fish species other than Atlantic salmon and rainbow trout has emerged. However, because of the limited production, no antibacterial drugs has as yet been specifically approved in Norway for use in these fish species (Tørisen 1996).

In Norway, all drugs intended for therapeutic use in farmed fish have to be prescribed by veterinarians. Moreover, such drugs have to be dispensed from a pharmacy or, for medicated feed, from a feed mill authorised by the Directorate of Health. The authorised feed mills are obliged to employ a pharmacist to be responsible for the distribution of the medicated feed. Overall sales data of antibacterial drugs for use in farmed fish, including those mixed in feed, sold by the feed mills, are recorded by the state-

owned drug wholesaler, the Norwegian Medicinal Depot AS (NMD). However, the wholesaler or feed-mill statistics do not provide any information concerning the fish species treated (Grave 1991, Grave et al. 1996, 1997). Furthermore, antibacterial drugs approved for use in other animals or human medicine may also be used in farmed fish of all species. These, however, are recorded by the wholesalers as sold for use in terrestrial animals or humans, respectively. Overall information about therapeutic profiles in the different farmed fish species in Norway has thus so far not been available.

To support the Norwegian Government Fish Inspection and Quality Control Service (NFCS) in the control of drug residues, a new surveillance programme for drug prescribing in fish farming was introduced in Norway in 1989 (Directorate of Health 1988). This programme requires that both the prescribing veterinarian and the dispensing pharmacy or feed mill have to send a copy to NFCS of each prescription for drugs intended for use in farmed fish within one week and one month, respectively. In connection with the introduction of the new surveillance programme, an authorised standard prescription form was introduced. The veterinarians have to use this form when prescribing drugs for use in farmed fish (Mork & Jøldal 1988). In addition to the name of the drug preparation, the fish species, fish weight, and indication for use, have to be given on the prescription. NFCS routinely computerises all information given on the prescription forms and are thus creating a nation-wide database for drug treatment in Norwegian fish farming (Bangen et al. 1994). This information makes the NFCS able to monitor that the withdrawal periods for the different drugs are complied with.

The main objective of this study was to investigate the prescribing patterns of antibacterial drugs in the different farmed fish species in

Norwegian fish farming during 1991-1996 using prescription data from the NFCS. The compliance by veterinarians with the reporting requirements concerning the prescribing of drugs in farmed fish was also examined.

Materials and methods

Prescription data for antibacterial drugs for the period 1991-1996 were collected from NFCS. For the purposes of the present study the following prescription data were compiled into a database: antibacterial drug, amount prescribed, diagnosis, fish species, fish weight, and date (year). Only prescriptions submitted by veterinarians were included, copies submitted by the feed mills or pharmacies being excluded. A total of $N = 5\,808$ prescriptions were included in the study. Prescriptions which lacked information about the fish species ($n = 24$) were excluded in the analysis of "off-label" use of antibacterial drugs in the different farmed fish species. "Off-label" use was defined as the use of an antibacterial drug substance in a fish species for which it was neither approved, nor had it been subjected to clinical trials organised by the pharmaceutical industry. In the present study, the term salmonids include Atlantic salmon and rainbow trout. The fish species arctic char (*Salvelinus alpinus*), Atlantic cod (*Gadus morhua*), European eel (*Anguilla anguilla*), halibut (*Hippoglossus hippoglossus*), European seabass (*Dicentrarchus labrax*), turbot (*Scophthalmus maximus*), and wolf-fish (*Anarhichas lupus*) are designated as other fish species.

Overall sales data of antibacterial drugs for use in farmed fish, including antibacterial drugs mixed in feed, are recorded by the state-owned drug wholesaler Norwegian Medicinal Depot AS (NMD). That the prescription data were representative for the study period was validated by comparing the prescribed amounts of

antibacterial drugs approved for use or subjected to clinical trials in farmed fish, calculated from prescriptions reported to NFCS, with the overall sales statistics of these drugs. Sales statistics from wholesalers and feed mills of antibacterial drugs approved for use in fish farming in Norway were collected from NMD. Information about which antibacterial drugs were approved for use in the indicated species was obtained from relevant editions of the Norwegian Compendium on Veterinary Medicines (Tørisen 1990, 1992, 1994, 1996). Data about the production of different fish species in Norwegian aquaculture from 1991 to 1996 were provided by Directorate of Fisheries (Aalvik 1997).

The units of measurement chosen were kg active substance and number of prescriptions.

Results

The amounts of antibacterial drugs prescribed for use in Norwegian aquaculture were reduced from 24 063 kg active substance in 1992 to 983 kg in 1996 (Table 1). In the study period, 13 different single or combination antibacterial preparations were prescribed, and of these, 5 were approved for use or had been subjected to clinical trials in Atlantic salmon and rainbow trout. Eight of the single or combination preparations prescribed were neither approved nor subjected to clinical trials in any fish species (Table 1-4). One of these preparations (procaine penicillin + dihydrostreptomycin) is recommended for the treatment against bacterial gill diseases in fry, parr and smolt (salmonids). The prescribing of antibacterial drugs intended for use in Atlantic salmon and rainbow trout is shown in Tables 2 and 3. In these fish species, 99% of the prescriptions were for approved drugs. Of the "off-label" prescriptions ($n = 47$) of antibacterial drugs intended for use in Atlantic salmon and rainbow trout, 22 were for the

combination preparation procaine penicillin + dihydrostreptomycin (Table 3). Of these prescriptions, 21 were intended for use in farmed salmon with a weight lower than 500 g and one prescription was for farmed salmon with a body weight of 700 g. The main indication given on the prescriptions for this combination preparation was bacterial gill disease (Table 3).

In 1991, 93% ($n = 1\ 687$) of the prescriptions for antibacterial drugs were for Atlantic salmon, 1% for rainbow trout and 6% for other fish species (Tables 2, 4). The corresponding figures in 1996 were 59%, 21% and 20% ($n = 158$). In 1996, 96% (982 kg) of antibacterial drugs prescribed were for Atlantic salmon and rainbow trout, while 4% (42 kg) were for the fish species other than salmon and trout. The proportion of prescriptions for the other fish species increased 3 times from 1991 to 1996. However, the annual number of prescriptions in this group decreased from 95 to 31 during the same period.

None of the antibacterial drugs prescribed for use in the other fish species ($n = 383$), was approved for use in these species (Table 4). For all these fish species, except for turbot, drugs only approved for use in Atlantic salmon and rainbow trout were prescribed.

Sales figures from wholesalers and feed mills of antibacterial drugs approved for use in farmed fish, and the amounts prescribed on prescriptions reported to NFCS during the period 1991-1996, are shown in Table 5. The production of different fish species in Norwegian aquaculture from 1991 to 1996 are given in Table 6.

Discussion

Materials and methods

The sales figures for antibacterial drugs recorded by the Norwegian Medicinal Depot AS (NMD) presented in this study are based on annual sales statistics from the feed mills and

Table 1. Amounts, in kg active substance, and number of prescriptions (No #) of antibacterial drugs prescribed for use in farmed fish (all species) in Norway, split into single and combinations of substances. Prescription data (N = 5 808) were collected from the Norwegian Government Fish Inspection and Quality Control Service.

Active substance	1991		1992		1993		1994		1995		1996	
	Kg	No #	Kg	No #	Kg	No #	Kg	No #	Kg	No #	Kg	No #
Benzyl penicillin ¹	0.5	1	2	3	4	3	0	0	2	2	3	2
Difloxacin ²	0	0	0	0	13	3	0	0	0	0	0	0
Dihydrostreptomycin ¹	0	0	0	0	0.3	1	0	0	0.4	2	0	0
Enrofloxacin ¹	0	0	0	0	0.2	2	0.1	2	0.1	2	0	0
Florfenicol ²	0	0	32	7	58	15	9	13	65	9	64	20
Flumequine ²	2 352	233	10 183	1 189	2 380	300	451	95	166	88	103	45
Fumagillin ¹	6	6	6	1	0	0	0	0	0	0	0	0
Furazolidone ¹	208	41	32	18	105	4	9	11	2	2	0	0
Oxolonic acid ²	11 301	690	8 264	655	2 374	178	657	87	2 892	214	797	83
Oxytetracycline ²	5 079	342	3 848	292	532	47	86	33	67	14	6	5
Procaine penicillin+DHS ^{3,4}	4	2	26	11	3	4	1	2	0	1	9	4
Sulfadimethoxine+ormethoprim ²	0	0	14	2	0	0	0	0	0	0	0	0
Trimethoprim+sulfadiazine ²	5 112	382	5 127	573	655	64	3	1	0	1	1	1
Total	24 063	1 697	27 534	2 751	6 125	621	1 216	244	3 195	335	983	160

¹ Not approved = neither approved nor subjected to clinical trials in any farmed fish species; ² Approved = approved for use or subjected to clinical trials in Atlantic salmon and/or rainbow trout; ³ Recommended = recommended for use in fry, parr and smolt.

Table 2. Total number of prescriptions (n = 5401) for antibacterial drugs issued for Atlantic salmon (salmon) and rainbow trout (trout) in Norwegian fish farming, split into single and combinations of substances. Prescription data were collected from the Norwegian Government Fish Inspection and Quality Control Service.

Active substance	1991		1992		1993		1994		1995		1996	
	Salmon	Trout	Salmon	Trout	Salmon	Trout	Salmon	Trout	Salmon	Trout	Salmon	Trout
Benzyl penicillin ¹	1	0	3	0	3	0	0	0	2	0	2	0
Difloxacin	0	0	0	0	3	0	0	0	0	0	0	0
Dihydrostreptomycin ¹	0	0	0	0	1	0	0	0	2	0	0	0
Enrofloxacin ¹	0	0	0	0	2	0	2	0	2	0	0	0
Florfenicol	0	0	7	0	15	0	10	0	9	0	12	7
Flumequine	221	0	1 139	20	252	13	35	20	29	12	14	6
Fumagillin ¹	0	0	1	0	0	0	0	0	0	0	0	0
Furazolidone ¹	2	0	1	0	1	0	0	0	0	0	0	0
Oxolonic acid	668	5	643	3	167	5	70	13	180	30	58	20
Oxytetracycline	305	11	269	7	36	3	14	2	8	1	2	0
Procaine penicillin+DHS ^{2,3}	2	0	8	3	2	0	2	0	0	1	4	0
Sulfadimethoxine+ormethoprim	0	0	2	0	0	0	0	0	0	0	0	0
Trimethoprim+sulfadiazine	374	4	560	6	56	5	1	0	1	0	1	0
Total	1 573	20	2 633	39	538	26	134	35	233	44	93	33

(¹) Not approved = neither approved nor subjected to clinical trials in any farmed fish species; (²) DHS = dihydrostreptomycin. (³) Recommended for use in fry, parr and smolt.

Table 3. Prescriptions (n = 47) for «off-label» (neither approved nor subjected to clinical trials) antibacterial drugs issued for Atlantic salmon and rainbow trout in Norwegian farming, split into single and combinations of substances. Prescription data were collected from the Norwegian Government Fish Inspection and Quality Control Service.

Species	Active substances	Diagnose	1991	1992	1993	1994	1995	1996
Atlantic salmon	Benzyl penicillin	Bacterial gill disease	0	0	2	0	1	1
		Fry disease	1	3	0	0	0	0
		Furunculosis	0	0	1	0	0	0
		Unknown ¹	0	0	0	0	1	1
	Dihydrostreptomycin	Bacterial gill disease	0	0	1	0	2	0
	Enrofloxacin	Bacterial infection	0	0	0	2	2	0
		Furunculosis	0	0	2	0	0	0
	Fumagillin	Furunculosis	0	1	0	0	0	0
	Furazolidone	Bacterial infection	0	0	1	0	0	0
		Cold-water vibriosis	1	1	0	0	0	0
	Procaine penicillin+DHS ²	Hexamitosis	1	0	0	0	0	0
		Bacterial gill disease	2	6	1	1	0	0
		Bacterial infection	0	1	0	0	0	0
		Fin rot/ulcers	0	0	1	0	0	2
		Furunculosis	0	1	0	0	0	0
		Unknown	0	0	0	1	0	0
		Winter ulcers	0	0	0	0	0	2
		Bacterial gill disease	0	3	0	0	1	0
Rainbow trout	Procaine penicillin+DHS ²	Bacterial gill disease	0	3	0	0	1	0
Total			5	16	9	4	7	6

¹ Diagnose is not given.

² DHS = dihydrostreptomycin.

from the national drug wholesalers to the pharmacies. The feed mills dispense antibacterial drugs directly to the fish farmers, and annual sales reported by the feed mills thus represent the amounts sold for use in farmed fish each year. The pharmacies dispense premixes for on-farm mixing of medicated feed. It has been shown that the practice of on-farm mixing of medicated feed declined substantially during the period 1992-1994 (Grave et al. 1996), a trend that continued in 1995 and 1996 (Rønning M, personal communication 1997). This was due to the introduction in 1992 of new regulations in Norway on the prescribing of antibacterial drugs to farmed fish (Bangen et al. 1994). Moreover, the pharmacies normally have a short storage period for these preparations. It is

concluded that sales figures reported by the wholesalers and feed mills give a good estimate of the prescribing of the drugs in question each year in the study period.

In the present study, it was found that the amounts prescribed of antibacterial drugs calculated from prescriptions recorded by the NFCS were in the same range as the sales figures recorded by the NMD. For some substances and years, the sales reported by the NMD of antibacterial drugs were slightly higher than the amounts calculated from the prescription material. As the NFCS data are based on the amounts prescribed, the NFCS figures will sometimes be higher than the actual amounts sold. Despite these minor pitfalls, it is, nevertheless, concluded that the prescription

Table 4. Prescriptions (n = 383) for antibacterial drugs issued for fish species other than salmon and trout in Norwegian aquaculture, split into single and combinations of substances. Data were collected from Norwegian Government Fish Inspection and Quality Control Service.

Year	Active substances	Arctic char	Atlantic cod	European eel	Halibut	European seabass	Turbot	Wolf-fish	Total
1991	Flumequine	1	1	0	0	0	7	0	9
	Fumagillin	0	0	0	0	0	6	0	6
	Furazolidone	0	0	0	0	0	38	0	38
	Oxolonic acid	2	2	0	0	0	11	0	15
	Oxytetracycline	5	3	0	0	0	11	0	23
1992	Trimethoprim+sulfadiazine	2	1	0	0	0	1	0	4
	Flumequine	4	5	2	1	0	13	0	25
	Furazolidone	0	0	0	0	0	17	0	17
	Oxolonic acid	3	4	0	0	0	1	1	9
	Oxytetracycline	2	5	0	2	1	4	2	16
1993	Trimethoprim+sulfadiazine	0	0	0	1	0	6	0	7
	Flumequine	1	2	14	1	0	16	0	34
	Furazolidone	0	0	0	0	0	3	0	3
	Oxolonic acid	0	3	0	0	0	0	0	3
	Oxytetracycline	0	6	0	2	0	0	0	8
1994	Procaine penicillin+DHS ¹	0	0	0	0	0	2	0	2
	Trimethoprim+sulfadiazine	0	0	0	0	0	1	0	1
	Florfenicol	0	0	0	2	0	1	0	3
	Flumequine	0	4	1	8	0	26	0	39
	Furazolidone	0	0	0	0	0	11	0	11
1995	Oxolonic acid	0	3	0	1	0	0	0	4
	Oxytetracycline	0	2	0	13	0	0	2	17
	Flumequine	0	4	0	13	0	30	0	47
	Furazolidone	0	0	0	0	0	2	0	2
	Oxolonic acid	0	3	0	1	0	0	0	4
1996	Oxytetracycline	0	0	0	3	0	0	2	5
	Florfenicol	0	0	0	1	0	0	0	1
	Flumequine	0	5	2	8	0	7	1	23
	Oxolonic acid	0	2	0	2	0	0	0	4
	Oxytetracycline	0	0	0	3	0	0	0	3

¹ DHS = dihydrostreptomycin.

Table 5. Sales figures, in Norway, from wholesalers and feed mills (NMD) and the amounts prescribed on prescriptions reported to the Norwegian Government Fish Inspection and Quality Control Service (NFCS) of antibacterial drugs, in kg active substance, approved for use or subjected to clinical trials in farmed Atlantic salmon and rainbow trout.

Active substances	1991		1992		1993		1994		1995		1996	
	NMD	NFCS	NMD	NFCS	NMD	NFCS	NMD	NFCS	NMD	NFCS	NMD	NFCS
Florfenicol	0	0	0	32	56	58	14	9	64	65	64	64
Flumequine	3 837	2 352	9 833	10 183	2 177	2 380	227	451	182	166	105	103
Oxolinic acid	11 400	11 301	7 687	8 264	2 554	2 374	811	657	2 800	2 892	841	797
Oxytetracycline	5 751	5 079	4 113	3 848	583	532	341	86	70	67	27	6
Trimethoprim+sulphadiazine	5 679	5 112	5 852	5 127	696	655	3	3	0	0	0	1
Total	26 667	23 844	27 485	27 454	6 066	5 999	1 396	1 206	3 116	3 190	1 037	971

data from the NFCS indeed represent the prescribing of drugs used in farmed fish during the study period. This present study has shown that Norwegian veterinarians comply with the requirement to report antibacterial drug use to the NFCS.

Use of antibacterial drugs during 1992-1996

The use of antibacterial drugs in Norwegian fish farming reached a peak in 1987 when the sales figures from the wholesalers and feed mills totalled about 49 tonnes active substance (Grave 1991). The major indication was cold-water vibriosis caused by *Vibrio salmonicida* in Atlantic salmon. Vaccines against this disease were introduced during 1987, and sales figures for antibacterial drugs fell considerably (Grave et al. 1996).

In 1989, furunculosis was endemic in several parts of Norway for the first time and caused severe losses, and again consumption of antibacterial drugs in fish farming increased. Vaccines based on antigens from *Aeromonas salmonicida* ss. *salmonicida*, introduced in 1989, were mainly bacterins containing aluminium salts as adjuvants, although non-adjuvanted vaccines intended for immersion were also used. Although farmed Atlantic salmon and rainbow trout were from then on vaccinated against the 3 dominant bacterial diseases, the treatment intensity of farmed fish continued to increase from 1989 to 1992. In 1993, the consumption of antibacterial drugs for use in farmed fish declined substantially compared to 1992 and has since remained at a low level. In the autumn of 1992, oil-adjuvanted vaccines containing antigens against furunculosis were introduced, this being the single most important cause of the substantial reduction in the use of antibacterial drugs in Norwegian fish farming which has occurred in the 90's (Markestad & Grave 1997). Other factors contributing to the decline in drug use are thought to be the introduction of improved management and husbandry practices in the fish farming industry, including an increased trend to separate different year-classes on different sites, improved hygienic procedures in each farm, stricter regulations concerning the movement of fish between regions, and a generally more responsible attitude towards dealing with infectious diseases in fish.

Table 6. Slaughtered weight (production) in Norwegian aquaculture during the period 1991-1996. The figures are generated by the Directorate of Fisheries, Bergen, Norway, and are given in metric tons measured as round weight.

Fish species	1991	1992	1993	1994	1995	1996
Atlantic salmon	155 000	141 000	170 000	207 000	265 000	301 430
Rainbow trout	5 700	6 500	8 970	14 570	14 700	22 270
Atlantic cod ¹	NA	232	367	561	289	198
Arctic char ¹	NA	185	136	241	298	200
Halibut ¹	0	0	11	63	134	138
Minor species ^{1,2}	NA ³	10	39	224	310	299
Total	160 700	147 927	179 523	222 659	280 722	324 535

¹ Estimated by calculated first hand value.

² Minor species includes European eel, European seabass, turbot and wolf-fish.

³ NA = not available.

"Off-label" use of antibacterial agents

The term "off-label" is normally applied for any use of a pharmaceutical product in a species, or for an indication, for which it is not registered. It was decided not to use this definition, as the statistics provided by NFCS only gave information about the active substances, not the specific products. In the present study, a more restricted definition of «off-label» use was chosen, namely use in a fish species for which the drug substance was neither approved, nor had it been subjected to organised clinical trials.

As many as 99% of the prescriptions for drugs for use in Atlantic salmon and rainbow trout were for antibacterial drugs approved for or subjected to clinical trial in these species. The "off-label" use of dihydrostreptomycin alone or in combination with procaine penicillin in these fish species is readily explained by a need for topical treatment against bacterial infections on gills and skin.

Dihydrostreptomycin has only been applied on fry, parr and smolts. The time-span from application until slaughter would therefore be as long as 1-2 years. The very limited use of enrofloxacin was due to subcutaneous administra-

tion of the injectable formulation of Baytril™ to brood-fish of 10 kg. Brood fish are not used for human consumption.

Although furazolidone may be an efficient drug, the ("off-label") use of this compound in salmonids in Norway ceased in 1993 due to recommendations from the Norwegian drug authorities. Furazolidone is now banned for use in food-producing animals in EU and several other countries.

The rationale behind the prescribing of benzyl penicillin against bacterial gill disease, "fry disease" and furunculosis on some occasions is hard to see. This antibiotic possesses little or no activity against the bacterial genera causing bacterial gill disease, *Cytophaga*, *Flexibacter* and *Flavobacterium* (Thurnbull 1993). The same is true for the pathogen causing furunculosis, *Aeromonas salmonicida* ss. *salmonicida* (Munro & Hastings 1993).

In 1996, 20% of the prescriptions for antibacterial agents for farmed fish in Norway were for farmed fish species other than salmon and trout, even though other fish species in 1996 accounted for no more than approximately 2.6% of the total Norwegian aquaculture production (Directorate of Fisheries 1987). Of the pre-

scriptions for other fish species, 86% were for fish below slaughter weight.

The major proportion of the antibacterial drugs prescribed for other fish species were drugs which were approved for, or which had been subjected to clinical trials in Atlantic salmon and rainbow trout. This may reflect the preparation market or that the veterinarians in their everyday practice 'feel safe' when prescribing 'an approved' drug. Both the rate of absorption and excretion of a drug may vary considerably between species. Thus, drugs used in a species for which it has not been approved for or subjected to clinical trial is not necessarily efficient although it is proved to be efficient in other species.

The prescribing of antibacterial drugs in Norwegian aquaculture proved to be almost completely reported to NFCS. It is therefore concluded that the prescription data recorded by NFCS indeed represented the antibacterial drug prescribing in Norwegian aquaculture in the study period. Apart from a few aberrations in the prescribing of drugs, the use in Atlantic salmon and rainbow trout of antibacterial drugs was found to be rational. The production of other species in Norwegian fish farming is increasing and in the future, antibacterial drug prescribing in these fish species should be surveyed by prescription studies to investigate if the prescribing patterns are prudent.

Acknowledgement

The authors wish to thank Anne Lise Haakonsen for entering the data into the computer.

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Sammendrag

Er forskrivningen av antibakterielle midler til oppdrettsfisk i Norge rasjonell? En undersøkelse basert på reseptdata.

I denne studien ble veterinærenes forskrivning av antibakterielle midler i norsk akvakultur i perioden 1991-1996 undersøkt basert på reseptdata samlet inn fra Fiskeridirektoratets kontrollverk. Veterinærenes rapportering av forskrivningen av antibakterielle midler til Fiskeridirektoratets kontrollverk ble funnet å være nær fullstendig og det ble derved konkludert med at datamaterialet representerte den reelle for-

skrivningen av slike midler i norsk fiskeoppdrett i studieperioden. De fleste forskrivningene ($n = 5\,401$) var på antibakterielle midler til Atlantisk laks eller regnbueørret, og 383 forskrivninger var til andre arter. For i alt 99% av forskrivninger til Atlantisk laks og regnbueørret var det ordinerte antibakterielle midlet enten godkjent til eller under klinisk utprøving for disse artene. Med unntak av et begrenset antall forskrivninger, kan det konkluderes at forskrivningen av antibakterielle midler til Atlantisk laks og regn-

bueørret i perioden 1991-1996 var rasjonell. Forskrivningen av antibakterielle midler som ikke var godkjente eller under klinisk utprøving til oppdrettsfisk var i hovedsak til fiskestørrelser langt under slaktevekt og representerte derved ikke noe næringsmiddelhygienisk problem. Det forventes at produksjonen av nye arter i norsk oppdrettsnæring vil øke sterkt. I fremtiden bør derfor forskrivningen av antibakterielle midler til nye arter overvåkes med tanke på rasjonell forskrivning.

(Received September 25, 1998; accepted March 15, 1999).

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