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ORIGINAL ARTICLE

Mobile Veterinary Clinic: an innovative approach to promote calf health

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Abstract

Background: Calf morbidity and mortality are of great concern for dairyman all over the world including Bangladesh. A mobile Veterinary Clinic (MVC) was established to identify the diseases associated with morbidity and mortality and provide veterinary services at farmers' doorstep to promote calf health.

Methods: A MVC was established and run from October 2011 to October 2014 to promote calf health. A total of 500 farmers from small and large holder private farms having at least two crossbred cattle were selected. A motorcycle and a mobile phone were provided to each research assistant (RA). The farmers were linked with RAs through mobile number. The ULO/VS were linked with the RA of the respective upazila for immediate treatment of the affected animal(s). The farms were under routine surveillance of the RA. In case of sickness or mortality, RA immediately contacted ULO/VS and project coordinator (PC) /principal investigator (PI) at Bangladesh Agricultural University. Necessary advice was given by ULO/VS/PC/PI to solve the problem as required. Health cards were distributed to the selected farmers for recording the health status of cattle. Diseases were confirmed by clinical and laboratory methods. Farmers were trained on better calf health management. Early disease diagnosis and treatment, routine deworming, and vaccination of cows and calves were performed regularly.

Results: Before implementing MVC services, the overall mortality at herd level was 11.5% which was 8.2% and 14.7% in Muktagacha and Shahjadpur respectively. The overall morbidity was 48.5% which was higher in Shahjadpur (57.94%) than Muktagacha (33.81%). The most common causes of calf mortality were pneumonia (66.2%), unknown (17.4%), adverse drug effect (5.3%), FMD (2.6%), and sudden death (2.4%). Due to MVC at farmers' doorstep, the overall herd level mortality reduced significantly from 11.5 to 2.9% which were 8.2 to 2.3% in Muktagacha and 14.7 to 3.6% in Shahjadpur.

Conclusion: Measures to control pneumonia and FMD in calves should be undertaken. The unknown etiology of mortality should be explored. Cautions should be taken before administering drugs to calves. As MVC was successful in reducing calf mortality, we recommend replicating in other parts of the country.

Keywords: Mortality, morbidity, deworming, vaccination, pneumonia,FMD, farmers' training

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Introduction

Animal productivity is increasing at a slower rate compared to human population, resulting in protein deficiency in the diet of our people. The cattle population in Bangladesh is about 24.34 million and availability of milk is 157.97 ml/day/person in 2016-17 fiscal year against the FAO recommendation of 250 ml/day (MoFL, 2017). In Bangladesh cattle are kept mainly by the poor, landless, marginal and small-scale farmers. In addition, 80% of the poor and ultra-poor people rear livestock as their major means of livelihood. Most of the cattle in this country are kept mainly in the stall which usually depend on feed consists of agricultural wastes and by products (rice straw, wheat, pulses, bran etc.) and only small quantities of grass principally on road sides. Poor husbandry practices and health care of these animals, diseases, along with non-availability of feed resources and nutrition are the most important constraints to milk production (Imtiaz and Rana, 2014). The major constrains for the development of dairy and the development of livestock industry in general have been summarized as policy, socioeconomic, institutional, technical and technological. Animal diseases are among the technical and technological constrains for dairy production system (Belihu, 2002; Tegene and Geberewold, 1998). However, a large number of smallholder dairy farms with high yielding crossbred cows have been established in private sector throughout the country. In fact, crossbreeding program has been taken up as a national policy to boost-up the milk production vis-à-vis rapid development of dairy and livestock industries in 1982 in Bangladesh (Khan et al., 2005). It is an established fact that the success of any breeding program as well as the future of the mini dairy farms depends upon the rate of survival of calf crop produced and accordingly calf morbidity and mortality are of great concern of dairyman, because most of the dairy farms are confronted with acute problems of calf morbidity & mortality (Samad et al., 2001; Wudu et al., 2008; Gulliksen et al, 2009; Gitauet al., 2010; Azizzadeh et al., 2012; Islam et al., 2015). High calf mortality rate is one of the important factors contributing to the insufficient supply of young dairy stock for breeding (Svensson et al., 2006; Lombard et al., 2007; Magalhaes et al., 2008; Torsein et al., 2011). These authors reported calf mortality rates ranging from 8% to 33% annually and mainly from small holder dairy farms. This early mortality represents an irrefutable and irrevocable economic loss to the dairyman due to loss of the present value of the calf and loss of genetic potential for herd improvement (Hossain et al., 1992; Debnath et al., 1990, 1995; Samad et al., 2002). Calf mortality up to 12 months of age with estimate of 9%-20.3% (Debnath et al., 1990, 1995; Samad et al., 2001) has been reported to be mostly associated with gastrointestinal and respiratory diseases in Bangladesh.

Calf diseases that cause morbidity and mortality are the results of complex interaction of the management practices, environment, infectious agents and the calf itself. Scours in neonatal period and pneumonia in older calves are known to be responsible for most of calfhood morbidity and mortality (Olsson et al., 1993; Debanth et al., 1995; Sivula et al., 1996; Hossain et al., 2013). Entero-pathogens which include bacteria, viruses, fungi, protozoa and helminthes have been recognized to be associated with diarrhea as well as calf morbidity and mortality (Radostitse t al., 2000; Santman-Berends et al., 2011; Khair et al., 2014). The risk factors associated with calf morbidity and mortality include unhygienic maintenance, inadequate feeding of first colostrums to newborn calves and malnutrition (Samad et al., 2001). It is well established that exotic and crossbred cattle are highly susceptible to diseases in compared to local zebu cattle and calf mortality is higher in crossbred than local zebu calves (Debnath et al., 1995; Hossain et al., 2013). As disease resistance among individuals or breeds is mainly governed by their genotype, there is wide variation in their adaptability to combat with various diseases which is reflected through variable survivability and growth of the young calves. The newborn calf is agammaglobunaemic and accordingly the

newborn animals are highly vulnerable to invasion of infectious agents for the first few weeks of life. Therefore, unless immunological assistance (antibodies-IgG) transferred from the mother to her offspring through colostrum, microorganisms that present little threat to an adult may kill newborn animals or predisposes a neonate to infection.

Calves are usually neglected as they don't bring any immediate financial return and the cost of their maintenance considerably adds to the production cost of milk. Calves under rural conditions in Bangladesh are at greatest risk of morbidity and mortality because they are usually maintained just to induce letting down of milk in cows.

Infectious diseases have been recognized as one of the most important limiting factors in the calf production worldwide but this situation is further deteriorated because of continuous and indiscriminate uses of antibacterial drugs which result in the emergence of drug resistance bacteria (Rahman et al., 2018). Most of the inland reports on calf diseases in Bangladesh have been confined on general morbidity and mortality rates based on hospital and /or farm records (Debnath et al., 1990; Debnath et al., 1995; Hoque & Samad, 1996; Masuduzzaman et al., 1999;Sarker et al., 2013Hossain et al., 2013), subclinical parasitic infection (Pharo, 1981; Motalib and Alam, 1983) and pathological findings (Hossain et al., 1992). Each upazilla in Bangladesh has only one veterinarian through whom it is almost impossible to provide veterinary service properly. There seems to be no reports on veterinary services at doorsteps. Considering these factors, a mobile Veterinary Clinic (MVC) was established to identify the diseases associated with morbidity and mortality and provide veterinary services at farmers' doorstep to promote calf health.

Materials and methods

Research area

The MVC services were delivered to two upazilasin Mymensingh (Muktagacha) and Sirajganj (Shahjadpur) district.

Study farms/Sample size

A list of registered as well as unregistered small holder dairy farms were collected from upazila Livestock Office of the respective upazila and a total of 500 small holder private farms having at least two crossbred dairy cattle were selected. Depending upon the number of cattle, the herd size was categorized into three groups (Small/subsistence: ≤ 3 cattle; Medium: 4-6 cattle and Large :>7). Calves from day old to 1 year of age were included in this study. Based on physical condition /nutritional status (Body weight), calves were divided into three groups: good condition (normal condition), moderate condition (slightly thin) and poor (very thin).

Study design (Approaches, supervision and monitoring)

The study was longitudinal prospective study and the calves were monitored throughout the study period. The questionnaire survey was also conducted at the beginning of the study period. A MVC was established to provide proper veterinary service at farmer's doorstep. MVC consisted of project coordinator (PC)/principal investigator (PI), veterinary surgeon (VS)/Upazila livestock officer (ULO) of respective area/ PhD fellow (PF) and research assistant (RA).A motor cycle and a cell phone were provided to each RA. Farms of the research areas were under routine surveillance of RAs who were supervised by PC/PI/VS/ULO/PF. The farms were under the routine surveillance of the RA through direct field visits and over telephone (Figure 1). RA visited each farm at least once in every 15 days. Besides, RA's telephone number was given to the farmers to contact in emergency. The ULO in Muktagacha and VS in Shahjadpur areas were linked with the RAs of the project areas so that they could be reached by the farmers whenever required. Moreover, regular visits as well as emergency visits whenever required were made by PC and PI. In case of sickness or mortality, RAs immediately contacted PC/PI/ULO/VS/PF over telephone. PC/PI gave necessary advice or necessary arrangements were made to solve the problem as required. A Health

card was developed and distributed to the farmers of research area to record health status of animals. A questionnaire waspretested and distributed to the research assistants to collect epidemiological data.

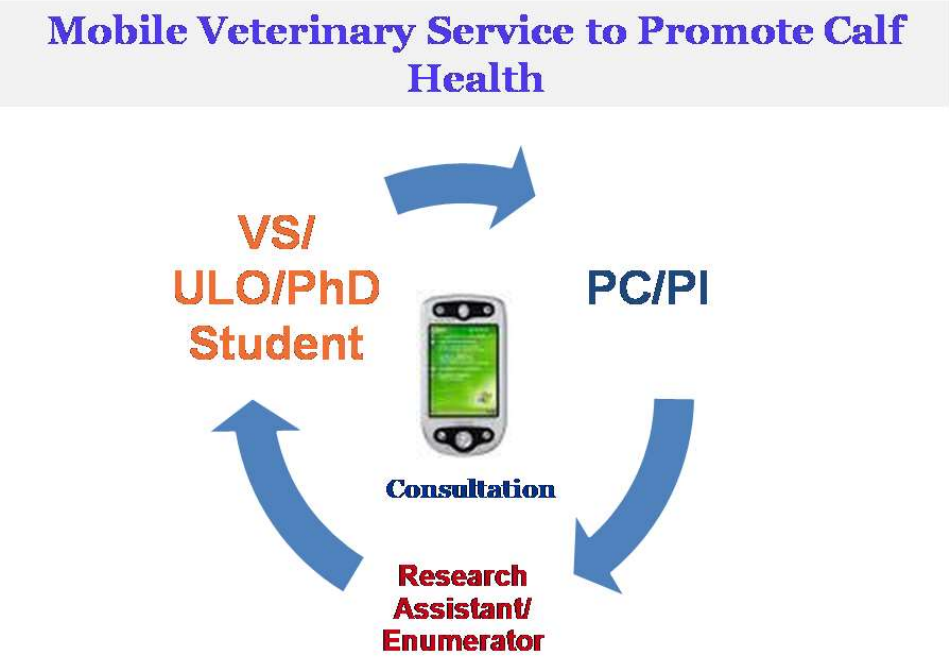

Figure 1. The schematic diagram of MVC services provided at farmers' doorstep

Disease diagnosis

Diagnosis of diseases was made by general physical examination of animals, clinical signs, gross pathology and laboratory procedures. During general physical examination animal's body condition, behavior, posture, gait, locomotive disturbance, pulse, respiration, temperature, abdominal distension, defecation etc. were observed and/or recorded. Examination of different parts and systems of the body of sick animals were performed by palpation, percussion, auscultation, needle puncture and walking of animals. Owner's complaints were taken into account while performing general physical examination of a sick animal. Animal's breed, sex, age etc. were also recorded. Specific bacterial, viral, and fungal diseases were diagnosed on the basis of specific clinical signs and gross lesions. In some cases, confirmatory diagnosis was made by cultural and biochemical characteristics of causative organisms following standard procedure. Parasitic infestations were diagnosed by feces examination under microscope as described previously (Soulsby, 1986). Blood smears were prepared and examined under microscope after Giemsa's staining according to the methods described elsewhere to confirm hemo-protozoan infection. The handling of animals in the study was performed in accordance with current Bangladesh legislation (Cruelty to Animals Act 1920, Act No.

I of 1920 of the Government of the People's Republic of Bangladesh).

Post-mortem Examination

When any mortality occurred, the carcass was subjected for post-mortem examination. Samples were collected as required to identify the cause of the death. In Muktagachaand Shahjadpur17 and 32 calves died respectively and post mortem of all dead calves were done. The samples collected during post mortem were liver, lung, kidney, small intestine, large intestine, heart, kidney, intestinal contents etc. as required.

Mitigation of calf morbidity and mortality

Farmers were trained on better calf health management. Routine monitoring and disease surveillance of the farms, early disease diagnosis and treatment of animals, routine de-worming and vaccination of cow and calves were performed by regular/continuous process. Based on the epidemiological data, laboratory findings and results of treatments a mitigation method was proposed for the prevention of calf morbidity and mortality and for better health management.

Results

Population survey in study area

At the beginning of the study, cattle population was 2957 in the research area (Muktagacha: 870 and Shahjadpur: 2087). In Muktagacha, there were 421 Cows, 97 heifers, 54 bulls and 299 calves. In Shahjadpur, there were 1022 cows, 515 heifers, 220 bulls and 330 calves. A total of 629 calves of both sexes (male: 343; female: 286) from Muktagacha (male: 162, female: 137) and Shahjadpur (male: 181, female: 149) were included from 500 farms. By the end of the monitoring (longitudinal study) further 2205 calves had been recruited to the study but 473 calves were lost to follow up during the study period. Among 500 farms 14 farms had also been withdrawn from the study. After completion of the research project the population was increased to 3692 (Muktagacha: 1190 and Shahjdpur: 2502) with an average increase of 22.89% (Table 1)

Total number of calves in Muktagacha and Shahjadpur

A total of 1999 (Muktagacha: 639 and Shahjadpur: 1360) calves were born during the research period of which 948 were male (Muktagacha: 333 and Shahjadpur: 615) and 1051 were female (Muktagacha- 306 and Shahjadpur-745) (Table 2).

Status of newborn calf, heifer and cow

Among 1051 newly borne female calves 102 attained maturity and became pregnant. Eight of them gave birth of calves, 5 faced abortion while 26 heifers suffered from repeat breeding. The remaining 61.8% (63/102) were maintaining pregnancy (Table 3).

Calf morbidity

During the research period, a total of 2524 calves (104 were sold and left) were observed where 988 calves were from Muktagacha and 1536 from Shahjadpur. Among the 2524 calves 1224 were affected with different diseases/disorders and the overall morbidity of calves was 48.5%. For Muktagacha, out of 988 calves 334 were affected with different disease accounting morbidity of 33.81%. In Shahjadpur, out of 1536 calves 890 were affected with different diseases and the morbidity was 57.94%. The morbidity of calves was significantly higher in Shahjadpur ($p<0.05$) (Table 4).

Calf mortality

It was observed that before implementation of MVC Services, in Muktagacha and Shahjadpur the herd level calf mortality was **8.2%%** and **14.7%** respectively which reduced significantly ($p<0.05$) to 2.3% and 3.6% in Muktagacha and Shahjadpur, respectively after the implementation of MVC services (Table 5).

Among 2524 calves, 49 died accounting an overall mortality of 1.94%. For Muktagacha among 988 calves, 17 died and the mortality was 1.72% and for Shahjadpur, among 1536 calves 32 died and the mortality was 2.08%. The mortality of calves was also significantly higher in Shahjadpur (Table 6).

Prevalence of diseases/disorders in calves during Surveillance

A total of 19 types of diseases/disorders were recorded to be associated with the morbidity of calves during study period which were divided into eight different groups: a) Congenital abnormalities, b) Systemic states, c) Digestive disorder, d) Diseases of eye/ear, e) Respiratory disorder, f) Abnormal skin conditions, g) Infectious diseases and h) Miscellaneous (Table 7).

The highest prevalence of diseases was digestive disorders (30%) followed by systemic states (5.48%), respiratory disorder (1.86%), infectious diseases (1.21%) (Table 7). Among the digestive disorders, diarrhea (12.9%) was most frequently encountered disorder followed by parasitic gastro enteritis (PGE) (12.6%) and dysentery (3.73%) (Table7). For systemic states, fever was most frequently encountered (5.04%) followed by pica (0.33%) and bottle jaw (0.11%) (Table 7). Pneumonia was found with a prevalence of 1.86% (Table 7). The highest prevalence of infectious disease was found for FMD (0.55%) followed by navel ill (0.44%) and actinomycosis (0.22%) (Table 7).

Mortality of calves during surveillance before implementation of MVC services

Before implementation of MVC services at farmers' doorsteps, deaths of 379 calves' due to different diseases/disorders were recorded in 168 (Muktagacha-58 and Shahjadpur-118) farms out of 584 farms. Mortality was higher in Shahjadpur (81.53%) in compared to Muktagacha (18.47%). Highest mortality was due to pneumonia and others followed by unknown causes (17.41%), adverse effects of drug (5.28%), FMD (2.64%) and others (Table 8). In Muktagacha, the highest mortality was recorded due to unknown causes (34.29%) followed by fever (12.86%), sudden death (12.86%), pneumonia and others (11.43%), FMD (8.57%), diarrhea (7.14%). In Shahjadpur, the highest calf mortality was due to pneumonia and others (78.64%), followed by unknown causes (13.59%), adverse effect of drugs (6.47%) and FMD (1.29%) (Table 8). It was also observed that before implementation of Mobile Veterinary Clinic (MVC) services, the overall herd level calf mortality was reduced from 11.52% which was 8.2% and 14.7% in Muktagacha and Shahjadpur respectively. But after the implementation of MVC services the overall calf mortality was significantly ($p<0.05$) reduced to 2.9%. The herd level mortality was reduced to 2.3% and 3.6% in Muktagacha and Shahjadpur respectively (Table 5).

The mortality of calf was reduced due to improved management practices and proper medication. Overall mortality level of calves was reduced from 13.4% (Debnath et al., 1995) to 1.94% (Figure 2).

Table 1. Animal population in the study area

Area		Cattle Population						New introduction of cattle					Exit of cattle				
		Cow	Heifer	Bull	Calf	Pregnant cow	Total cattle	Cow	Heifer	Calf	Bull	Total entry Cow	Heifer	Calf	Bull	Total exit
Muktagacha	**Initial**	421	97	54	299 M:162 F-137	215	870	--	--	--	--	--	--	--	--	--	--
	At end	557	156	199	278 M-119 F-159	259	1190	122	15	134	116	387	178 S-172 D-6	85 S-83 D-2	198 S-181 D-17	245 S-244 D-1	706 S-146 D-26
	Increase (%)	Total 546 calves increased with an average increasing rate of 20.92% per year															
	Total (%)	Total Increase = (1190+639-870-387-26) =546 Initial + increase (870+546) = 1416 (Excluding the number of purchased cattle and including all new born calf), Increase rate =546*100/870=62.75%															
Shahjadpur	**Initial**	1022	515	220	330 M-181 F-149	409	2087	--	--	--	--	--	--	--	--	--	--
	At end	1210	429	302	561 M-226 F-335	1096	2502	76	36	72	25	209	367 S-341 D-26	192 S-178 D-14	275 S-243 D-32	320 S-9 D-311	1154 S-1073 D-81
	Increase (%)	Total 1485 cattle increased with an average increasing rate 23.72% per year															
	Total (%)	Total Increase= (2502+1360-2087-209-81=1485) Initial + increase = (2087+1485) = 3572, (Excluding the number of purchased cattle and including all new born calf), Increase rate =1485*100/2087= 67.17%															
Overall	**Initial**	1443	612	274	629	624	2957										
	At end	1767	585	501	839	1355	3692										
	Increase (%)	Total 2031 cattle increased with an average increasing rate 22.89% per year															

M=Male, F= Female, D= Died, S= Sold

Table 2.Initial and newly born calf in study period

Research area	Period	Number of calves		
		Male	Female	Total
Muktagacha	Initial calf	162	137	299
	New born	333	306	639
Shahjadpur	Initial calf	181	149	330
	New born	615	745	1360
Overall	Total initial calf	343	286	629
	Total new born	948	1051	1999
Grand total		1291	1337	2628

Table 3. Newborn calves attained maturity during November 2011 to October 2014

Area	Newly born calf			Total Heifer/cow upto Oct'14	Total Pregnant heifer	Heifer became cow	Abortion	Repeat Breeder
	Total	Male	Female					
Shahjadpur	1360	615	745	461	66	4/66 (6.1%)	5/66 (7.57%)	3 (4.54%)
Muktagacha	639	333	306	202	36	4/36 (11.1%)	0/36 0%)	23 (63.9%)
Overall	1999	948	1051	663	102	8/102 (7.84%	5/102 (4.9%)	26 (25.49%)

Table 4. Overall calf morbidity from November 2011 to October 2014

Study Area	No. of calves	Diseased calves	Morbidity (%)	P-value
Muktagacha	988	334	33.81	p<0.05
Shahjadpur	1536	890	57.94	
Total	2524	1224	48.5	

Table 5.Calf mortality at herd level during November 2011 to October 2014

Area	Period	Herd observed	Farm with dead calves	Mortality (%)/Year	P-value
Muktagacha	Before inception	236	58	8.2	p<0.05
	After inception	236	16	2.3	
Shahjadpur	Before inception	250	110	14.7	p<0.05
	After inception	250	27	3.6	
Overall	Before inception	486	168	11.5	p<0.05
	After inception	486	43	2.9	

Table 6. Calf mortality at individual level during November 2011 to October 2014

Area	Observed	Calf died	Mortality (%)	P-value
Muktagacha	988	17	1.72	p<0.05
Shahjadpur	1536	32	2.08	
Grand Total	2524	49	1.94	

Table 7.Prevalence of diseases/disorders in calvesduringNovember 2011 to October 2014

Diseases	Muktagacha (N=988)	Prv. (%)	Shahjadpur (N=1536)	Prv. (%)	Overall (N=2524)	Prv. (%)
Congenital	1	0.1	4	0.26	5	0.2
Atresia ani	1	0.1	0	0	1	0.04
Blindness	0	0	4	0.26	4	0.16
Systemic states	101	10.2	397	25.8	498	19.7
Anorexia	21	2.13	24	1.56	45	1.78
Bottle jaw	3	0.3	0	0	3	0.12
Fever	47	4.76	40	2.6	87	3.45
Malnutrition/Debility	15	1.52	235	15.3	250	9.9
Pica	14	1.42	79	5.14	93	3.68
Potbelly	1	0.1	19	1.24	20	0.79
Digestive disorder	137	13.9	350	22.8	487	19.3
Bloat	5	0.51	3	0.2	8	0.32
Colic/indigestion	3	0.3	14	0.91	17	0.67
Constipation	1	0.1	0	0	1	0.04
Diarrhea	43	4.35	221	14.4	264	10.5
Dysentery	27	2.73	48	3.13	75	2.97
PGE	56	5.67	59	3.84	115	4.56
Rumen impaction	0	0	4	0.26	4	0.16
Tympany	2	0.2	1	0.07	3	0.12
Eye/Ear Diseases	2	0.2	1	0.07	3	0.12
Conjunctivitis	2	0.2	31	2.02	33	1.31
Corneal opacity	0	0	15	0.98	15	0.59
Respiratory disorder	5	0.51	7	0.46	12	0.48
Pneumonia	5	0.51	7	0.46	12	0.48
Skin condition	30	3.04	26	1.69	56	2.22
Allergy/Dermatitis	16	1.62	8	0.52	24	0.95
Alopecia	11	1.11	2	0.13	13	0.52
Ringworm	1	0.1	2	0.13	3	0.12
Wound	0	0	6	0.39	6	0.24
Tick infestation	2	0.2	8	0.52	10	0.4
Infectious diseases	43	4.35	28	1.82	71	2.81
Actinomycosis	2	0.2	5	0.33	7	0.28
Babesiosis	1	0.1	0	0	1	0.04
BQ	2	0.2	0	0	2	0.08
Dog bite/Rabies	1	0.1	0	0	1	0.04
FMD	20	2.02	4	0.26	24	0.95
Foot rot	0	0	2	0.13	2	0.08
Navel ill	16	1.62	15	0.98	31	1.23
UTI	0	0	2	0.13	2	0.08
Warts	1	0.1	0	0	1	0.04
Miscellaneous/others	15	1.52	32	2.08	47	1.86
Accidental injury	0	0	4	0.26	4	0.16
Arthritis	4	0.4	14	0.91	18	0.71
Cerebral Hypoxia	4	0.4	0	0	4	0.16
Hernia	5	0.51	5	0.33	10	0.4
Intestinal torsion	1	0.1	0	0	1	0.04
Leg paralysis	0	0	1	0.07	1	0.04
Pharyngeal paralysis	0	0	6	0.39	6	0.24
Posthitis	0	0	1	0.07	1	0.04
Tumor	0	0	1	0.07	1	0.04
Urolithiasis	1	0.1	0	0	1	0.04
Grand Total/Overall	334	33.8	890	57.9	1224	48.5
		P<0.001				

Prv. = Prevalence

Cause specific calf mortality

The cause specific calf mortality recorded during the study period is presented in Table 8. The most common causes of mortality were pneumonia (66.2%), unknown (17.4%), adverse drug effect (5.3%), FMD (2.6%) and sudden death (2.4%).

Table 8.Cause specific calf mortality recorded during November 2011 to October 2014

Disease	Overall (N=379)	Mortality (%)	Muktagacha n =70	Mortality (%)	Shahjadpur (N =309)	Mortality (%)
Adverse effect of Drug	20	5.3	0	0.0	20	6.5
Anthrax	4	1.1	4	5.7	0	0.0
Bloat	2	0.5	2	2.9	0	0.0
Diarrhea	5	1.3	5	7.1	0	0.0
Fever	9	2.4	9	12.9	0	0.0
FMD	10	2.6	6	8.6	4	1.3
Unknown	66	17.4	24	34.3	42	13.6
Pneumonia & others	251	66.2	8	11.4	243	78.6
Sudden death	9	2.4	9	12.9	0	0.0
Weakness/ malnutrition	3	0.8	3	4.3	0	0.0

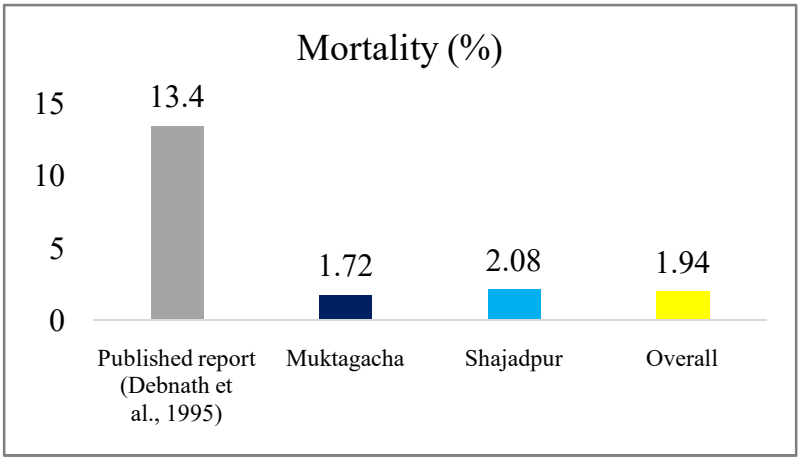

Figure 2. Calf mortality before and after implementation of MVC

Discussion

Overall morbidity and mortality

The overall morbidity and mortality in calves recorded in this study were 48.5 % and 1.94 %, respectively. The morbidity recorded in Muktagacha and Shahjadpur was 33.81% and 57.94% respectively. The morbidity of calves was significantly higher in Shahjadpur. This finding is in agreement with the findings reported earlier as 53.42% in Bangladesh (Samad et al., 2001). The morbidity in the present study is also congruent with the findings reported by others (Debnath et al. 1990; Virtalaet al., 1996). However, some authors reported higher morbidity which varied from 58.4 to 66.7% (Wudu et al., 2008; Yeshwas et al., 2014; Asmare and kiros, 2016).

In general, most of the times, morbidity statistics is unavailable in many farms and difficult to make comparisons, unlike mortality. If available, variations are wide; this might be partly due to lack of reliable morbidity records by dairy producers and the different methods used in diagnosis. For instance, some authors reported calf morbidity based on producers' diagnosis and treatments, while others depended on veterinarians' diagnosis (Wudu, 2004).

The calf mortality recorded in this study were 1.72% and 2.08% in Muktagacha and Shahjadpur, respectively. The mortality of calves was significantly higher in Shahjadpur. In the present study crude calf mortality before implementation of mobile veterinary clinic at herd level was 11.52% (calculated for one year) which was significantly reduced to 2.95% (calculated for one year) after implementation at herd level. This result is in agreement with the findings of Svensson et al. (2006) who reported 2.1% mortality risk at herd level. The death risk of calves less than 6 months of age in 2002 was 1.76% in Inverness, 5.83% in Cheshire and 4.8% in Norfolk (Ortiz-Pelaez et al., 2008) in Britain.

The crude calf mortality at calf level previously reported by different author in Bangladesh were 9% - 18.28%% (Debnath et al., 1990; Debnath et al., 1995, Taleb et al., 2001). But the overall calf mortality in this study was 1.94% which was 1.72% in Muktagacha and 2.08% in Shahjadpur. The significant reduction in calf mortality may be due to regular monitoring and the impact of mobile veterinary services provided to recruited farms through MVC. This mortality record is in the economically tolerable level, where an economically acceptable level of mortality was also set like, 3% in Sweden (Svensson et al., 2006), 5% in Norway (Gulliksen et al., 2009) and 2–6% in Britain (Ortiz-Pelaezet al., 2008). However, the present study was conducted in large and small-holder dairy farms. Farmers holding small number of calves per farm can easily monitor calves and take measures to prevent calf health problems. This could be one of the reasons for lower mortality rate in small sized farms than in large herd sized farms mentioned above. For instance, the lower mortality rate in many developed countries might be influenced by better management practices. In the tropical environment where the temperate breeds are not well adapted and might have been exposed to an additional stress to increase the risks of health problems (Wudu, 2004). Variations in morbidity and mortality between Muktagacha and Shahjadpur can be explained by the differences in the calf and herd-level risk factors, management practices and agro-ecology (Windeyeret al., 2014).

Generally, when mortality and morbidity comparisons were made between the present and other previous reports, there was an inherent difficulty. Such kind of difficulties was also previously mentioned by Wudu (2004). The discrepancy between the present and previous reports in Bangladesh and other parts of the world, might be attributed to variations in many calves and herd-level risk factors, management practices, age of the calf considered, breed of study calves, agro-ecology and the method they used to measure mortality (incidence rate/risk or prevalence) (Windeyer et al., 2014). For instance, most previous reports from Bangladesh were based on studies in research stations/University Veterinary Clinic/Upazila or District Veterinary Hospital data and government farms with large

herd sizes and usually having high exotic genetic makeup; apparently these are associated with increased risk of calf disease occurrence (Wudu, 2004).

Morbidity/Disease prevalence

The highest prevalence of disorder was systemic states (19.7%) followed by digestive disorder (19.3%), infectious diseases (2.81%) and skin condition (2.22%). Different authors reported wider range of prevalence of diseases as well as disorders in calves that are associated with morbidity (Debnath et al., 1990; Samad et al., 2003; Megersa et al., 2009; Asmare and Kiros, 2016). Similar prevalence of systemic states (11.65%) and infectious diseases (5.86%) were reported by Samad et al. (2003). In this study, the prevalence of diarrhea (10.5%) was highest followed by malnutrition (9.9%), parasitic gastroenteritis (4.56%), pica (3.68%), fever (3.45%) and dysentery (2.97%). Diarrhea was also reported be the most frequently encountered cause of morbidity and mortality (Wudu et al., 2008; Gulliksen et al., 2009; Megerasaet al., 2009). Comparatively higher prevalence of diarrhea was also reported previously in Bangladesh and other countries (Debnath et al., 1990; Samad et al., 2003; Asmare and Kiros, 2016; Islam et al., 2015). Debnath et al., (1990) reported 52.08% gastro-intestinal disturbances, 20.63% skin diseases, 4.73% specific infectious disease and 7.29% respiratory diseases in calves. Asmare and Kiros (2016) reported 63.3% diarrhea and 3.3% pneumonia in dairy calf.

The overall herd level mortality obtained in this study was 34.57%. In the central cattle breeding and dairy farm, the calf mortality was reported to be 71.01% (Hossain et al., 2013). The mortality was higher in Shahjadpur (81.53%) in comparison to Muktagacha (18.47%). Higher mortality was due to pneumonia (66.23%), followed by unknown causes (17.41%), adverse effect of drug (5.28%) and FMD (2.64%). The overall herd level calf mortality was reduced from 11.52% to 2.95% due to improved management practices. The overall calf level mortality was reduced significantly from 13.4% (Debnath et al., 1995) to 1.94%. A total of 49 calves died and high mortality occurred due to pneumonia with fever (42.85%) followed by diarrhea (12.24%), FMD (6.12%) and congenital (6.12%). Gastro-enteritis and respiratory diseases were reported as the most common causes of calf mortality (Samad et al., 2003; Debnath, 1995). Gitauet al. (1994) reported 28.6% diarrhea was associated with calf mortality. The overall mortality of 1.43% was observed due to digestive disorder (Bangar et al., 2013). Pneumonia (17.7%) and gastroenteritis (16.1%) in young calves were reported as the most important causes of calf mortality worldwide (Gitauet al., 2010).

Mortality was significantly ($p<0.001$) higher in farms of Shahjadpur (44%) in comparison to farms in Muktagacha (24.6%). The overall morbidity/prevalence of diseases up to 12 months was 48.5% which was higher in Shahjadpur (40.33%) than in Muktagacha (38.72%) This prevalence of disease is higher than the earlier reports which varied from 17.16% to 26.98% (Gitau et al., 1994; Sarkar et al., 2013; Choudhury et al., 2015) but slightly lower than the findings reported by other authors [56.17%-81.09%] (Wudu, 2004; Tiwari et al., 2007; Islam et. al., 2015). This variation might be due to differences in cattle management practices, farmer awareness, geographic location, disease prevalence, breeds, age, sex, sample size.

Impact of Mobile Veterinary Clinical Services (MVC)

Morbidity and mortality of calves was reduced in comparison to the morbidity and mortality reported earlier. During this study period a total of 2628 calves were borne. As per earlier trend of mortality, a total of 352-480 calves had to die, but there were only 49 death that accounted 2% mortality, i.e., 303-431 calves were saved which saved Tk. 75,75,000-1,07,75000 (Tk. 25,000/calf). All of these achievements were due to efficient implementation of MVC services. This MVC played an important role to provide veterinary services at farmers' doorstep that resulted reduced morbidity and mortality by rapid disease diagnosis and treatment, routine de-worming routine vaccination, management of manageable risk factors and farmers training.

Farmers training on better cow and calf health management helped to improve fertility of heifer of the research areas that also provided more milk and progeny calves for better stock management.

Conclusion:

Mobile Veterinary Clinic played important role to provide veterinary services at farmers' doorstep that reduced mortality by rapid disease diagnosis and treatment, routine deworming and vaccination, management of manageable risk factors and farmers training. Farmers training on better cow and calf health management helped to improve fertility of heifer of the research areas that also provided more milk and progeny calves for better stock management. We recommend replicating MVC in other areas of Bangladesh.Farmer's training on better cow and calf health management should also be extended.

Conflict of Interest

The authors declared no conflict of interest.

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