RESEARCH REPORT
SWINE HEALTH

Title: An Assessment of Urinary Tract Infections in Sows **NPB #03-059**

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Abstract: Previous studies revealed that 22% to 40% of sows in confinement operations are affected with urinary tract infections (UTI) and UTI contribute to sow mortality. This study was designed to determine if UTI are detrimental to sow performance and to identify the stage of the production cycle that sows are at greatest risk of acquiring UTI. The study was conducted on a commercial sow farm and urine samples were collected from sows in late gestation, shortly after farrowing, in late lactation, after weaning and during early gestation. Approximately 300 sows were included in the study. All efforts were made to match sows with UTI (cases) to sows without UTI (controls). Abnormal urine samples (increased protein and white blood cells) were more common in sows during lactation and postweaning than in sows during late lactation. Based on urine evaluations, it was evident that water intake was insufficient in late lactation and sow urine was concentrated. Some sows appeared to recover from the UTI with the sole intervention of increased access to water in the gestation/breeding facilities. Surprisingly, the subclinical UTI, as detected with urinalysis methods, did not interfere with sow reproductive performance, as farrowing rates and litter sizes were similar in control sows and case sows. Urine abnormalities, indicative of UTI, are common in sows; however, it is evident that further refinements of urinalysis methods are required to adequately predict the outcome of UTI in sows.

Introduction: Few studies previously evaluated the role of urinary tract infections (UTI) in sow performance in the USA. UTI include cystitis (inflammation of the urinary bladder) and pyelonephritis (inflammation of the kidney). Our studies (Howell et al., 1994; Almond and Stevens, 1995) confirmed European reports that revealed 22 to 40% of sows in confinement operations are affected with UTI. The proportion of sow deaths attributable to cystitis/pyelonephritis varies from 10% to greater than 40% in Europe, Canada, and the USA (Sanz et al., 2002).

Death is the extreme outcome of UTI; however, early and subtle clinical signs, such as anorexia and frequent urination and increased drinking, commonly are overlooked in commercial farms. Without therapy, the infectious process progresses to involve the kidneys and ureters. Once the kidneys are affected, the animal's condition rapidly deteriorates and becomes life threatening.

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Evaluation of UTI in sows previously depended on necropsies of dead sows and/or laboratory confirmation of the lesions and potential pathogens. However, necropsy procedures provided little information on the rest of the sow herd. Therefore, we established practical urinalysis procedures for evaluation of urinary tract infections in sows (Almond and Stevens, 1995).

Objectives:

1. Determine if urinary tract infections are detrimental to sow performance (farrowing rates, litter size).
2. Determine the stage of the production cycle (breeding, gestation or lactation) that sows are at greatest risk of acquiring UTI.
3. Determine if UTI resolve without intervention and treatment.

Materials & Methods:

Animals and Farm: The study was conducted on a 7500-sow farm in North Carolina. Urine samples were collected from the same breeding group of sows in late gestation, one day after farrowing, 17-19 days of lactation, during the weaning-to-service interval and at days 25-30 of the subsequent gestation. Gestating sows were housed in stalls with a common water trough. Water was available for most of the day. The farrowing facilities included conventional crates equipped with one water drinker per crate. Based on the urine analyses of samples collected in late gestation, all efforts were made to identify sows (cases) with UTI and match them with control sows (controls) without UTI. Approximately 300 sows were included in the study.

Animal Health: Antibiotic treatments of sows, clinical disease problems and sow mortality were recorded by farm personnel. Sow performance (litter size [PBA, Stillborn, mummies], farrowing rate, pigs weaned, weaning-to-service interval) and culling/removal reasons were compared between the cases and controls.

Urine Sampling and Analysis: Urine samples were evaluated using previously established procedures (Almond and Stevens, 1995). Urine reagent sticks were used to determine urine pH and to detect urine glucose, bilirubin, ketones, blood, protein, urobilinogen, nitrite and leukocytes. Specific gravity was determined using a refractometer and urine sediment was evaluated with standard procedures to quantify white blood cells (WBC), triple phosphate crystals and other urine constituents. Bacterial cultures were performed on urine samples with any abnormalities detected with the reagent strips or sediment examination.

Statistical Analysis and Evaluation: A scoring system (Almond and Stevens, 1995) was used to quantitate color changes on urine dipsticks, quantity of cells and other abnormalities in urine sediment and bacteriology culture results. For farrowing rates, litter sizes and other performance data, the data was analyzed with epidemiologic measures of association (Chi square and odds-ratio) (Martin et al., 1987).

Results: Although we anticipated that sows with UTI would have abnormal urine samples during each successive collection period, our case sows did not consistently stay as cases. It was not unusual to have sows with UTI infections, based on the urinalysis tests, test negative on a successive sample. Each case was matched with a control sow of the same parity. For the subsequent analyses, each case sow was maintained as a case, despite negative tests at one or more of the collection periods. To evaluate the influence of stage of production, additional urine samples were collected

from sows within the same breeding group that had not been previously included as a case or control.

Objective 1: Determine if urinary tract infections are detrimental to sow performance.
Objective 3: Determine if UTI resolve without intervention and treatment.

In regard to production parameters (Table 1), the control sows tended to have greater pigs born alive/litter from the first farrowing and reduced weaning-to-service intervals. These results must be viewed with caution, since numerous other factors, which were not measured in this study, contribute to litter size. Considerable cross-fostering of piglets occurred between sows and thus, pigs weaned per litter may not be the best estimate of preweaning mortality. For the second farrowing, there were no differences between case and control sows. Other production parameters were similar between case and control sows. The overall mortality and reasons for removal did not differ between groups. Penicillin administration was common in sows within the first few days after farrowing. For case and control sows, 68% and 54% were treated with penicillin (and oxytocin), respectively. The penicillin treatments were given for post-parturient dysgalactia and not directed at UTI.

Objective 2: Determine the stage of the production cycle (breeding, gestation or lactation) that sows are at greatest risk of acquiring UTI.
Objective 3: Determine if UTI resolve without intervention and treatment.

Based on the results shown in Table 2, abnormal urine constituents were more evident during lactation and during the post-weaning stages of production. Approximately 50% of the sows had urinalysis results indicative of UTI. In particular, the high WBC counts emphasized that UTI were evident in the case sows. These sows also had significant bacteriuria, with mixed infections. The common use of antibiotics in the immediate post-partum period interfered with the bacteriological results of sow urine collected one day post farrowing. However, the high levels of protein and WBC's revealed that UTI also were present in these sows.

It was interesting to note that ketones were evident in the urine of case sows and to a lesser extent, control sows after farrowing and after weaning (Table 2). Also, triple phosphate crystals were common in the urine of both groups of sows at most stages of production.

The data for two urine parameters, namely pH and specific gravity, provided unexpected results (Figure 1). For both case and control sows, urine pH was less than 7 in lactation. In contrast urine pH was alkaline (>7) in gestation and during the post-weaning interval. Urine specific gravity increased during lactation and then decreased during the post-weaning interval. Specific gravity was similar between late and early gestation.

Discussion: Based on the results, it is evident that UTI are relatively common in sows. The prevalence of UTI in gestating sows was similar to previous reports; however, the present results indicate that UTI apparently are more common in lactation. To the best of our knowledge, the incidence of UTI previously was not reported for lactating sows. The causes for UTI in lactation are speculative. Initially, we anticipated that sows with UTI during late lactation would most likely represent the vast majority of sows with UTI in lactation. Our observations did not reveal that a gestating sow with UTI was at greater risk of UTI during lactation. In addition, many sows with UTI, as diagnosed with urine constituents, did not consistently test positive. This infers that in some sows, the UTI

may resolve without intervention. In contrast, a percentage of animals did have UTI on two or more samples and the UTI did not resolve; however, the UTI did not interfere with their subsequent reproductive performance.

Other factors clearly must contribute to UTI in lactating sows. First, it was well established that the water requirements of lactating sows are considerably greater than gestating sows. Although sows have access to drinkers in the farrowing crates, it is obvious that they fail to drink sufficient water. As shown in the results, the high specific gravity (Figure 1) demonstrates that lactating sows are concentrating their urine in an effort to conserve water. Lactating sows urinate infrequently and their urine is concentrated as indicated by specific gravity. Therefore, it is not surprising that UTI are common in lactating sows – the beneficial effect of frequent urination with high volumes of urine are lost during lactation. After the piglets were weaned from the sows, it was noted that specific gravity decreased and thereby indicating that the sows were drinking more water and their water demands had diminished.

The excessive presence of ketones (ketonuria) in the urine of sows after farrowing and after weaning should not be surprising. During both phases of production, there are decreases in feed consumption. The recently farrowed sow has diminished feed intake and the weaned sow is switched from an ad libitum to a restricted feed allowance. Presumably, some sows become ketotic and modify metabolism in a response to changing feed intake.

Overall, marginal differences in production and performance were noted between case and control sows. In fact, farrowing rates and litter sizes on the second (subsequent) litter were the same. It was apparent that a single or even multiple episodes or UTI does not necessarily affect the performance of sows. The mortality, including the case sows, was considerably lower than industry averages, particularly for a herd of this size. Recorded treatments were restricted to the sows in the farrowing house with postpartum administration of penicillin representing a fairly routine procedure. Additional treatments and medications in gestation were rare.

In summary, the present study did not demonstrate a clear association between UTI and sow productivity. The prevalence of cystitis, as diagnosed with urinalysis methods, in sows in the study farm was comparable to previous reports. Compared to industry averages, sow mortality was surprisingly low. Although several reports indicate that UTI are an important factor in sow mortality, the present results indicate that the “subclinical” UTI are not typically detected by farm personnel and that affected sows often continue to provide adequate reproductive performance. We suspect that many sows have cystitis to varying degrees and unless the infection ascends to the kidney, the infection does not become life-threatening. Despite the high frequency of abnormal urine samples in lactation, these sows either recovered by early gestation or continued as subclinical animals. The elevated specific gravity of urine from lactating sows is somewhat alarming. It is evident that these sows are not consuming sufficient water. The impact of marginal water intake on sow lactational performance and piglet growth requires further clarification.

References:

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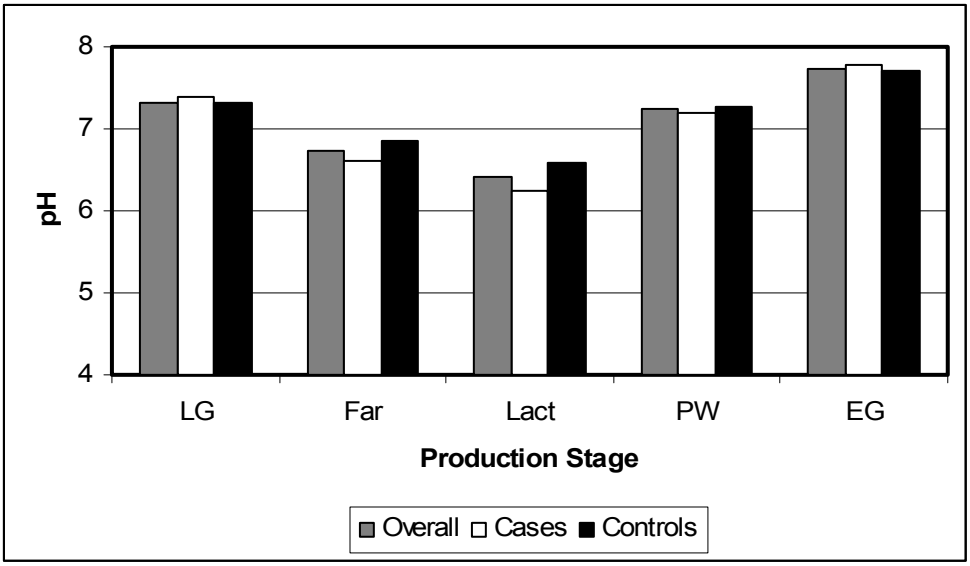
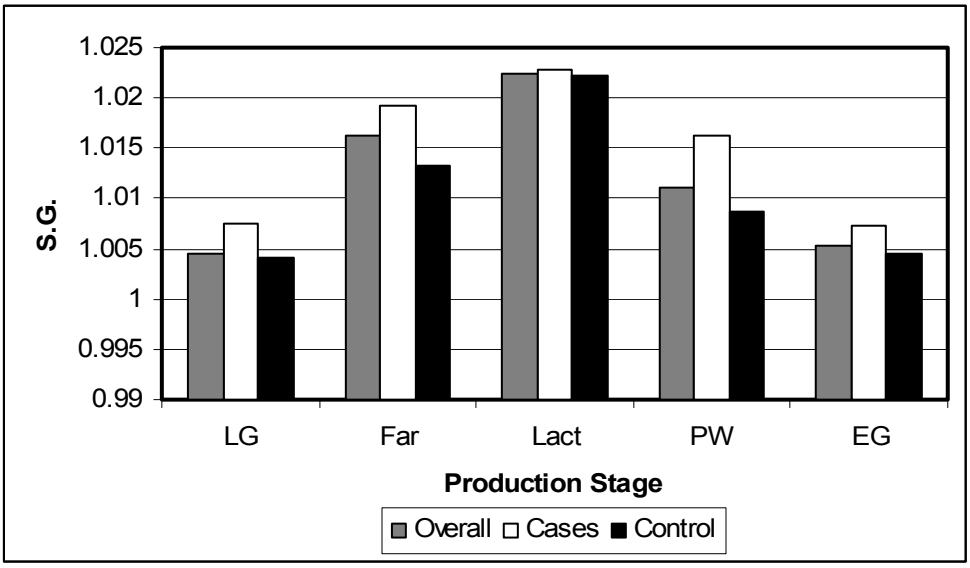
Lay Interpretation: Previous studies revealed that 22% to 40% of sows in confinement operations are affected with urinary tract infections (UTI), which contribute to sow mortality. This study was designed to determine if UTI are detrimental to sow performance and to identify the stage of the production cycle that sows are at greatest risk of acquiring UTI. The study was conducted on a commercial sow farm and urine samples were collected from sows in late gestation, shortly after farrowing, in late lactation, after weaning and during early gestation. Our results demonstrated that abnormal urine samples were more common in sows during lactation and postweaning than in gestating sows. Based on urine evaluations, it was evident that water intake was insufficient in late lactation. Some sows appeared to recover from the UTI with the sole intervention of increased access to water in the gestation/breeding facilities. The study farm provided free choice water to sows in breeding and gestation. We suspect that many sows have cystitis to varying degrees and remain "subclinical". Unless the infection ascends to the kidney, the infection is not necessarily life-threatening and remains undetected. Surprisingly, the subclinical UTI, as detected with urinalysis methods, do not appear to interfere with sow reproductive performance. Urine abnormalities, indicative of UTI, are common in sows; however, it is evident that further refinements of urinalysis methods are required to adequately predict the outcome of UTI.

Table 1. Production parameters for sows with (cases) or without (control) urinary tract infections. Production data was collected for two successive farrowings.

	Production Parameter	Control Sows	Case Sows
First Farrowing			
	Average Parity	2.2	2.0
	Pigs Born Alive/Litter	11.01 $\pm$ .3	10.49 $\pm$ .3
	Stillborn Pigs/Litter	0.7 $\pm$ .1	0.9 $\pm$ .2
	Mummies/Litter	0.14 $\pm$ .03	0.14 $\pm$ .03
	Pigs Weaned/Litter	8.8 $\pm$ .17	9.01 $\pm$ .15
	Weaning-to-service interval (days)	5.2 $\pm$ .23	6.2 $\pm$ .27
	Percent weaned & bred	89.5	86.2
	Farrowing Rate – 1st estrus (%)	74.2	74.7
	Farrowing Rate -1st & 2nd estrus (%)	86.7	85.3
	Not-in-pig (%)	0	4.6
	Mortality in Lactation (%)	1.4	0
	Mortality in Gestation (%)	3.5	5.8
	Cull at Weaning (%)	7.0	5.8
	Cull – Anestrous (%)	4.2	6.9
	Cull – Repeat Breeder (%)	3.5	4.6
	Cull – Abortion (%)	2.8	1.2
Second Farrowing			
	Pigs Born Alive/Litter	9.6 $\pm$ .3	9.7 $\pm$ .4
	Stillborn Pigs/Litter	0.7 $\pm$ 0.1	0.8 $\pm$ .1
	Mummies/Litter	0.1 $\pm$ .01	0.1 $\pm$ .01

Figure 1. **M**ean pH (upper figure) and urine specific gravity (SG; lower figure) of urine samples collected from approximately 300 sows at different stages of production (LG – late gestation; Far – 1 day after farrowing; Lact – days 17-19 of lactation; PW – 4-6 days after weaning; EG – early gestation). Values are provided for all sows (overall) and sows (cases) with or without (controls) urinary tract infections.





Urine Constituent	Late Gestation (90-95 d)		One Day Post Farrowing		Late Lactation (d 17-19)		Post-weaning (4-6 d)		Early Gestation (25-30 d)	
	PRODUCTION STAGE									
PROTEIN										
Score	**Control**	**Cases**	**Control**	**Cases**	**Control**	**Cases**	**Control**	**Cases**	**Control**	**Cases**
0	99.5	69.2	100	36	100	83.3	96.6	29.6	100	84.6
1	0.5	26.9	0	52	0	13.3	3.4	40.7	0	15.4
≥2	0	3.8	0	12	0	3.3	0	29.6	0	0
KETONES										
Score	**Control**	**Cases**	**Control**	**Cases**	**Control**	**Cases**	**Control**	**Cases**	**Control**	**Cases**
0	97.5	100	88.9	64	100	100	93.1	63.0	99.0	100
1	2.5	0	7.4	24	0	0	5.2	11.1	0	0
≥2	0	0	3.7	12	0	0	1.7	25.9	1.0	0
WBC										
Score	**Control**	**Cases**	**Control**	**Cases**	**Control**	**Cases**	**Control**	**Cases**	**Control**	**Cases**
0	42.9	34.6	11.1	0	6.3	0	22.5	3.7	20.6	0
1	57.1	46.2	88.9	60	93.7	10	58.6	11.1	50	2.6
≥2	0	19.2	0.0	40	0	80	18.9	85.2	28.4	97.4
CRYSTALS										
Score	**Control**	**Cases**	**Control**	**Cases**	**Control**	**Cases**	**Control**	**Cases**	**Control**	**Cases**
0	73.2	53.8	55.6	52	40.6	30	79.3	59.3	79.4	64.1
1	14.6	19.2	40.7	40	34.4	46.7	12.1	18.5	7.8	5.1
≥2	12.2	26.9	3.7	8	25.1	23.3	8.7	22.2	12.8	30.8

Table 2. Urinalysis results for sows at different stages of production. The scoring system was based on previously established methods (Almond and Stevens, 1995). For protein and ketones, a score of 0 is considerable normal. For the white blood cells (WBC) and triple phosphate crystals, a score of ≥2 is considered abnormal. The values represent the percentage of samples collected during the respective stages.