Cryptosporidiosis is a common parasitic infection causing diarrhea in humans and animals. Although diarrhea in livestock results in economic loss, symptomatic and asymptomatic infections in animals have the potential for transmission and are a threat to public health. Cryptosporidium spp. are generally considered to be host specific. Cryptosporidium galli and C. baileyi are found predominantly in chickens, C. muris in rodents, C. canis in dogs, C. felis in cats, C. suis in pigs, and C. meleagris in turkeys; and in recent years, C. xiaoii in sheep and goats. In cattle, although C. parvum is seen in calves, C. bovis, C. ubiquitum, C. ryanae, and C. andersoni have been reported from heifers and adult cows.

In humans, cryptosporidiosis is predominantly caused by C. hominis and C. parvum, with occasional reports of zoonotic species including C. meleagris, C. felis, and C. canis.

In India, there have been numerous studies of cryptosporidiosis in humans and a few in animals, but only one recent study from eastern India has investigated zoonotic transmission. In previous studies from Vellore, we identified C. hominis as the predominant species in children with diarrhea from the community and hospital, with differences in the distributions of subgenotypes depending on the study setting. In this study, we explored the potential for zoonotic transmission of cryptosporidiosis in this region by comparing cryptosporidial species in animals and children with diarrhea in the same geographic area.

Diarrheal samples from animals were collected from a veterinary clinic and several dairy farms near Vellore during February 2007–May 2008. At the dairy farms, diarrheal samples included 589 cows (25 were calves), 2 buffaloes, 11 bullocks, and 25 goats (11 were kids). The mean duration of diarrhea was 4.5 days for adult animals, 4 days for calves, and 3 days for goat kids. Twelve (1.9%) samples were positive for Cryptosporidium spp., by PCR. Among these samples, seven C. muris, three C. bovis, one C. parvum, and one C. hominis were identified by RFLP. However, sequencing of the SSU ribosomal RNA PCR product showed that banding patterns identified by RFLP as C. muris were C. andersoni and the banding patterns identified as C. bovis were C. xiaoii. Further sequencing and analysis of the actin and HSP-70 PCR products confirmed the isolates as C. xiaoii (Figure 1).

Cryptosporidium andersoni was identified in adult cows, and C. xiaoii was identified in one goat and two cows. Cryptosporidium parvum was also identified in a goat kid, and C. hominis was also identified in a cow. No cryptosporidiosis were identified in buffaloes or bullocks.

Most studies from India and other countries have documented C. parvum as the predominant species in calves; in...
other regions, *C. bovis* has been found to predominate.5,7,9 *Cryptosporidium andersoni* is recognized as a major species in adult cattle.5,8,10 This finding is consistent with that of our study in which we detected *C. andersoni* in 7 adult cows. *C. andersoni* has also been reported in 3 of 2,414 patients with diarrhea,18 suggesting possible zoonotic transmission to humans.

This study is the first report of *C. xiaoi* in India and is also the first report of this species in a cow. Previous reports have documented *C. xiaoi* in sheep, goats, and lambs.14 When the *C. parvum* and *C. hominis* animal isolates were subjected to *Cpgr*40/15 PCR-RFLP, only the *C. parvum* sample (VD 333 from a goat kid) could be subgenotyped and was identified as subgenotype IId. This result was further confirmed by sequencing the SSU ribosomal RNA PCR product from a goat kid) could be subgenotyped and was identified as subgenotype IId. This result was further confirmed by sequencing the SSU ribosomal RNA PCR product.

The *C. hominis* isolate that could not be genotyped was confirmed by sequencing the SSU ribosomal RNA PCR product (Genbank accession no. HM627527). This is the first report of *C. hominis* in a cow in India. A study from Scotland has also reported *C. hominis* from cows21 and studies from other regions have reported this species from goats, sheep, and dugs, indicating that *C. hominis* may not be completely host restricted.22,23

Among the 394 samples from children hospitalized with diarrhea in the same geographic area, 13 (3.2%) were positive for *Cryptosporidium* by SSU ribosomal RNA PCR, all of which were *C. hominis*. Ten of the 13 positive samples could be subgenotyped (six as Ia, two as Ib, one as Ie, and one as Id). These circulating subgenotypes have been identified in studies from Vellore in hospital and community settings.11,12,15

This preliminary report identified a relatively low prevalence of cryptosporidial species in samples obtained from animal and human diarrhea. *Cryptosporidium andersoni*, which showed an RFLP pattern resembling that of *C. muris* but was identified by sequencing, was the predominant species in livestock,17 and *C. hominis* was the predominant species in children.18 *Cryptosporidium xiaoi* was reported for the first time in India in three animals.

Although no zoonotic species were identified in children in this study, studies in this area have identified *C. parvum*, *C. felis*, and *C. meleagridis* among children with diarrhea and in human immunodeficiency virus–infected adults.25–27 In the present study, detection of one *C. hominis* isolate in a bovine diarrheal sample and detection of *C. xiaoi* in a previously unreported animal species indicate that in an endemic setting, there is potential for cross-species transmission, including reverse zoonotic transmission. Although studies in northern India have documented the presence of diverse species of *Cryptosporidium* in cattle,7,8,10 *C. hominis* has not been reported in animals in any studies in India. To address zoonotic transmission in more detail, ongoing longitudinal studies are being conducted in the community where animal–human contact is prolonged.

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