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Primary vaccination of replacement yearlings without any revaccination allowed a long-term control of Coxiellosis in sheep

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INTRODUCTION
Small ruminants are a major source of human infection with Coxiella burnetii (Cb). In 2008 and 2012 Q fever in humans was linked to a sheep flock with 650 ewes. Since 2013 annual vaccination of gimmers (replacement yearlings) with Coxevac™ (Ceva Santé Animale) had been introduced. The long-term effect of this minimalistic vaccination schedule was monitored until 2023.

MATERIALS AND METHODS
Annually gimmers were vaccinated twice three weeks apart (primary vaccination), no further revaccination was performed. The following groups were ear-tagged for control purposes:
20-30 vaccinated gimmers each year (VG13, 14, 15 etc.).
30 ewes were vaccinated in 2013 (VE13) for control purposes.
Annually 30 unvaccinated gimmers were kept as sentinels (S). Additionally, gimmers at first vaccination were included as sentinels.Blood was collected at first vaccination and 22-32 weeks thereafter. In 2013/2014 the control period was extended to 9-54 weeks.
Shedding was monitored by PCR-testing of vaginal swabs collected hours after parturition (2013-2023, average 118 swabs/year) and nasal swabs during lambing (2013-2018, 2021, average 45 swabs/year). Sentinels were sampled until 2021 (average 85 samples/year).
The immune response (PhI/PhII-antibodies, IFN-?-Recall Assay (RA)(1)) was assessed before and after primary vaccination. The increase of antibody-titres and IFN-?-reactivity after vaccination were assessed as n-fold (nx) increase.
In 2018, animals primary vaccinated in 2013 (n=6 i.e. VG13 and VE13), 2014 (n=3), 2015 (n=10), 2016 (n=11) and 2017 (n=10) were once revaccinated and the immune response was assessed before and 3 weeks after revaccination.

RESULTS
In 2012/2013 and February 2014 the rate of positive vaginal and nasal swabs was 78/268 and 67/263, respectively. The mean pathogen load in positive samples was 102,6 and 101,6 Cb per vaginal and nasal swab, respectively. Thereafter two vaginal (2021/2023) and one nasal swab (2021) tested weak positive.
Seroconversion of sentinels to PhII significantly decreased after 2014, and faded out until 2017; however, a very weak and inconsistent seroconversion in single animals persisted as assessed by retrospective analysis of all sera in 2021.
VE13 and VG13 responded well to vaccination; e.g., VG13 showed an n-fold increase of PhI-, PhII-titres and IFN-?-reactivity of 116x, 168x and 6x, respectively. Vaccination primarily induced a serological PhI+/PhII+-pattern. In contrast, since 2015 (VG15-21) the n-fold increase of PhI-, PhII-titers and IFN-?-reactivity was 1x, 2,5x, 2,7x (e.g., VG16), respectively. A PhI-/PhII+-pattern dominated.
Revaccination of VE13/VG13/VG14 and VG15-17 in 2018 induced a strong n-fold increase of PhI-, PhII-titres and IFN-?-reactivity (e.g., VG16: PhI-titer (11x), PhII-titer (38x) IFN-? (33x). No difference was observed for age-groups.

DISCUSSION AND CONCLUSIONS
Prophylactical primary vaccination of gimmers allowed a long-term control of infection, although, a subliminal infection persisted. Vaccination initially (2013/2014) boosted a pre-existing immunity resulting in a serological PhI+/PhII+-pattern. Thereafter, as susceptibility increased vaccination induced a weak immune response characterized by a PhI-/PhII+-pattern. Revaccination induced a strong recall immune response. Therefore, it might be considered as an emergency measure.

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