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## **A systematic review of the potential uses of on-animal sensors to monitor the welfare of sheep evaluated using the Five Domains Model as a framework**

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### **Abstract**

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*This systematic review explores the use of on-animal sensors in sheep and their potential application in objective welfare monitoring. The key questions posed were: To what extent can current scientific knowledge inform a sensor-based approach to welfare evaluations? And, how might this knowledge shape development of commercial monitoring systems? These questions were explored through retrospective classification of published sensor applications using The Five Domains (FD) Model as a framework for animal welfare assessment. A total of 71 studies were reviewed. The results indicate studies specifically evaluating the use of sensors for welfare assessment are limited, though many experiments could still be related to some aspect of welfare. The assessment of sensor utilisation revealed the greatest proportion of applications within the 'Behaviour' Domain (90.1%; n = 64), and the lowest within the 'Health' (25.4%; n = 18) and 'Mental state' Domains (25.4%; n = 18). The review also highlights how different sensor types (location, motion or physiological) differ in their applicability for welfare assessment. This paper is the first to classify published sensor applications using the FD Model as a framework and highlights the potential for sensor technology in sheep welfare monitoring. The results suggest that any attempt to create a commercial sensor-based system for objective welfare assessment will require the integration of more than one sensor type, particularly if multiple Domains are to be addressed.*

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**Keywords:** animal welfare, Five Domains Model, remote monitoring, sensor, sheep, systematic review