The bladder cancer incidence is the eleventh most common among malignancies in the world in both sexes. In western countries bladder cancer occurrence is more common than in developing or third World countries. About three out of four cases concern men and the most important cause of this distribution is cigarette smoking pattern. In Poland, among all malignancies, bladder cancer male morbidity rate is 6,5% and mortality 5,4% and in female these rates are 2% and 1,8%, respectively. Bladder cancer is the fourth (in male) and the thirteenth (in female) most frequent death cause. Bladder cancer has the highest recurrence rate ranging from 50 to 70%. Cancer recognition involves histological examination of bladder excisions. Unfortunately, to put a recognition and start treatment an invasive method – the histopathological examination, has to be performed. The 'gold standard' method is quite expensive, subjective and demands involves medical specialists.

The most important cancer prognostic factor is tumor stage, evaluated based on infiltration of tissues and metastases. Average 5-year survival is about 98% for cancer in situ and papillary carcinoma (Tis/Ta; restricted to epithelium) but for cancer invading muscularis propria it is 63% [T2]. The staging helps to decide if regional excision or radical bladder resection should be done. Tumor grade, based on tumor architecture, cellular and nuclear pleomorphism, is less important prognostic factor, however, given the information on genetic background, help asses further behavior or give an information on possible resistance to the therapy.

Currently possible bladder cancer noninvasive detection is based on urine cytology, molecular and radiological imaging methods. The molecular methods include Next-Generation Sequencing [NGS] and enzyme-linked immunosorbent assay (ELISA). Today whole genome sequencing is not in common use, because of price barrier. The pathogenesis from mutation to cancer takes several years or decades and not all cells with mutation will become cancerous. The bladder cancer heterogeneity is high, but as it is known not only a single mutation but as well immunological barrier and gene penetration are important. In the early stages there is no metastases that would appear through transporting cancerous cells vessels. Molecular methods, analyzing blood circulating cancerous cells, aim to be implemented as a tool of personalized treatment, but not monitoring test. Radiological imaging methods as PET-CT/MRI can detect changes bigger than several mm.

The screening and monitoring bladder cancer methods should be similarly sensitive, cheap, accessible for high percentage of risk population and detect cancer on early stage. To detect non-disseminated bladder cancer state, material from this organ seems to be used. The two types of bladder material - excisions and urine, differ from themselves in representativeness – several bladder fragments diameter about 5mm or urine proteins and single or clusters cells from all bladder epithelium. Histological changes are not always unequivocal (e.g. inflammation, post radiotherapy state, coagulation of material caused by electrosection or crushing with forceps). Due to many hard assessing features, differences among pathologist and cytology quality, sensitivity of urine cytology is about 30% for low grade and 70% for high grade tumours. The urine sediment is composed of cells and bladder wall matrix proteins. Nonetheless, some research indicates that urine proteins speak for infiltration and prognosis.

The possible support for bladder cancer diagnosis might be cytology infrared imagining (IR). Spectroscopic method is nondestructive and one simple measurement detects many biocomponents from a small sample (approximately 2 mg). The IR characteristic vibrational spectrum of atoms bounds. Molecular changes always precede or accompany morphological changes. With accordance to fingerprint molecular theory, components concentration and conformation can be examined. Furthermore, no special pretreatment (e.g. extraction or labeling) is needed, however, it may be used.

The main purpose of this project is to investigate a potential of detection bladder cancer cells in urine sample with the use of label-free and rapid vibrational imaging and to divide the investigated cells according to their increasing infiltration ability.