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Supplementary Information

Highly stable intrinsically radiolabeled indium-111 quantum dots with multidentate zwitterionic surface coating: dual modality tool for biological imaging

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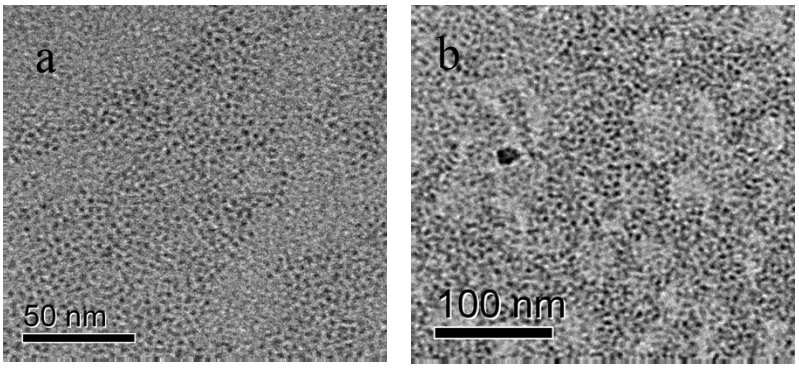

Fig. S1. TEM image of Cu-In-Se (a) and Cu-In-Se/ZnS (b).

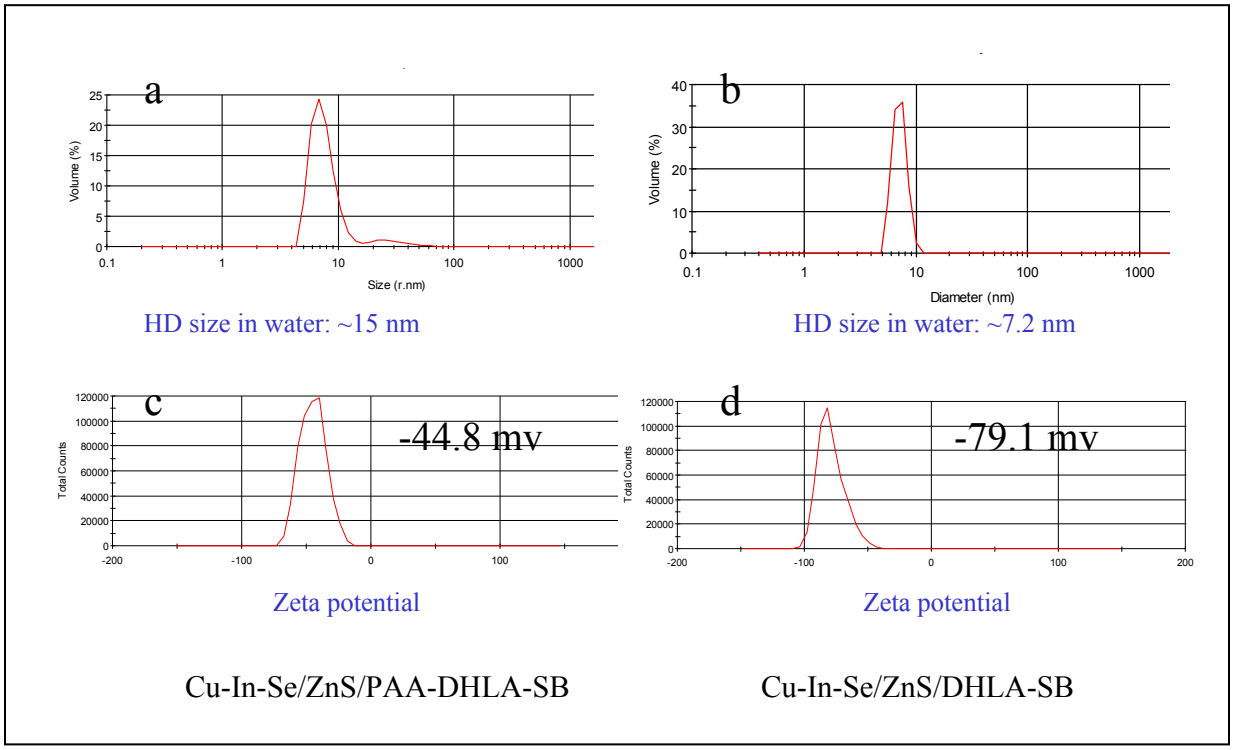

Fig. S2. DLS and Zeta potential of multidentate zwitterionic ligand (PAA-DHLA-SB) coated CuInSe/ZnS (a, c) and bidentate zwitterionic ligand (DHLA-SB) coated CuInSe/ZnS (b, d) in D.I H_2O (PH 7.2).

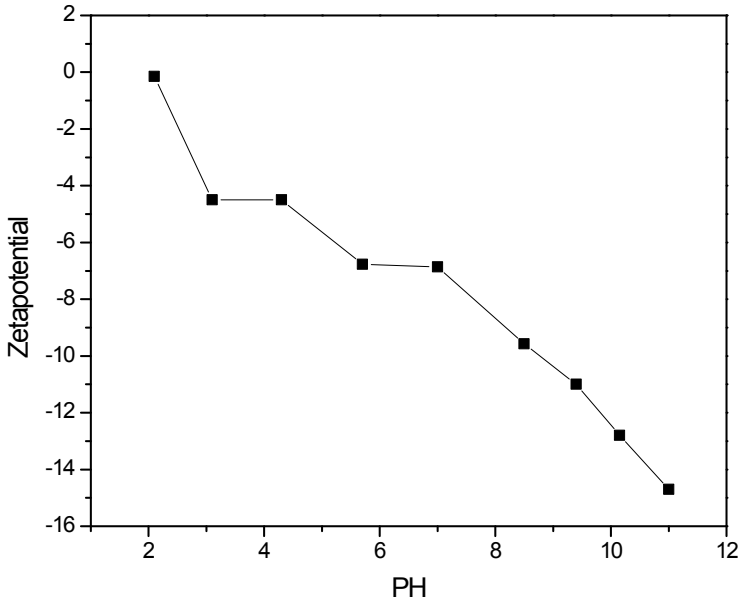

Fig. S3. Effect of PH on zeta potential of zwitterionic CIS-QDs. The measurement was performed in PBS buffer with various PH from 2 to 11. (the zeta potential of same sample in D.I water is -43.3 mv vs -6.9 mv in PBS at PH 7, highlighting the dependency of zeta potential on the dispersion medium)

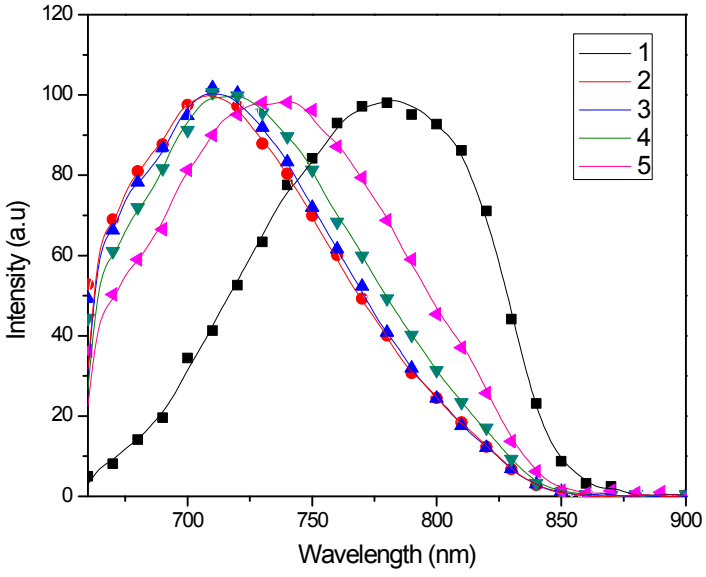

Fig. S4. Emission spectra of CuInSe core in $CHCl_3$ (1) and CuInSe/InZnS in $CHCl_3$ with doping amount of indium in shell: 2.4 µg (2), 24 µg (3), 120 µg (4) and 240 µg (5)

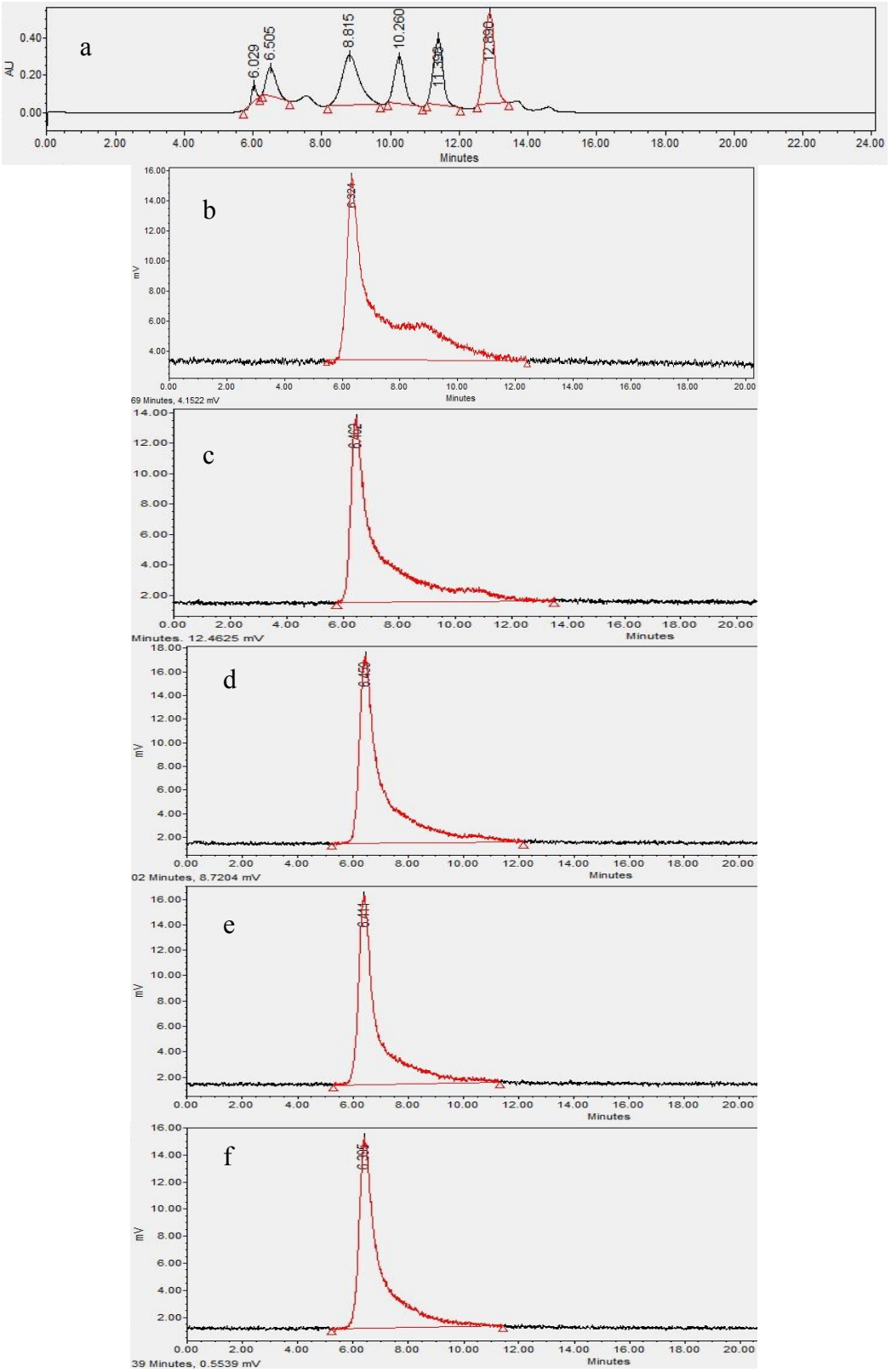

Fig. S5. HPLC-GFC retention time of protein standards: thyroglobulin (6.5 min, 669 kDa, 18.8 nm HD), γ-globulin (8.8 min, 158 kDa, 11.1 nm HD), ovalbumin (10.3 min, 44 kDa,

6.1 nm HD), myoglobin (11.4 min, 17 kDa, 3.8 nm HD), and vitamin B12 (12.9 min, 1.4 kDa, 1.67 nm HD). (a) Peaks of multidentate zwitterionic ligand coated CIS-rQDs (6.3 min) before (b) and after incubation with plasma protein at 1 hr (6.5 min) (c), 2 hrs (6.4 min) (d), 4 hrs (6.4 min) (e) and 24 hrs (6.4 min) (f).

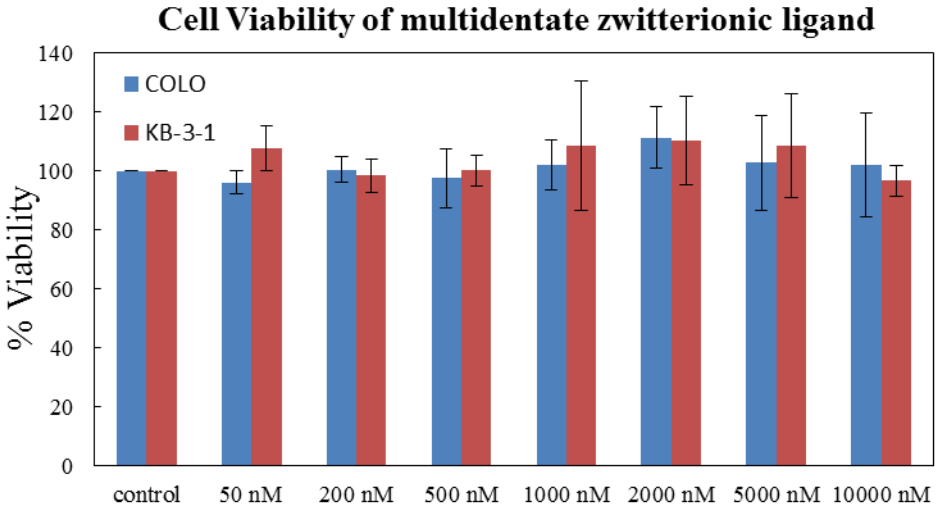

Fig. S6. Cell viability of COLO-205 and KB-3-1 cells incubated with PAA-DHLA-SB multidentate zwitterionic ligand for 24 hrs, evaluated using Cell Titer-Glo cell viability assay kit. Data is expressed as % Viability in treated groups compared to untreated (100% viability) ± S.D. *P<0.05 compared to control.

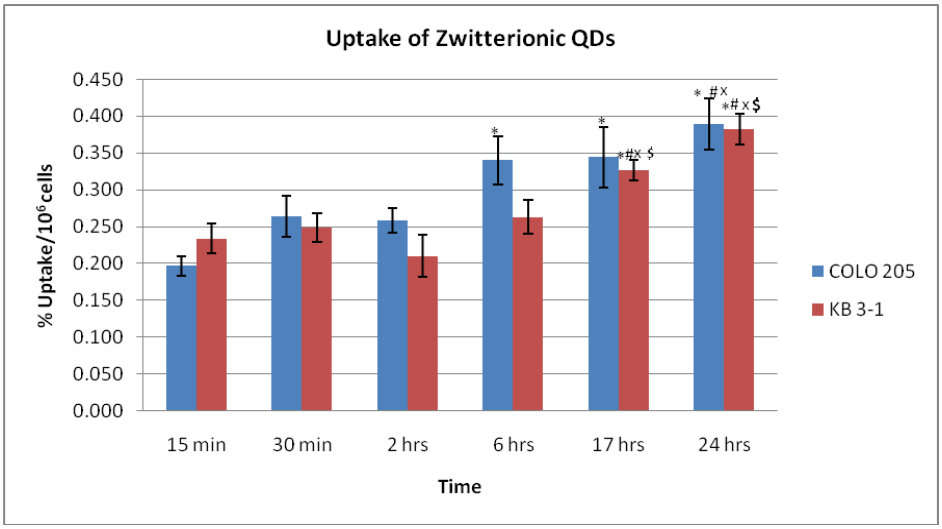

Fig. S7. The percentage uptake of 15 nM zwitterionic CIS-rQD after various time points in COLO 205 and KB 3-1 cell lines based on gamma-counting. The amount of r-QD taken up by cells at each time points were compared to each other. Data is expressed as %Uptake/10^6 cells ± Std Error. Fisher's PLSD test was done to evaluate statistical difference in uptake between different time points. *,#,x and $ indicate statistical differnce in uptake between 15 min, 30 min, 2 hrs and 6 hrs and indicated time points.

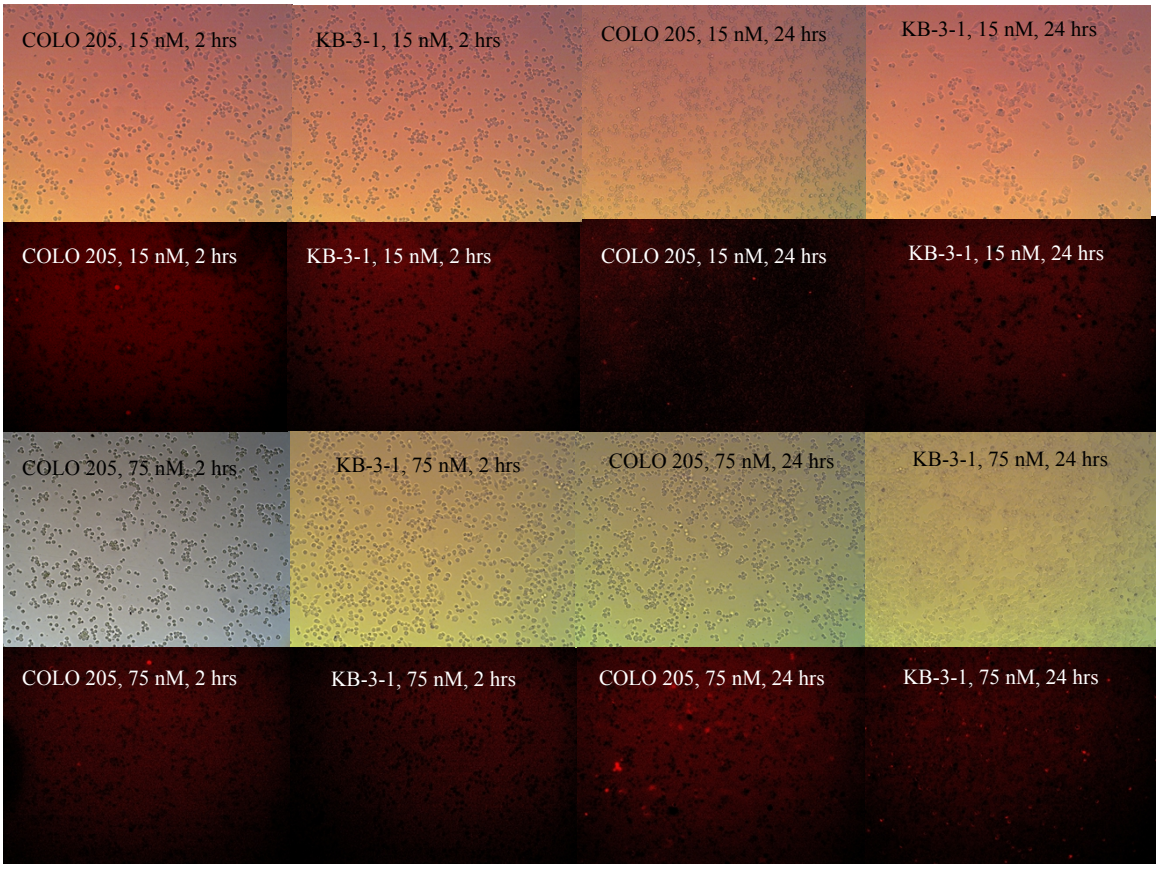

Fig. S8. Bright field and fluorescence microscopy of COLO 205 and KB-3-1 cells incubated with various concentrations of CIS-rQDs (15 nM or 75 nM) for 2 hrs and 24 hrs. Red fluorescence originated from CIS-rQDs.

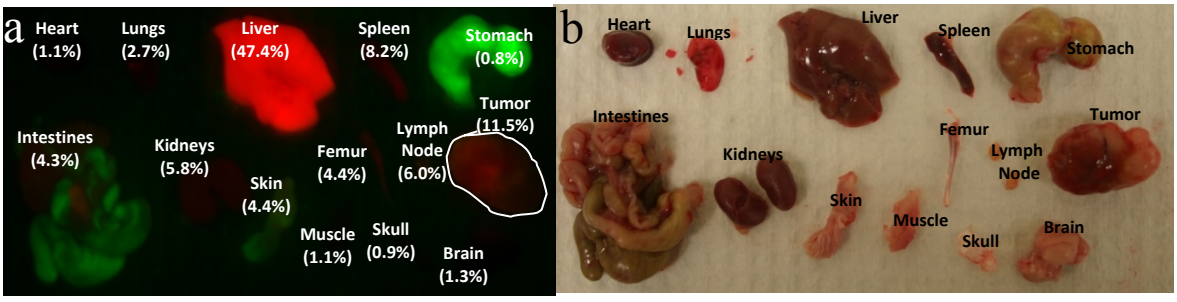

Fig. S9. Multispectral fluorescent images (a) of zwitterionic CIS-rQDs, 48 hours after injection, in organs dissected from same nude mouse (after *in vivo* SPECT/fluorescence imaging) as seen in the photograph (b). The red color corresponds to the signal from the CIS-rQDs and green color denotes autofluorescence. The numbers within parentheses indicate the percentage of CIS-rQDs per organ, which was quantified by analysis of fluorescence intensity of ROI.

Table S1 %ID/g of CIS-rQDs in major organs of six tumor bearing mice acquired from ROI analysis of *in vivo* SPECT (6 hrs, 24 hrs and 48 hrs post injection) images. *In vivo* SPECT/fluorescence imaging of mouse 4 was shown in Fig. 3.

SPECT	6 hrs	Mouse1	Mouse2	Mouse3	Mouse4	Mouse5	Mouse6	AVG	STD
	Heart	6.77	2.46	2.62	**5.25**	5.85	4.12	4.51	1.75
	Lungs	4.44	2.19	2.57	**5.43**	3.90	3.92	3.74	1.20
	Liver	23.56	14.67	16.42	**18.10**	13.64	12.47	16.48	4.00
	Spleen	9.95	4.80	7.22	**9.16**	6.59	5.90	7.27	1.96
	Brain	0.37	0.22	0.13	**0.11**	0.65	0.15	0.27	0.21
	Tumor	1.30	0.65	0.75	**3.04**	0.50	0.21	1.08	1.03

SPECT	24 hrs	Mouse1	Mouse2	Mouse3	Mouse4	Mouse5	Mouse6	AVG	STD
	Heart	1.66	1.55	4.27	**3.22**	1.54	0.73	2.16	1.31
	Lungs	2.61	1.27	4.00	**3.52**	1.81	1.48	2.45	1.13
	Liver	18.55	17.21	17.71	**21.18**	16.27	20.35	18.55	1.89
	Spleen	9.24	5.10	6.04	**7.01**	8.28	7.19	7.14	1.49
	Brain	0.20	0.80	0.16	**0.12**	0.18	0.59	0.34	0.28
	Tumor	1.11	0.56	0.38	**3.95**	0.58	0.82	1.23	1.36

SPECT	48 hrs	Mouse1	Mouse2	Mouse3	Mouse4	Mouse5	Mouse6	AVG	STD
	Heart	1.54	0.91	1.97	**1.36**	0.74	0.50	1.17	0.55
	Lungs	1.60	1.78	2.12	**2.60**	1.07	1.15	1.72	0.58
	Liver	25.00	18.90	15.45	**18.44**	15.94	20.87	19.10	3.51
	Spleen	12.64	6.97	8.69	**8.42**	7.72	7.68	8.69	2.03
	Brain	0.15	0.70	0.47	**0.30**	0.23	0.12	0.33	0.22
	Tumor	1.36	0.75	0.33	**4.55**	0.57	1.09	1.44	1.56