SEQUENCE LISTING

<110> LigoCyte Pharmaceuticals, Inc.
Steadman, Bryan
Taylor, Ross

<120> TARGETED HETEROLOGOUS ANTIGEN PRESENTATION ON CALICIVIRUS VIRUS-LIKE PARTICLES

<130> LIGO-023/01WO 306927-2136

<150> US 61/297,109
<151> 2010-01-21

<160> 7

<170> PatentIn version 3.5

<210> 1
<211> 530
<212> PRT
<213> Norovirus Norwalk virus sp.

<400> 1

Met Met Met Ala Ser Lys Asp Ala Thr Ser Ser Val Asp Gly Ala Ser
1 5 10 15

Gly Ala Gly Gln Leu Val Pro Glu Val Asn Ala Ser Asp Pro Leu Ala
20 25 30

Met Asp Pro Val Ala Gly Ser Ser Thr Ala Val Ala Thr Ala Gly Gln
35 40 45

Val Asn Pro Ile Asp Pro Trp Ile Ile Asn Asn Phe Val Gln Ala Pro
50 55 60

Gln Gly Glu Phe Thr Ile Ser Pro Asn Asn Thr Pro Gly Asp Val Leu
65 70 75 80

Phe Asp Leu Ser Leu Gly Pro His Leu Asn Pro Phe Leu Leu His Leu
85 90 95

Ser Gln Met Tyr Asn Gly Trp Val Gly Asn Met Arg Val Arg Ile Met
100 105 110

Leu Ala Gly Asn Ala Phe Thr Ala Gly Lys Ile Ile Val Ser Cys Ile
115 120 125

Pro Pro Gly Phe Gly Ser His Asn Leu Thr Ile Ala Gln Ala Thr Leu

```
    130                 135                 140

Phe Pro His Val Ile Ala Asp Val Arg Thr Leu Asp Pro Ile Glu Val
145                 150                 155                 160

Pro Leu Glu Asp Val Arg Asn Val Leu Phe His Asn Asn Asp Arg Asn
                165                 170                 175

Gln Gln Thr Met Arg Leu Val Cys Met Leu Tyr Thr Pro Leu Arg Thr
            180                 185                 190

Gly Gly Gly Thr Gly Asp Ser Phe Val Val Ala Gly Arg Val Met Thr
        195                 200                 205

Cys Pro Ser Pro Asp Phe Asn Phe Leu Phe Leu Val Pro Pro Thr Val
    210                 215                 220

Glu Gln Lys Thr Arg Pro Phe Thr Leu Pro Asn Leu Pro Leu Ser Ser
225                 230                 235                 240

Leu Ser Asn Ser Arg Ala Pro Leu Pro Ile Ser Ser Met Gly Ile Ser
                245                 250                 255

Pro Asp Asn Val Gln Ser Val Gln Phe Gln Asn Gly Arg Cys Thr Leu
            260                 265                 270

Asp Gly Arg Leu Val Gly Thr Thr Pro Val Ser Leu Ser His Val Ala
        275                 280                 285

Lys Ile Arg Gly Thr Ser Asn Gly Thr Val Ile Asn Leu Thr Glu Leu
    290                 295                 300

Asp Gly Thr Pro Phe His Pro Phe Glu Gly Pro Ala Pro Ile Gly Phe
305                 310                 315                 320

Pro Asp Leu Gly Gly Cys Asp Trp His Ile Asn Met Thr Gln Phe Gly
                325                 330                 335

His Ser Ser Gln Thr Gln Tyr Asp Val Asp Thr Thr Pro Asp Thr Phe
            340                 345                 350

Val Pro His Leu Gly Ser Ile Gln Ala Asn Gly Ile Gly Ser Gly Asn
        355                 360                 365
```

```
Tyr Val Gly Val Leu Ser Trp Ile Ser Pro Pro Ser His Pro Ser Gly
    370                 375                 380

Ser Gln Val Asp Leu Trp Lys Ile Pro Asn Tyr Gly Ser Ser Ile Thr
385                 390                 395                 400

Glu Ala Thr His Leu Ala Pro Ser Val Tyr Pro Pro Gly Phe Gly Glu
                405                 410                 415

Val Leu Val Phe Phe Met Ser Lys Met Pro Gly Pro Gly Ala Tyr Asn
            420                 425                 430

Leu Pro Cys Leu Leu Pro Gln Glu Tyr Ile Ser His Leu Ala Ser Glu
        435                 440                 445

Gln Ala Pro Thr Val Gly Glu Ala Ala Leu Leu His Tyr Val Asp Pro
    450                 455                 460

Asp Thr Gly Arg Asn Leu Gly Glu Phe Lys Ala Tyr Pro Asp Gly Phe
465                 470                 475                 480

Leu Thr Cys Val Pro Asn Gly Ala Ser Ser Gly Pro Gln Gln Leu Pro
                485                 490                 495

Ile Asn Gly Val Phe Val Phe Val Ser Trp Val Ser Arg Phe Tyr Gln
            500                 505                 510

Leu Lys Pro Val Gly Thr Ala Ser Ser Ala Arg Gly Arg Leu Gly Leu
        515                 520                 525

Arg Arg
    530
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<210> 2
<211> 540
<212> PRT
<213> Artificial Sequence

<220>
<223> Composite GII.4 Norovirus VP1 amino acid sequence

<400> 2

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Met Lys Met Ala Ser Ser Asp Ala Asn Pro Ser Asp Gly Ser Thr Ala
1               5                   10                  15
```

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Asn Leu Val Pro Glu Val Asn Asn Glu Val Met Ala Leu Glu Pro Val
            20                  25                  30

Val Gly Ala Ala Ile Ala Ala Pro Val Ala Gly Gln Gln Asn Val Ile
        35                  40                  45

Asp Pro Trp Ile Arg Asn Asn Phe Val Gln Ala Pro Gly Gly Glu Phe
    50                  55                  60

Thr Val Ser Pro Arg Asn Ala Pro Gly Glu Ile Leu Trp Ser Ala Pro
65                  70                  75                  80

Leu Gly Pro Asp Leu Asn Pro Tyr Leu Ser His Leu Ala Arg Met Tyr
                85                  90                  95

Asn Gly Tyr Ala Gly Gly Phe Glu Val Gln Val Ile Leu Ala Gly Asn
            100                 105                 110

Ala Phe Thr Ala Gly Lys Ile Ile Phe Ala Ala Val Pro Pro Asn Phe
        115                 120                 125

Pro Thr Glu Gly Leu Ser Pro Ser Gln Val Thr Met Phe Pro His Ile
    130                 135                 140

Ile Val Asp Val Arg Gln Leu Glu Pro Val Leu Ile Pro Leu Pro Asp
145                 150                 155                 160

Val Arg Asn Asn Phe Tyr His Tyr Asn Gln Ser Asn Asp Pro Thr Ile
                165                 170                 175

Lys Leu Ile Ala Met Leu Tyr Thr Pro Leu Arg Ala Asn Asn Ala Gly
            180                 185                 190

Asp Asp Val Phe Thr Val Ser Cys Arg Val Leu Thr Arg Pro Ser Pro
        195                 200                 205

Asp Phe Asp Phe Ile Phe Leu Val Pro Pro Thr Val Glu Ser Arg Thr
    210                 215                 220

Lys Pro Phe Thr Val Pro Ile Leu Thr Val Glu Glu Met Thr Asn Ser
225                 230                 235                 240

Arg Phe Pro Ile Pro Leu Glu Lys Leu Phe Thr Gly Pro Ser Gly Ala
```

```
                245                 250                 255

Phe Val Val Gln Pro Gln Asn Gly Arg Cys Thr Thr Asp Gly Val Leu
            260                 265                 270

Leu Gly Thr Thr Gln Leu Ser Pro Val Asn Ile Cys Thr Phe Arg Gly
        275                 280                 285

Asp Val Thr His Ile Ala Gly Thr Gln Glu Tyr Thr Met Asn Leu Ala
    290                 295                 300

Ser Gln Asn Trp Asn Asn Tyr Asp Pro Thr Glu Glu Ile Pro Ala Pro
305                 310                 315                 320

Leu Gly Thr Pro Asp Phe Val Gly Lys Ile Gln Gly Val Leu Thr Gln
                325                 330                 335

Thr Thr Arg Gly Asp Gly Ser Thr Arg Gly His Lys Ala Thr Val Ser
            340                 345                 350

Thr Gly Ser Val His Phe Thr Pro Lys Leu Gly Ser Val Gln Phe Ser
        355                 360                 365

Thr Asp Thr Ser Asn Asp Phe Glu Thr Gly Gln Asn Thr Lys Phe Thr
    370                 375                 380

Pro Val Gly Val Val Gln Asp Gly Ser Thr Thr His Gln Asn Glu Pro
385                 390                 395                 400

Gln Gln Trp Val Leu Pro Asp Tyr Ser Gly Arg Asp Ser His Asn Val
                405                 410                 415

His Leu Ala Pro Ala Val Ala Pro Thr Phe Pro Gly Glu Gln Leu Leu
            420                 425                 430

Phe Phe Arg Ser Thr Met Pro Gly Cys Ser Gly Tyr Pro Asn Met Asn
        435                 440                 445

Leu Asp Cys Leu Leu Pro Gln Glu Trp Val Gln His Phe Tyr Gln Glu
    450                 455                 460

Ala Ala Pro Ala Gln Ser Asp Val Ala Leu Leu Arg Phe Val Asn Pro
465                 470                 475                 480
```

```
Asp Thr Gly Arg Val Leu Phe Glu Cys Lys Leu His Lys Ser Gly Tyr
                485                 490                 495

Val Thr Val Ala His Thr Gly Gln His Asp Leu Val Ile Pro Pro Asn
            500                 505                 510

Gly Tyr Phe Arg Phe Asp Ser Trp Val Asn Gln Phe Tyr Thr Leu Ala
        515                 520                 525

Pro Met Gly Asn Gly Thr Gly Arg Arg Arg Ala Leu
    530                 535                 540
```

<210> 3
<211> 551
<212> PRT
<213> Sapovirus sp.

<400> 3

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Met Glu Gly Asn Gly Leu Pro Gln Ala Gly Gln Gln Gln Ala Leu Asp
1               5                   10                  15

Val Pro Gly Thr Thr Gly Pro Thr Ser Ser Ala Val Val Val Ala Asn
            20                  25                  30

Pro Asp Gln Pro Ser Ala Gln Ala Gln Arg Met Glu Leu Ala Val Ala
        35                  40                  45

Thr Gly Ala Val Ser Ser Asn Val Pro Asp Ala Val Arg Gln Cys Phe
    50                  55                  60

Ala Leu Leu Arg Thr Phe Pro Trp Asn Thr Arg Gln Ala Thr Gly Thr
65                  70                  75                  80

Tyr Leu Gly Ser Ala Ala Leu Ser Pro Ala Leu Asn Pro Tyr Thr Ala
                85                  90                  95

His Leu Ser Ala Met Trp Ala Gly Trp Gly Gly Ser Met Glu Ala Arg
            100                 105                 110

Val Thr Ile Ser Gly Ser Gly Thr Phe Ala Gly Lys Ile Ile Val Ala
        115                 120                 125

Leu Leu Pro Pro Gly Leu Asp Pro Thr Arg Val Arg Asp Pro Gly Val
    130                 135                 140
```

```
Leu Pro His Ala Gln Val Asp Ala Arg Ala Val Asp Pro Ile Thr Phe
145                 150                 155                 160

Asn Ile Asn Asp Val Arg Ala Val Asp Tyr His Arg Thr Asp Gly Gln
                165                 170                 175

Glu Ala Thr Ser Thr Leu Gly Phe Trp Val Leu Gln Pro Leu Ile Asn
            180                 185                 190

Pro Phe Ser His Asp Ala Leu Ser Thr Ala Trp Val Ser Val Glu Thr
        195                 200                 205

Arg Pro Gly Pro Asp Phe Asp Phe Cys Leu Leu Lys Pro Pro Gln Met
    210                 215                 220

Glu Met Glu Asn Gly Leu Ser Pro Ser Thr Leu Leu Pro Arg His Leu
225                 230                 235                 240

Gly Arg Ser Arg Gly Asn Arg Cys Gly Gly Phe Ile Val Gly Met Ala
                245                 250                 255

Val Val Ala Met Ala His Gln Val Asn His His Phe Ser Thr Ala Ala
            260                 265                 270

Thr Thr Tyr Gly Trp Ser Thr Leu Pro Leu Gly Pro Cys Ala Ala Lys
        275                 280                 285

Ile Thr Ser Ser Leu Pro Gly Glu Ile Asn Asn Tyr Thr Gly Phe Ala
    290                 295                 300

Asp Val Asp Gly Ala Gly Glu Gly Pro Ile Met Pro Asn Ile Pro Asn
305                 310                 315                 320

His Trp Pro Asp Ser Cys Ala Ser Ser Val Ile Ala Thr Trp Asp Ser
                325                 330                 335

Ser Leu His Arg Pro Asn Leu Gly Ile Ser Gly Ser Ile Met Thr Phe
            340                 345                 350

Asp Asn His Gly Asp Ala Asp Glu Ala Gln Ile Thr Gly Ala Met Ala
        355                 360                 365
```

```
Ala Thr Val Asp Pro Ser Pro Ser Arg Arg Thr Gln Leu Gln Gly Ser
    370                 375                 380

Phe Thr Ala Asn Thr Met Arg Ile Met Arg Thr Ser Gly Leu Asp Lys
385                 390                 395                 400

Ile Gly Glu Val Asn Lys Asn Val Tyr Phe Ile Pro Ile Leu Leu Asp
                405                 410                 415

Gly Ala Thr Gly Tyr Ile Asn Glu Lys Val Thr Asn Leu Ala Asp Ile
            420                 425                 430

Asn Ile Ser Tyr Gly Pro Val Gly Ser Asn Asn Val Ile Leu Trp Arg
        435                 440                 445

Glu Arg Val Phe Ser Ser His Pro Arg Pro Gly Ile Leu Tyr Ser Ser
    450                 455                 460

Gln Leu Glu Ser Thr Ala Ser Ile Phe Gln Asp Gly Pro Val Asn Ile
465                 470                 475                 480

Pro Asn Asn Tyr Met Ala Val Phe Asn Val Ser Asp Thr Gly Ala Asp
                485                 490                 495

Phe Gln Ile Gly Ile Cys Pro Asp Gly Tyr Met Arg Thr Gly Ser Pro
            500                 505                 510

Val Gly Thr Val Val Asp Leu Thr Pro Glu Cys Thr Phe Thr Phe Val
        515                 520                 525

Gly Leu Phe Pro Phe Thr Ser Pro Leu Asn Gly Pro His Gly Thr Gly
    530                 535                 540

Arg Gly Arg Ser Val Tyr Gln
545                 550
```

<210> 4
<211> 558
<212> PRT
<213> Vesivirus San Miguel sea lion sp.

<400> 4

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Ser Asp Gly Pro Gly Ser Ala Glu Ile Val Thr Glu Glu Gln Gly Thr
1               5                   10                  15
```

```
Val Val Gln Gln Gln Pro Ala Pro Ala Pro Thr Ala Leu Ala Thr Leu
            20                  25                  30

Ala Thr Ala Ser Thr Gly Lys Ser Val Glu Gln Glu Trp Met Thr Phe
        35                  40                  45

Phe Ser Tyr His Thr Ser Ile Asn Trp Ser Thr Val Glu Ser Gln Gly
    50                  55                  60

Lys Ile Leu Tyr Ser Gln Ala Leu Asn Pro Ser Ile Asn Pro Tyr Leu
65                  70                  75                  80

Asp His Ile Ala Lys Leu Tyr Ser Thr Trp Ser Gly Gly Ile Asp Val
                85                  90                  95

Arg Phe Thr Val Ser Gly Ser Gly Val Phe Gly Gly Lys Leu Ala Ala
            100                 105                 110

Leu Leu Val Pro Pro Gly Val Glu Pro Ile Glu Ser Val Ser Met Leu
        115                 120                 125

Gln Tyr Pro His Val Leu Phe Asp Ala Arg Gln Thr Glu Pro Val Ile
    130                 135                 140

Phe Thr Ile Pro Asp Ile Arg Lys Thr Leu Phe His Ser Met Asp Glu
145                 150                 155                 160

Thr Asp Thr Thr Lys Leu Val Ile Met Val Tyr Asn Glu Leu Ile Asn
                165                 170                 175

Pro Tyr Glu Asn Gly Val Glu Asn Lys Thr Thr Cys Ser Ile Thr Val
            180                 185                 190

Glu Thr Arg Pro Ser Ala Asp Phe Thr Phe Ala Leu Leu Lys Pro Pro
        195                 200                 205

Gly Ser Leu Ile Lys His Gly Ser Ile Pro Ser Asp Leu Ile Pro Arg
    210                 215                 220

Asn Ser Ala His Trp Met Gly Asn Arg Trp Trp Ser Thr Ile Ser Gly
225                 230                 235                 240

Phe Ser Val Gln Pro Arg Val Phe Gln Ser Asn Arg His Phe Asp Phe
```

```
                245                 250                 255

Asp Ser Thr Thr Thr Gly Trp Ser Thr Pro Tyr Tyr Val Pro Ile Glu
            260                 265                 270

Ile Lys Ile Gln Gly Lys Val Gly Ser Asn Asn Lys Trp Phe His Val
        275                 280                 285

Ile Asp Thr Asp Lys Ala Leu Val Pro Gly Ile Pro Asp Gly Trp Pro
    290                 295                 300

Asp Thr Thr Ile Pro Asp Glu Thr Lys Ala Thr Asn Gly Asn Phe Ser
305                 310                 315                 320

Tyr Gly Glu Ser Tyr Arg Ala Gly Ser Thr Thr Ile Lys Pro Asn Glu
                325                 330                 335

Asn Ser Thr His Phe Lys Gly Thr Tyr Ile Cys Gly Thr Leu Ser Thr
            340                 345                 350

Val Glu Ile Pro Glu Asn Asp Glu Gln Gln Ile Lys Thr Glu Ala Glu
        355                 360                 365

Lys Lys Ser Gln Thr Met Tyr Val Val Thr Ala Asp Phe Lys Asp Thr
    370                 375                 380

Ile Val Lys Pro Gln His Lys Ile Ser Pro Gln Lys Leu Val Val Tyr
385                 390                 395                 400

Phe Asp Gly Pro Glu Lys Asp Leu Thr Met Ser Ala Thr Leu Ser Pro
                405                 410                 415

Leu Gly Tyr Thr Leu Val Asp Glu Gln Pro Val Gly Ser Val Ser Ser
            420                 425                 430

Arg Val Val Arg Ile Ala Thr Leu Pro Glu Ala Phe Thr Gln Gly Gly
        435                 440                 445

Asn Tyr Pro Ile Phe Tyr Val Asn Lys Ile Lys Val Gly Tyr Phe Asp
    450                 455                 460

Arg Ala Thr Thr Asn Cys Tyr Asn Ser Gln Ile Leu Met Thr Ser Gln
465                 470                 475                 480
```

```
Arg Leu Ala Glu Gly Asn Tyr Asn Leu Pro Pro Asp Ser Leu Ala Val
                485                 490                 495

Tyr Arg Ile Thr Asp Ser Ser Ser Gln Trp Phe Asp Ile Gly Ile Asn
            500                 505                 510

His Asp Gly Phe Ser Tyr Val Gly Leu Ser Asp Leu Pro Asn Asp Leu
        515                 520                 525

Ser Phe Pro Leu Thr Ser Thr Phe Met Gly Val Gln Leu Ala Arg Val
    530                 535                 540

Lys Leu Ala Ser Lys Val Lys Ala His Thr Ile Thr Ala Lys
545                 550                 555
```

<210> 5
<211> 9
<212> PRT
<213> Artificial Sequence

<220>
<223> influenza hemagglutinin antigen epitope

<400> 5

```
Tyr Pro Tyr Asp Val Pro Asp Tyr Ala
1               5
```

<210> 6
<211> 9
<212> PRT
<213> Artificial Sequence

<220>
<223> Respiratory syncytial virus F protein antigenic epitope

<400> 6

```
Leu Ile Asn Asp Met Pro Ile Thr Asn
1               5
```

<210> 7
<211> 29
<212> PRT
<213> Artificial Sequence

<220>
<223> Respiratory syncytial virus F protein antigenic epitope

<400> 7

```
Tyr Met Leu Thr Asn Ser Glu Leu Leu Ser Leu Ile Asn Asp Met Pro
1               5                  10                  15

Ile Thr Asn Asp Gln Lys Lys Leu Met Ser Asn Asn Val
            20                  25
```